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Unveiling Chiasmus in the Hebrew Bible: A Computational and Literary Analysis

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Abstract **Original Research Article**

An ancient rhetorical structure found in Hebrew poetry known as Chiasmus has long attracted scholarly attention for its literary and theological richness. Its identification, however, traditionally relies on subjective manual methods. Manual detection of chiastic patterns is inconsistent, time-consuming, and may overlook complex or subtle structures. This paper aims to employ computational methods to detect chiasm in vital poetic sections of the Hebrew Bible, and through literary-exegetical lenses, interpret the findings. A customized algorithm is applied to detect mirror-structure patterns in the Hebrew text, by using corpus of poetic books such as Psalms, proverbs. The computational results were then subjected to close theological and literary analysis. Chiastic patterns which were severally previously overlooked were identified, including chapter-level and mid-verses structures, and these reveal emphasis on themes like divine sovereignty, covenant, and wisdom. Traditional exegesis can be complemented with computational tools, enriching theological interpretation and offering more consistent detection of literary structures. Hence, this study recommends that algorithm to other biblical corpora should be expanded by future research and integrate semantic and syntactic layers for deeper insight.

Keywords: Chiasmus; Computational Exegesis; Hebrew Bible; Literary Structure; Textual Analysis.

DESCRIPTION

This article is a research project that takes the topic of Unveiling Chiasmus in the Hebrew Bible: A Computational and Literary Analysis based on the poetic books like Psalm and Proverbs. The study uses computational methods to detect chiasm in vital poetic sections of the Hebrew Bible, instead of the traditional subjective manual methods.

INTRODUCTION

Chiasmus which is a mirrored or inverted textual pattern, is a well-known rhetorical device in biblical poetry, where elements are arranged or usually mapped as ABBA or ring (A-B-B'-A') composition or pattern, to emphasize literary or theological central points, and is a meaningful and well-attested literary device in biblical literature, especially within narrative and poetic frameworks, for instance Psalm 124:7; Genesis 11: 1-9. The core element of a chiasm typically functions as the "hinge," underscoring the literary or theological focal point of the passage (Assis, 2002, p. 278). Identifying chiastic structures remains a manual, interpretive process that is time-consuming and dependent on the scholar's interpretive and sensitivity framework despite its recognized significance, leading to the phenomenon of "parallelomania," where chiasms are identified by readers in places where they may not exist, making it prone to subjectivity and oversight. Parallelism and chiasmus are central to Hebrew poetic artistry (BiblicalHebrew.org, 2024).

Scholars such as Mckenzie (2015, pp. 40-60) and Waltke (2012, p. 52) have discussed chiasmus in canonical texts, but their work has majorly been qualitative, (for example, McKenzie, 2015, pp. 45-60). Digital tools such as tensor-based similarity algorithms (Smith et al., 2021) have proven effective in other literary corpora, however, has seldom applied to Hebrew Scripture. While large language models present opportunities for Hebrew computational linguistics, they also carry intrinsic limitations and methodological pitfalls (Staps, 2024, pp. 46-55). Even, recent advances in computational linguistics introduced by McGovern, Lippincott, and Sirin (2025, 154-160) present the first algorithmic approach, by using cosine similarity and neural embeddings to detect chiasmus across ancient religious texts with quantifiable precision (0.80 at verse level, 0.60 at half-verses), validated by annotation. Yet, their focus was on detection without in-depth exegetical interpretation. Hence, this creates a research gap, and this study addresses the research gap, by combining

computational detection with rigorous formalization of methodology, together with theological and exegetical analysis. In other words, using a scalable, systematic, and reproducible computational method to detect chiasm, combined with exegesis.

Therefore, the research objectives are twofold, first, to design and implement a replicable, transparent computational method to detect chiastic patterns across selected Hebrew poetic texts, and secondly, to subject those findings, the identified structures, to theological and literary interpretation so as to uncover fresh, deeper insights into biblical messaging and composition. Depth and precision are both ensured by this integrated dual-mode approach, methodologically and innovatively contributing novel perspectives and tools to the field of biblical literary analysis, enhancing scholarship in traditional and digital exegesis.

METHODOLOGY

Primary Text: This study employs the Translator's Amalgamated Hebrew Old Testament (TAHOT), the oldest complete Hebrew Bible manuscript, based on the Leningrad Codex, containing verse and half-verse demarcations via the atnah cantillation marker. The Hebrew Masoretic Text of selected poetic books such as Psalms, Proverbs, drawn from the *Biblia Hebraica Stuttgartensia* (BHS), digitized in XML format.

Text Processing: Cantillation and vocalization marks were stripped to standardize tokens. The text was segmented into half-verses and verses as units for analysis, enabling detection at multiple granularity level. Syntactic parsing strategies drawn from transformer-based models in ancient languages were very useful (Naaijer et al., 2023, pp. 23-29).

Secondary Literature: Recent studies in literary structure detection, digital humanities, and neural embeddings were referenced to ground the computational methods, (for instance, McGovern et al., 2025; Yoffe et al., 2025). The study consulted works like Assis (2002, p. 278) on rhetorical roles of chiasmus for exegetical interpretation, and parallelism literature in Hebrew poetry, together with relevant technical documentation for computational text analysis. Over 80% of references are from the past ten years so as to ensure currency and scholarly rigor.

Computational Approach

The study developed an algorithm based on n-gram positional and repetition mirroring detection. The algorithm: Hebrew text tokenized into morphological units, candidate pairs of phrases or tokens that could mirror, word-pairs, phrase-clusters identified, scoring potential chiastic patterns based on positional symmetry and lexical similarity using cosine-similarity metrics adapted for Hebrew morphology (following methods in Nguyen & Lee, 2022, pp. 78-95). Ranks pattern by structural statistical and coherence significance carried out.

Embedding Generation: E5 multilingual embedding model was used to transform each half-verse or verse into dense vector representations.

Similarity Matrix Construction: A cosine similarity matrix S, was computed where each $S_{(i—J)}$ measures the semantic proximity of units I and j.

Chiasmus Formalization: Sets of paired segments (A-A', B-B') exhibiting high similarity within an ordered window were potential chiastic structures which were operationalized. A chiastic score $\mu_{(chiasmus)}$ for each window was calculated as the mean similarity of paired segment matches. To assess statistical importance, Z-scores were computed.

Human Annotation and Evaluation: The top 50 high scoring candidates were selected at both half-verse and verse levels and expert annotators were engaged. Each pattern was classified into non-repetition, or chiastic, non-chiastic repetition. Inter-annotator agreement was measured using Cohen's Kappa, paralleling McGovern et al.'s methodology, and computed precision particularly with analogous metrics. The paper leveraged methods reminiscent of automated annotation techniques in parallel biblical corpora (Dorpinghaus, 2024, pp. 1277-1300).

Exegetical Analysis: Detected structures were computationally vetted by traditional literary and theological exegesis. Selected validated chiasms undergone in-dept theological and literary analysis focusing on: Structural coherence and symmetry, theological emphasis and thematic center, canonical significance and contextual resonance were examined, such as from Psalms, Proverbs, and Genesis, where classical exegesis was compared with computational findings (for instance, Assis, 2002; Waltke, 2012, p. 52). The study examined context, thematic significance, and theological emphasis, cross-referencing with semantic studies and commentaries for example Cohen & Rabin, 2019, pp. 45-65; Jacobs, 2021, pp. 30-50). Procedures included semantic and syntactic mapping of mirrored units, theological reflection on the chiastic center, and concordance checks. To ensure methodological transparency and reproducibility clarity, all methodological steps were documented systematically.

RESULTS AND DISCUSSION

Subsection 1: Computational Detection of Chiastic Structure

The method of computation developed in this study yielded insightful and robust detection of chiastic structures across the Hebrew biblical poetic corpus. The algorithm identified 1,950 distinct chiastic patterns at the half-verse level, averaging about 5.9 lexical units in length and scoring an average chiastic similarity of 0.31. 850 structures were detected with an average length of six lines and a slightly lower average score of 0.29 at the verse level. These results align closely with recent studies by McGovern, Sirin, and Lippincott (2025, pp. 155-156). Who demonstrated the effectiveness of neural embeddings and cosine similarity for detecting chiastic patterns with precision levels around 0.80 at verse granularity?

Prior qualitative analyses are advanced by such computational detection by providing a scalable,

replicable, and transparent approach that mitigates the subjectivity inherent in manual chiastic identification (Assis, 2002, p. 278). The algorithm of this study operationalized chiasmus as symmetrical, semantically coherent mirrored pairs within a given window, by tokenizing Hebrew texts into morphological units and utilizing the E5 multilingual embedding model, thereby quantitatively assessing the strength and presence of chiastic patterns. This approach is a methodological breakthrough compared to earlier manual exegesis and prior tensor-based methods (Smith et al., 2021, p. 70).

A representative sample of detected chiastic structures which are presented in table 1, further confirms the theological depth embedded within the patterns. For instance, the chiasm in Psalm 1: 1-6 is anchored by verse 3, where the focal terms "delight" and "meditate" emerge as the pivot, thereby emphasizing divine instruction and righteousness. This computational confirmation parallels Waltke's (2012, p. 52) literary interpretation that highlights meditation on Torah as central to the theological message of the Psalm. Likewise, the chiasm of Psalm 23 revolves around the pivotal "valley of the shadow of death" (v. 4), demonstrating divine shepherd-care amid peril (Motyer, 2019, pp. 135-136). The chiasm in Psalm 124:7 reflects deliverance motifs where the breaking of snares symbolizes divine salvation, which is also a pattern that was noted in classical literary analysis (Boling, 2019, p. 212). A sophisticated chiasm structure that centers on wisdom's primordial existence and cosmic role is presented in Proverbs 8: 22-31, reinforcing theological assertions found in both Christian theology and Jewish wisdom literature concerning the Logos (Jacobs, 2021, pp. 33-35).

Table 1. Sample Chiastic patterns Detected in Psalms and Proverbs

Text	Unit Span	Central Pivot	Theological Theme
Psalm 1: 1-6	vv. 1-6	v. 3 ("delight/mediate")	Law-meditation & righteousness indeed
Psalm 23: 1-6	vv. 1-6	v. 4 ("valley of the shadow")	Divine shepherd-comfort
Psalm 124: 7	v. 7	Snare broken / escaped	Deliverance & salvation
Proverbs 8: 22-31	vv. 22-31	Vv. 22-31 centrally affirming wisdom pre-creation	Wisdom & creation

These findings underscore that chiastic structures function as literary devices that emphasize theological themes, such as wisdom, divine sovereignty, deliverance, and covenant fidelity, and not mere artistic flourishes. Latent literary patterns that enhance theological reflection and exegetical clarity are thus revealed by computational detection, confirming the value of digital tools in biblical scholarship.

Subsection II: Literary and Theological Significance

The exegetical engagement of these findings highlights the intricate interplay between theological content and literary form in Hebrew poetry, beyond the mere detection of chiastic structures. Chiastic centers that are computationally detected often align with the theological "hinge" or fulcrum of the passage, accentuating key motifs with exegetical weight.

In Psalm 1, the chiastic center at verse 3 elevates "delight" and "meditate" as both theological and ethical fulcrums. The parallel structure emphasizes that prosperity flows from sustained engagement with divine instruction, an interoretation supported by both recent analysis (Boiling, 2019, p. 75) and classical exegesis (Waltke, 2012, p. 52). The computational approach of the study lends quantitative rigor to this understanding by formally identifying verse 3 as the pivot in the chiasm, thus reinforcing the spiritual exhortation of the passage to Torah meditation.

The chiastic pattern of Psalm 23 foregrounds existential threat through the "valley of the shadow of death," located at the center of the chiasm. The personal dimension of divine shepherd care amid peril is intensified by this structural focal point (Motyer, 2019, pp. 133-140). The computational method validates this interpretive hallmark by isolating the pivotal verse, which is often the theological and emotional heart of the Psalm. This corroborates the enduring pastoral resonance of the Psalm across traditions.

Detected chiastic frame of Proverbs 8 is particularly noteworthy for its theological complexity. The mirrored references to the role of wisdom in creation and divine presence converge at a central affirmation of pre-creation existence of wisdom (Jacobs, 2021, pp. 33-35). This chiastic structure reinforces theological claims regarding the divine and cosmic nature of wisdom, and not only enhances literary coherence, echoing themes later appropriated in Christian thought about the Logos (Cohen & Rabin, 2019, p. 52). The detection of such complex chiastic patterns that had previously been overlooked illustrates the ability of computational methods to enrich theological discourse.

Furthermore, the algorithm of the study successfully detected chiastic patterns in larger narrative passages, including the flood narrative (Genesis 6: 10-9:18), the Tower of Babel, and Jacob/Esau stories, which conform to well-established ring composition frameworks (Assis, 2002, p. 280). This suggests that the computational approach can extend beyond poetry to narrative texts, opening new avenues for theological and literary study of

biblical texts.

Implications for Biblical Scholarship and Interpretation

The integration of traditional exegetical frameworks with computational methods represents a significant methodological advancement in biblical studies. The replicable and objective nature of computational detection counters the subjective pitfalls of "parallelomania," where interpreters may perceive patterns where none exist (Assis, 2002, p. 280). Computational tools can filter potential chiastic structures by statistical importance and semantic coherence as demonstrated by this study, thereby providing a reliable foundation for subsequent theological interpretation.

Besides, the findings of the study reinforce the centrality of chiastic structures as hermeneutic keys that elucidate textual unity and theological emphases (Waltke, 2012, p. 52). Computational exegesis fosters a dialogical synergy between traditional biblical scholarship and digital humanities, by confirming classical interpretations with empirical rigor. This is consistent with recent calls for interdisciplinary collaboration to expand biblical literary analysis through digital means (Elrod, 2023, pp. 15-18).

Scholars are also challenged by the results to reconsider the function and scope of chiasmus beyond formal aesthetics. Chiastic patterns appear to serve as structural markers that guide readers toward theological "hinges" within the text, thus shaping reception history and canonical reading (Cohen & Rabin, 2019, p. 60). How biblical texts are taught, interpreted, and applied in religious contexts may be influenced by such insights, bringing ancient literary artistry with contemporary theological concerns.

Subsection III: Strengths, Challenges, and Future Directions

The computational approach of this study offers several notable strengths. Firstly, its replicability ensures that findings can be independently verified and applied to broader corpora, which is a vital advance for biblical studies. Secondly, the integration of semantic similarity metrics allows detection of chiastic patterns beyond superficial lexical repetition, thereby capturing deeper semantic resonances (Nguyen & Lee, 2022, pp. 85-86). Thirdly, previously overlooked chiastic structures are surfaced by the method, opening fresh avenues for literary and theological exploration. Replicability, objectivity, and breadth are provided by the computational method, and this avoids interpretive fatigue and bias. Also, it surfaces potential patterns that have been overlooked by human readers, thereby opening avenues for fresh interpretation.

However, there are also limitations with the approach. Detection algorithms are sensitive to parameter settings such as threshold values and window size, which may exclude legitimate but large-scale or asymmetrical chiasms (Interpreter Foundation, 2025). Moreover, reliance on semantic and lexical similarity metrics may under-represent chiasms based on thematic or syntactic symmetry that lack overt lexical mirroring (Staps, 2024, p. 50). Consequently, human interpretive judgment remains indispensable for validating computational outputs and avoiding false positives. Detection is sensitive to thresholds and window size, of which some legitimate large-scale chiasms may be missed. Also, the method applied relies largely on semantic/lexical similarity, which may under-represent structural chiasms with thematic rather than lexical symmetry. Likewise, to avoid "parallelomania," interpretive judgment remains essential, which is evident in critiques in reddit discussions, where readers find chiasms where none exist.

Future research directions are promising. Narratives-level chiasms spanning extended storylines, like Jacob cycle or flood narrative, could be better captured through integration of thematic embedding and narrative parsing models (McGovern et al., 2025, p. 158). Additionally, advances in syntactic parsing and semantic role labeling tailored to biblical Hebrew can enhance detection of non-lexical but structurally significant chiastic patterns (Naaijer et al., 2023, pp. 25-27). The development of annotated chiasm corpora would also facilitate supervised machine learning, improving educational resources and algorithm precision for biblical studies (Dorpinghaus, 2024, pp. 1285-1290). In short, narrative level chiasms should be expanded, where conceptual symmetry spans extended storylines, for instance flood narrative, by using narrative parsing and thematic embedding. Furthermore, semantic role labeling and syntactic parsing should be integrated, so as to detect non-lexical but structural symmetries. Beside, annotated chiasm corpora should be developed for educational use and machine learning validation. The study remains cautious as asymmetry may still function rhetorically (Interpreter Foundation, 2025).

Summarily, a rigorous framework that complements traditional biblical exegesis with computational precision is established by this study, unlocking new interpretive potentials in biblical literary analysis. The findings encourage a reappraisal of chiasmus as a hermeneutical and theological tool, and not merely as an aesthetic device, thereby advancing both scholarly understanding and engagement of faith communities with scripture.

CONCLUSION

This study demonstrated the significance and viability of combining computational techniques with theological and literary exegesis to identify and interpret chiastic structures in the Hebrew Bible. The research breaks new ground in biblical studies, both hermeneutically and methodologically by integrating natural language processing (NLP) tools with classical interpretive frameworks. The algorithm successfully detected both well-known and previously unidentified chiastic structures across selected poetic texts, providing a replicable, scalable, and objective method for structural pattern recognition in ancient sacred literature.

The principle that theological content and literary form in biblical texts are intimately intertwined lies at the heart of this investigation. The results assert that chiasmus functions as a deliberate rhetorical device designed to highlight theological pivots and narrative climaxes, and

not a mere stylistic flourish. These chiastic centers often coincide with moments of theological profundity, like meditation on Torah (Psalm 1), cosmic role of wisdom (Proverbs 8), or divine guidance (Psalm 23), thereby confirming the long-held scholarly view that structure itself to be meaning-laden (Assis, 2002, p. 278; Waltke, 2012, p. 52).

This perspective is significantly enhanced with the computational analysis, by offering a systematic method to detect such structures at scale, thus overcoming the limitations of manual approaches. Traditional chiastic analysis is constrained by inconsistency, limited scope, and subjectivity, even while rich in insight. Where chiasms begin and end have long been debated by scholars, and whether proposed structures reflect intentional design or reader-imposed interpretation, which is a concern often labeled "parallelomania" (Assis, 2002, p. 280). These issues are migrated with this present study by applying machine-readable criteria, coherence metrics, semantic similarity, and positional mirroring, so as to identify chiastic patterns with statistical rigor.

The theological implications of this paper are considerable. For instance, identifying "meditate" and "delight" as the chiastic center in Psalm 1 reinforces the theological centrality of divine instruction and covenant obedience in the religious life of Israel, and not only validates long-held interpretations (Waltke, 2012, p. 52). Also, placing the "valley of the shadow of death" at the chiastic center of Psalm 23 confirms the emphasis of the structure on divine presence amid suffering, which is a message resonant across Christian traditions and Jewish (Motyer, 2019, pp. 134-135). The ability of algorithm to isolate these theological centers with precision illustrates the potential for computational methods to deepen faith-based readings of Scripture without replacing traditional exegesis.

Moreover, the growing significance of interdisciplinary approaches in biblical scholarship is underscored by the study. Digital humanities tools are increasingly becoming essential components of rigorous textual analysis, which was once seen as ancillary. This aligns with the broader shift in academic research toward reproducibility, collaborative scholarship, and transparency (Elrod, 2023, pp. 10-18). The methodology developed here provides a blueprint for future studies seeking to analyze literary features such as parallelism, inclusion, and structural symmetry across diverse biblical genres. Likewise, it serves as a model for how digital technologies can illuminate the layered complexity of sacred texts offering insights that neither computational methods nor traditional literary analysis could achieve alone.

The contribution of the study to pedagogy and theological education is equally important. There is a growing need for annotated databases, computational resources, and visualization that can assist pastors, scholars, and students in understanding the theological depth and structural beauty of biblical texts, with the rise of digital tools and learning platforms. A searchable repository of validated chiasms, informed by both human and computational annotation, would be an invaluable asset in seminaries, faith communities, and universities. This would promote a deeper appreciation of the theological and literary sophistication of the Bible, and not only enhance textual literacy.

However, the challenges ahead are also recognized by the study. No algorithm can fully replace the contextual sensitivity, discernment, and theological insight of the human interpreter, despite advances in machine learning and natural language processing (NLP). Computational tools can point to potential patterns, but interpretation remains a huge task, which is shaped by context, spiritual reflection, and tradition. Hence, the role of the interpreter is redefined in dialogue with it and not diminished by automation. Large language models and algorithms must be used critically with awareness of their epistemological assumptions and limitations (Staps, 2024, p. 50).

Looking forward, several avenues for future research emerge. First, extending the algorithm to prophetic and narrative books may reveal previously unnoticed macro-level chiastic structures that span chapters or entire story cycles. Second, integrating semantic and syntactic role parsing could improve the detection of deeper, thematic symmetries that are not captured by surface lexical similarity. Third, interdisciplinary collaboration among biblical scholars, theologians, linguists, and computer scientists will be essential to refine tools, develop accessible resources, and interpret findings for wider use (McGovern et al., 2025, p. 160).

Summarily, the integration of literary exegesis with computational methods has demonstrated significant promise for illuminating chiasmus in biblical texts of Hebrew. The algorithm effectively identified novel and traditional chiastic structures across poetic books, and the understanding of key themes has been deepened by the theological interpretation of these findings, especially such as wisdom, covenant, and divine presence. The digital turn in biblical scholarship continues to reshape methodologies (Elrod, 2023, pp. 1-32).

In conclusion, this study reaffirms the enduring value of chiasmus as a theological and literary device in the Hebrew Bible and demonstrates how computational methods can enrich its study. The fusion of traditional exegesis and digital tools opens a new chapter in biblical scholarship, one that honours the ancient text while engaging with contemporary analytical technologies. By making visible the hidden symmetries of Scripture, this paper deepens the spiritual engagement with biblical texts, and not only advances academic inquiry, affirming their beauty, theological depth, and unity.

RECOMMENDATIONS

Corpus Expansion: The method should be applied to wider biblical corpora either in the wisdom, prophetic, and narrative literatures, so as to assess the role and prevalence of chiastic structures across genres.

Methodological Enhancement: Syntactic and semantic modeling should be incorporated to detect thematic rather than strictly lexical chiasms.

Scholarly Collaboration: By combining biblical exegetes, computational linguists, and digital humanities scholars,

build interdisciplinary teams for robust tool development and interpretation.

Resource Development: Students, educators, annotated database of chiastic structures for scholars, and open-access should be established.

Way for a new methodology in biblical literary analysis has been paved, one that is reproducible, scalable, and exegetically rich, helping to advance both theological reading and digital philology.

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