Stylometry without Words:
Analyzing John Milton's Grammatical Style

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In this article, Harvey Quamen investigates the structures—syntax, grammar, unconscious multi-lingualisms, hypotaxis, parataxis, punctuation, orthography, archaic words and spellings, ambiguous antecedents, and even simple errors—that support Milton's language. Quamen demonstrates how contemporary computational methods can go beyond word frequency counts to assist us in learning more about Milton's literary style, while showing us that the history of computational analysis in Milton studies is surprisingly long. He is meticulous in the methodology he uses, which he describes clearly and carefully in this article; and he concludes with a series of recommendations designed to align the interests of textual scholars and digital humanists.

Dans cet article, Harvey Quamen étudie les structures – la syntaxe, la grammaire, le recours inconscient à plusieurs langues, l'hypotaxe, la parataxe, la ponctuation, l'orthographe, les mots et graphies archaïques, les antécédents ambigus et même les simples erreurs – qui nourrissent la langue de Milton. Quamen montre comment les outils informatiques contemporains peuvent aller au-delà du décompte de la fréquence des mots pour nous aider à mieux comprendre le style littéraire de Milton ; en même temps, il explique que l'histoire de l'analyse informatique dans les études sur Milton est étonnamment longue. L'auteur fait un usage méticuleux de la méthodologie adoptée, qu'il décrit par ailleurs clairement et soigneusement dans cet article, et il conclut par une série de recommandations destinées à aligner les intérêts des spécialistes de l'analyse textuelle et des spécialistes des humanités numériques.

This article has three goals.[1] First, it is an attempt to come to terms with what might be revealed computationally about literary style, especially John Milton's literary style. Historically, questions like these have been the purview of text analysis or computational stylometry, both of which have traditionally looked to word frequency lists as a way to measure and to compare style because diction is perhaps the most obvious place where style—that is to say, authorial choice—expresses itself. I depart from that approach here, however, because the second goal of this article is to explore style at deeper literary substrates where authorial choice is barely articulable, where the governing principles of language—the heavy restrictions of grammar, especially—render authorial

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choice problematic and sometimes even impossible. More than fifty years ago, Ronald Emma wrote *Milton's Grammar* and Delores Burton used a computer to analyze what she called Shakespeare's "grammatical style"; my work follows their scholarly precedents.[2] But understanding grammar in a computational way, especially seventeenth-century grammar's idiosyncrasies and eccentricities, is not a trivial undertaking and some of its challenges will be apparent in the analysis that follows. Nonetheless, besides Emma and Burton, there already exists, as we shall see, significant scholarship to be built upon in the work of Mindele Treip, Thomas Corns, Daniel Shore, and others. My third goal is to question whether, given the advances of the Internet and open-source tools, work of this kind is any easier today. As we shall see, the short answer is "no, not much easier at all," but that pessimism belies much of the real progress that is currently being made. And so I will close with a series of recommendations, all of which point toward a newly reinvigorated and synergistic collaboration between textual editors and digital humanists.

"Scholars have studied Milton's style in detail," says Shore, "for as long as there has been commentary on the poem,"[3] and Milton's reputation suffered especially egregiously in the hands of twentieth-century New Critics like F. R. Leavis and T. S. Eliot, for whom literary style became a proxy through which they could argue against Milton's political, historical, and canonical worth. "The movement that came to be called modernism marked its modernity by the repudiation of Milton," alliterate editors Stephen Orgel and Jonathan Goldberg. "The real complaint," they continue, "was that Milton had shattered a world that modernism sought to reassemble."[4] That world—English, sensuous, Shakespearean in style—was poorly represented by Milton's apparently non-English, Latinate, political, learned diction. Modernism, as much a stylistic invention as a cultural one, set the tone for almost thirty years until Milton's reputation began to be resurrected, in part, by critics like Christopher Ricks, whose 1963 book, *Milton's Grand Style*, argued against the anti-Miltonists in

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2. Ronald Emma, *Milton's Grammar* (The Hague: Mouton, 1964); Delores M. Burton, *Shakespeare's Grammatical Style: A Computer-Assisted Analysis of* Richard II *and* Antony and Cleopatra (Austin: University of Texas Press, 1973), xxx.

3. Daniel Shore, *Cyberformalism: Histories of Linguistic Forms in the Digital Archive* (Baltimore: Johns Hopkins University Press, 2018), 167. Shore is referring, of course, to *Paradise Lost*.

4. Stephen Orgel and Jonathan Goldberg, "Introduction," in *John Milton: The Major Works* (Oxford: Oxford University Press, 2008), ix–xxvii, xxiii–xxiv.

favour of Milton's "decorum," maintaining that he was indeed "comparable […] to Shakespeare and Dante."[5] So too Emma, whose 1964 *Milton's Grammar* used rigorous statistical analysis to pinpoint the distinctive aspects of Milton's literary style, all in an attempt to "avoid the impressionistic and establish the characteristic," as he said.[6] Later, Milton's Englishness would be buttressed further by Thomas Corns's computational work in *The Development of Milton's Prose Style* (1982) and *Milton's Language* (1990).[7] More recently, Daniel Shore's *Cyberformalism* has tackled the difficulty of analyzing literary form computationally. Of particular interest to us here, as we shall examine shortly, is his analysis of Milton's "depictive adjectives"—adjectives displaced from the nouns they modify and thereby disrupting in creative ways the grammatical structure of a sentence.[8]

And so, Milton studies have had a surprisingly long history of computational analysis. But challenging questions remain: Can literary style be appreciated computationally? Can contemporary approaches drawn from digital humanities (DH) illuminate these issues further? And, perhaps most importantly, has this work been made any easier by contemporary online corpora, open-source tools, scripting languages, and data visualization toolkits? As we shall see, despite new corpora and powerful new tools, this work is still surprisingly onerous. Small computational victories analyzing Milton's literary style lead to larger ones; however, the longstanding debate about Milton's relative Englishness versus Latinism remains unresolved, even after all this time, even after all this computational power. Still, we always hope to bring new insights to enduring questions.

My methodology here departs from the more common family of computational stylistics that often begins and ends with word counts, often called "word frequency lists." Frequency analysis techniques compare these lists—sometimes with, and sometimes without, the inclusion of so-called "stopwords" or "function words": terms such as prepositions and pronouns and conjunctions and other words that do not carry much content or meaning but that nonetheless must be present in order to render sentences properly

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5. Christopher Ricks, *Milton's Grand Style* (Oxford: Oxford University Press, 1963), 9.

6. Emma, 18.

7. Thomas N. Corns, *The Development of Milton's Prose Style* (Oxford: Clarendon Press, 1982) and *Milton's Language* (Oxford: Basil Blackwell, 1990).

8. See Shore, 154–89 (chapter 6, "Milton's Depictives and the History of Style").

grammatical. Instead, many textual analysis studies favour "content words," the nouns and verbs and adjectives that convey meaning, delineate themes, and build metaphors. However, John Burrows's work on Jane Austen's style in his 1987 *Computation into Criticism* is still requisite reading for those interested in stylometry, if only because he defended the retention and analysis of function words and argued that Austen's style manifested itself even in seemingly insignificant syntactic structures. It would be wrong, he maintained, to assume that "the very common words constitute a largely inert medium while all the real activity emanates from more visible and more energetic bodies."[9] Function words or no, this method of stylistic analysis rests squarely upon diction—that is to say, word choice—the place where authorial intention manifests itself most obviously. This is the position taken by Annabel Patterson, for example, in her aptly titled *Milton's Words*. Relying on close reading, she suggests that "'style' is just another word for 'language,' and 'language,' of course, means primarily words, the choice of words and their arrangement in units of sense and communication."[10] As we shall see, however, the question of Milton's literary style is stickier than Patterson's view might suggest.

The question of style

"Literary style," John Keene wrote recently, "is the material articulation, in whatever genre and form, of an author's attempt to record their vision, sensibility, and apperception of the world."[11] In Keene's formulation, style is an author's attitude, a way of being in the world, the residual trace of a unique personality that survives into print. Keene rather elusively lists over fifty names without describing in any detail the style at hand. "In each case," he concludes, "the style for me is synonymous with the writer."[12] The problem is that the measurable things, words, substitute as proxies for an immeasurable thing, personality. Writing about Shakespeare, Delores Burton pointed to just this double bind

9. J. F. Burrows, *Computation into Criticism: A Study of Jane Austen's Novels and an Experiment in Method* (Oxford: Clarendon Press, 1987), 2.

10. Annabel Patterson, *Milton's Words* (Oxford: Oxford University Press, 2009), 3, dx.doi.org/10.1093/acprof:oso/9780199573462.001.0001.

11. John Keene, "Elements of Literary Style: Form vs. Content, the Eternal Conversation," 17 April 2018, lithub.com/john-keene-elements-of-literary-style/.

12. Keene, "Elements of Literary Style."

of stylistic studies: "one can talk about language in literature and ignore the fictional world that subsumes it; or one can discuss that fictional world without reference to language." The second option is often preferred by literary critics, but Burton rejects it: "at the level of the fictional world, language no longer exists, because it is no longer perceived as such."[13] The same seems true of an author's personality, apperception, world view, perhaps even the music of style itself, its grandeur, its decorum—they all reside outside of language. These things can be either the cause of literary style or its effect, but they always act as proxies, not directly interpretable themselves as style per se.

We might put Keene on one end of a continuum, then, an endpoint at which style becomes extra-linguistic, something antecedent to literary expression. On the other end, we might situate the serious, furrow-browed, post-war New Critics and their focus on close reading. In *Theory of Literature*, for example, René Wellek and Austin Warren located style exclusively at the intersection of linguistics and literary study. "Stylistics," they wrote, "cannot be pursued successfully without a thorough grounding in general linguistics." For them, concerned as they were to police the line between the literary and the non-literary, "one of [stylistics'] central concerns is the contrast of the language system of a literary work of art with the general usage of the time. Without knowledge of what is common speech […] stylistics can scarcely transcend impressionism."[14] Style is perceptible because it articulates something that could have been said differently. Deciphering "what the author ought to have said is the true difficulty in judging style," suggested their fellow New Critic, W. K. Wimsatt.[15]

Common, then, is the belief that style is measured by authorial choice. Opting for one thing rather than another is what matters—conscientious and intentional arrangement. Style is manifested, Wellek and Warren suggest, in "such deviations as the repetition of sound, the inversion of word order, the construction of involved hierarchies of clauses, all of which […] serve some aesthetic function."[16] Style is visible, argued Richard Ohmann, only because there

13. Burton, 10–11.

14. René Wellek and Austin Warren, *Theory of Literature* (New York: Harcourt, Brace, and Company, 1949), 180.

15. W. K. Wimsatt, Jr., *The Prose Style of Samuel Johnson* (New Haven: Yale University Press, 1941), 10.

16. Wellek and Warren, 184.

exists a "background against which 'choice' is a meaningful concept," only insofar as "the phrase '[a particular] *way* of saying *it*' makes sense." An author's style is identifiable only when *choice* is a concept that "really exists for the author."[17] But if style is what we can point to on the page, then style is locatable, measurable, structural, quantitative. Shore, too, asserts that stylistic markers are established through repetition; they are "defined by iterability, and iterations are by definition enumerable." Numeracy, he suggests, implicitly substantiates our stylistic claims that "Milton *tends* to use a construction this way, or that he does so *often* or *habitually* or *rarely*, or that his usage is *uncommon* or *conventional* or *idiomatic*."[18]

My own goal is to analyze Milton stylometrically, but to do so without compiling word frequency lists. By focusing less on the words themselves and more on the structures that support them, I argue that we can gain new insights into Milton's style while simultaneously considering the limits at which style can still be measured. Two earlier projects illuminate my experiment, highlighting both best practices and potential obstacles. First, Anupam Basu's "Form and Computation: A Case Study"[19] surveys the early modern texts now available through projects like the Early English Books Online-Text Creation Partnership (EEBO-TCP; quod.lib.umich.edu/e/eebogroup/) and points out how this growing corpus might be used in increasingly scalable ways. Basu's own EarlyPrint Lab, which "aims to render EEBO-TCP more tractable for quantitative historical analyses by virtue of some intensive reprocessing of the TCP texts and their metadata,"[20] is one such set of tools. In "Form and Computation," Basu extracts only the metadata from each text in order to cluster texts based on their descriptive tags. The experiment produces a kind of prototypical "recommendation engine," not unlike the kind of thing one finds on Netflix or YouTube. "The results provide some surprising insights," he says, "into the tractability of formal concerns for computation and the ways in which they might be harnessed to accommodate the central concerns of literary reading."[21]

17. Richard M. Ohmann, "Prolegomena to the Analysis of Prose Style," in *Essays in Stylistic Analysis*, ed. Howard S. Babb (New York: Harcourt Brace Jovanovich, 1972), 35–49, 41, 43.

18. Shore, 181.

19. Anupam Basu, "Form and Computation: A Case Study," in *Digital Milton*, ed. David Currell and Islam Issa (Cham, Switzerland: Palgrave MacMillan, 2018), 111–28, dx.doi.org/10.1007/978-3-319-90478-8_5.

20. EarlyPrint Lab, accessed 26 September 2021, earlyprint.org/lab/.

21. Basu, 121.

Like my project here, Basu's is an analysis of a text's formal qualities, and, by focusing exclusively on metadata, a project that ignores the author's words themselves. The metadata makes the project more computationally tractable, but Basu reminds readers that other promising work must still negotiate pressing problems in those early modern texts. Despite the significant promise of corpora like EEBO-TCP, he says, "moving from access to analysis has proved especially difficult […] due to the range of variation in early modern grammar and orthography." Contemporary algorithms and tools assume standard spellings, for example, "an assumption that breaks down spectacularly in the case of early English print." As a result, Basu suggests, DH finds itself caught between two processes that often have different goals: "large-scale text analysis on one hand, and text editing and encoding on the other." In DH circles, human readability is not the only goal of textual editing. Basu's own early modern print project promises appealing solutions to these problems—appending "to every word in this two billion-word corpus" data like "regularized spelling, lemma, and part-of-speech information."[22] Until that kind of markup is available, however, we are left to hack together our own corpora, and test drive different software packages, all the while seeking better and more accurate texts and tools that can help answer our research questions.

Shore's *Cyberformalism: Histories of Linguistic Forms in the Digital Archive* is another instructional text in this regard, not only because of his fascinating commentary on the history of literary style, or because of his use of powerful natural language processing tools, but also due to his stylistic analysis of Milton's "depictive adjectives"—adjectives that "modify the subject of the sentence" but are nonetheless "part of the predicate and syntactically dependent on the verb"—adjectives like "She drove **drunk**" or "He cooked **naked**."[23] Shore makes a convincing case that depictives are important "telltale markers of Milton's epic style," a case especially relevant here because of the way that depictives effectively combine surface-level dictional word choice with a deeper, structural, wrenched grammatical syntax. "Milton works on the blurry edge of [grammatical] rules," says Shore, "putting pressure not simply on the semantic boundary between sense and nonsense but on the grammatical boundary between acceptable and unacceptable."[24]

22. Basu, 112, 113, 115.

23. Shore, 154 (his emphasis).

24. Shore, 170.

Shore demonstrates how Milton's sentences force human readers, as they read, to construct, to rethink, and to reconstruct patterns of sense-making in repetitive, iterated, decision-making loops. By postposing adjectives behind the nouns they modify—for example, the mantling vine "gently creeps / **Luxuriant**" (4.260) or "The great Creator from his work returned / **Magnificent**" (7.567–8)—Milton forces the reader to choose "between two parses and […] two meanings" in which "there is difference but not discrepancy."[25] The adjectives may be read legitimately either as adjectives or adverbs, but the reader must reconcile the passage's possible meanings within the shifting parallax of unorthodox grammatical placement.

Shore's work combines an elegant and eloquent survey of the history of style with an appreciation of Milton's direct challenges to both diction and grammar, all analyzed by means of sophisticated and cutting-edge computational stylometry. Shore can therefore speak authoritatively when he summarizes our predicament: "Current natural language processing is not up to the task," he admits.[26] No wonder, then, that Shore draws a pessimistic conclusion about the potential of computational stylistics: "[T]he historical domain of [stylistic] markers will only ever be a limited subset of a text's infinite reserve," he says. Between historical style and computational analysis, "these two approaches constitute, in their non-unity, a negative dialectic, with each serving as a continuous reminder or critique of the other's limitations."[27]

Even so, I believe that computational stylometry can still teach us much about how style works—the style of a text, of an author, or of a historical period. Both Basu and Shore convincingly argue that the markers of form and style are not merely superficial linguistic features. There is stylistic substance in the depths. And to see Milton's style at depths lower than dictional word choice is to understand something about the poet's ability to wrench the syntax and grammar of English into different shapes. It is to understand something of his various fluencies in different languages, to witness how his deep, unconscious multilingualisms merge. Emma plumbed these depths too. In *Milton's*

25. Shore, 168, 171, 172.

26. Shore adds in a footnote that he worked with a computational linguist to develop a "machine learning classifier that uses a support vector machine to identify depictives in a corpus of parsed sentences. At the time of writing, the classifier was not performing with anything approaching sufficient recall or precision" (272–73n60).

27. Shore, 188–89.

Grammar, he maintained that "the fact is that if language yields only slightly, though at times interestingly, to all insurgence, it may be where alternatives are restricted that a usage bears the true impress of a man's mind."[28] My goal here, however, is less to understand the impress of Milton's mind than to discover what the computer may reveal to us of language's malleability, especially at moments where Milton's English collides with his Latin.

Milton's Latinate style

The importance and omnipresence of Latin in early modern literature is an essential fact of the period. Latin was taught alongside English in grammar schools and, by the time students matriculated university, Latin had become for them the *lingua franca* of every pursuit from law to medicine, from history to theology. J. W. Binns has reminded us of the historical moment:

> Chaucer was, even in the Elizabethan period, in danger of becoming unintelligible to his own countrymen. So it made sense for any serious English writer to write in Latin, a language of unquestioned prestige, which could be read by intellectuals all over Europe, which had endured pre-eminent for a millennium and a half, and which there was no reason to doubt would last for ever [sic].[29]

By the mid-seventeenth century, the Inkhorn Controversy—the *Questione della Lingua*, the debate whether one should write in Latin or in the English vernacular—was beginning to tip irretrievably toward English. The subsequent critical disagreement over Milton's style suggests that his work, so heavily grounded in Latin composition, squarely straddles this historic transition. Leavis had complained "that Milton has forgotten the English language";[30] T. S. Eliot had insisted that "Milton writes English like a dead language";[31] on the

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28. Emma, 17.

29. J. W. Binns, *Intellectual Culture in Elizabethan and Jacobean England: The Latin Writings of the Age* (Leeds: Francis Cairns, 1990), 3.

30. F. R. Leavis, "Milton's Verse," in *Revaluation: Tradition and Development in English Poetry* (Aylesbury, UK: Penguin, 1972), 46–67, 56.

31. T. S. Eliot, "Milton I," in *On Poetry and Poets* (New York: Noonday Press, 1957), 156–64, 159.

other hand, Thomas Corns has defended Milton as being "in no way alien or unEnglish."[32]

Either way, Milton's Latin influences must be reckoned with. In *Milton's Languages*, John K. Hale traces their presence through multiple registers: from the mannerisms of Milton's general thought, to grammatical syntax, to his diction and word choice, down even to the musicality of the aural sounds themselves: "I am sure he preferred Latin sounds in some instances. Latin and euphony often coincided."[33] Hale contends that Milton knew as many as ten languages, though not all with equal fluency, and that Milton's multilingualism informed practically every aspect of his writing: "his languages merged and meshed both when learning and then later when writing."[34] It did not particularly "matter to Milton as *thinker* whether an idea came to him in English words or Latin ones," Hale maintains, "since his two most-used languages had long ago interpenetrated as far as concerned his thought."[35] Indeed, Hale's comments suggest to the enterprising digital humanist an atypical kind of analysis. One might look where Hale points: "beyond the lexicographical monad, the word, towards clauses or sentences, which Milton makes so long that they give strong contextual guidance into meaning."[36]

The dilemma for a contemporary scholar, of course, is that English sentences are not what they once were. And that sentiment was true in Milton's time as well. Emma has noted, for example, that a Middle English "sentence of any length tended to be an artless succession of loosely joined clauses," suggesting that "the native English tradition is rooted in *parataxis*."[37] The parallel constructions of parataxis—as opposed to the more modern, nested, hierarchical grammars of *hypotaxis*—contribute to the challenge of working on the grammatical structures found in historical literature. Parataxis, with its almost haphazard joining of syntactic parts and almost arbitrary use of coordinating punctuation and coordinators, had been the norm for English

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32. Corns, *Milton's Language,* 118.

33. John K. Hale, *Milton's Languages: The Impact of Multilingualism on Style* (Cambridge: Cambridge University Press, 1997), 118, dx.doi.org/10.1017/CBO9780511585487.

34. Hale, 14.

35. Hale, 114.

36. Hale, 110.

37. Emma, 140.

prose, according to George Krapp, at least until John Wycliffe and others imported a more structured, subordinated, hypotactic arrangement into English from Latin.[38] "Despite Milton's classical learning and his efforts to adapt foreign usages," Emma writes, "parataxis is a fundamental element in his prose […] and an influence on his poetry."[39] Ernst Häublein agrees: although following Genesis quite closely, the style of *Paradise Lost*'s book 7 has "a tendency to lengthen the sentences and to approach something like a Miltonic paragraph without obscuring its indebtedness to the more paratactic style of the Bible."[40]

A case-inflected language like Latin relies far less upon word order than does English. Moreover, much classical Latin was written in *scriptura continua*, which used neither spaces between words nor punctuation,[41] and so the location of the verb itself came to signal the end or closure of an utterance. The result formed what became classically known as periodic style, a type of writing in which the resolution provided by the main clause is deferred until the end of the sentence. To the reader, the effect is not unlike having a number of ideas in suspension, all of which at last are coalesced into a harmonious whole by the verb. The *Oxford English Dictionary* tracks the term "period" from "[Greek-derived but] post-classical Latin *periodos*," meaning the "conclusion of a sentence, full stop,"[42] to sixteenth-century English where it begins to signify both a mark of punctuation and the grammatical unit of a full thought: "Classical theories of rhetoric usually stipulated that a period should express a complete thought self-sufficiently."[43] Like many other early modern writers, Milton had been heavily influenced by Roman orator and stylist Cicero, whose writings even today are regarded as the best examples of periodic style: "A *period* or *periodic sentence* (Gk. **periodos**, a circuit) has logical and syntactical subordination to a main idea, which usually is not completed until the very

38. George Philip Krapp, *The Rise of English Literary Prose* (New York: Oxford University Press, 1915), 50.

39. Emma, 140.

40. Ernst Häublein, "Milton's Paraphrase of Genesis: A Stylistic Reading of *Paradise Lost*, Book VII," *Milton Studies* 7 (1975): 101–25, 108.

41. E. Otha Wingo, *Latin Punctuation in the Classical Age* (The Hague: Mouton & Company, 1972), 16, dx.doi.org/10.1515/9783110805215.

42. *Oxford English Dictionary*, 2nd ed. (Oxford: Oxford University Press, 2004), s.v. "period," definition A17.

43. *Oxford English Dictionary*, s.v. "period," definition A16.

end of the sentence. Among Roman writers and orators, Cicero is especially associated with the periodic style."[44]

Morris Croll's once-popular essay, "The Baroque Style in Prose," first published in 1929, wholly eschewed the language of "sentences" and "clauses," preferring instead to speak of "periods" and the "members" that comprise them.[45] Croll saw seventeenth-century literature as being divided between two styles. The first was an oratorical style that emulated Gorgias and Cicero and that was devoted to the studied practice of rhetorical figures and schemes, to the sensuousness of language, to the expansiveness of *copia*, and to the classical sense of the verb-ending periodic style. Hale wrote that "Reading a neo-Latin writer whose sole strength is copia is like eating a meal of marshmallows."[46] The other style, argued Croll, the essay style, having been championed by the so-called "anti-Ciceronians," was more straightforward and plainer. It enacted the unmediated processes of thought, pretended to abandon the polished tropes of rhetoric, and, indeed, seemed to disavow the very discipline of revision itself. In this style, wrote Croll, "the period—in theory at least—is not made; it becomes. It completes itself and takes on form in the course of the motion of the mind which it expresses."[47]

In either style, however, the sentence or "period" is not bound by the notion of a "complete thought." In their natural habitat, the codified grammar of seventeenth-century sentences seems to be a tradition more honoured in the breach than the observance, to say nothing about wildly diverse styles of punctuation. Common usage and rules were two different things. "Milton could surely pick out and employ adjectival constructions," writes Shore, "that he took no account of in the grammar he published in 1669."[48] Likewise, Ben Jonson's *English Grammar* of 1640 details parts of speech and English's case inflections but has almost nothing at all to say about the sentence as a unit of either grammar or meaning.[49] Later, Warner Taylor, studying Samuel

44. Stephen Ciraolo, ed., *Cicero: Pro Caelio*, 2nd ed. (Wauconda, IL: Bolchazy-Carducci, 2000), 3–4.

45. Morris W. Croll, "The Baroque Style in Prose," in *Style, Rhetoric, and Rhythm: Essays by Morris W. Croll*, ed. J. Max Patrick, Robert O. Evans, John M. Wallace, and R. J. Schoeck (Princeton, NJ: Princeton University Press, 1966), 207–33.

46. Hale, 12.

47. Croll, 224.

48. Shore, 167.

49. Ben Jonson, *The English Grammar*, ed. R. C. Alston (Menston, UK: Scolar Press, 1640, 1972).

Johnson's eighteenth-century periodic style, went so far as to count the number of "fully expressed ideas per period"; "it took Johnson 36.7 words during the *Rambler* period," Taylor says, "to express one complete thought."[50] But how many complete thoughts are expressed by the first sentence of *Paradise Lost*? To think of historical style—and in particular seventeenth-century literary style—computationally, then, we must abandon some cherished notions, like periods that make "good sense" or the grammatical equivalence between a "fully expressed idea" and a well-structured hypotactic sentence.

Milton's grammar, shaped by both parataxis and hypotaxis, inherited stylistic texture from a number of sources: early and Middle English, Latinate periodic style, and of course shifting, seventeenth-century conventions of grammar and punctuation. Mindele Treip's study, *Milton's Punctuation and Changing English Usage, 1582–1676*, suggests that, in this regard, Milton's work straddles an important historical transition. Earlier punctuation use, "rhythmical and oratorical, or sometimes theatrically dramatic," encouraged "individuality and flexibility of expression," but by the time *Paradise Lost* was published, writers' and printers' views on punctuation were gravitating "toward more logically and grammatically oriented views."[51] Milton's punctuation, she argues, was due partly to his own preferences and partly to the conventions of print houses like that of Samuel Simmons.

This long history is meant to draw special attention to the study and preparation necessary before one can apply contemporary stylometric tools to historical texts. Tools, like readers, make fundamental assumptions about how language works, and in both cases we can appreciate how important it is to understand and to respect the eccentricities of any historical period's language use. To evaluate Milton's grammatical structures properly, one must wrestle with parataxis, punctuation, orthography, archaic words and spellings, ambiguous antecedents, and even simple editorial errors.

All three grammatical projects described in this article—finding periodic sentences, discovering ablative absolutes, and diagramming sentences—depended first and foremost upon having texts tagged with every word's part of speech. Fortunately, we have access to a number of good part-of-speech taggers,

50. Warner Taylor, "The Prose Style of Johnson," *University of Wisconsin Studies in Language and Literature* 2 (1918): 22–56, 39–40.

51. Mendele Treip, *Milton's Punctuation and Changing English Usage, 1582–1676* (London: Methuen, 1970), x.

computational tools that can assign a correct grammatical part of speech—or at least a best guess—to every word in a sentence. I supplied the tagger with a set of useful texts—not just correct readerly texts, but texts suitable for computational analysis, which has sometimes meant creating hybrid corpora to help compensate for some of the shortcomings of the part-of-speech tagger itself (such as a preference for modern spellings).

Determining parts of speech in contemporary sentences, let alone seventeenth-century sentences, is still not always a straightforward task and not all taggers are up to the job. Parts of speech are usually determined by two factors: a word's definition and the context in which it is used. That relationship is often symbiotic—the definitions of ambiguous words like "refuse" or "permit" depend on their parts of speech as either nouns or verbs, yet their parts of speech depend upon the identification of proper definitions. Oral speech helps to untangle the knot via different pronunciations, but written text cannot provide those telltale clues. Consequently, even with the simplest of twenty-first-century texts, the computer is often caught in a bind; determining the appropriate part of speech is helped by knowing the word's most appropriate definition, but determining the best definition is helped by knowing the word's correct part of speech.[52] That Gordian knot is tied significantly tighter with Milton: the strained grammar renders context, and hence parts of speech, all the more difficult to identify.

I opted to use the University of Leicester's part-of-speech tagger, called CLAWS (the Constituent Likelihood Automatic Word-tagging System),[53] a robust tool that was used to tag the gigantic British National Corpus.[54] In my preliminary tests, CLAWS was the most accurate tagger of Milton's language.[55]

52. For more on how part-of-speech (POS) taggers operate, see chapter 5, "Categorizing and Tagging Words," in Stephen Bird, Ewan Klein, and Edward Loper, *Natural Language Processing with Python* (Sebastopol, CA: O'Reilly, 2009), 179–220. For more on the two "families" of POS taggers (rule-based and stochastic), see Divya Godayal, "An Introduction to Part-of-Speech Tagging and the Hidden Markov Model," *freeCodeCamp*, 8 June 2018, freecodecamp.org/news/an-introduction-to-part-of-speech-tagging-and-the-hidden-markov-model-953d45338f24/.

53. CLAWS Part-of-Speech Tagger for English, 23 April 2020, ucrel.lancs.ac.uk/claws/.

54. British National Corpus, 26 January 2009, natcorp.ox.ac.uk/.

55. Contemporary POS taggers meet their match in Milton. One challenging example comes from the very beginning of the poem: "What in me is dark / **Illumine**, what is low **raise** and **support**; / That to the heighth of this great argument / I may assert eternal providence, / And justify the ways of God to men."

The tool parses a text into words and identifies each word's particular part of speech. The tagger has a variety of output formats, but a particularly convenient format adds a coded suffix to each word—an underscore character followed by a code that denotes the word's part of speech. For example, the first portion of *Areopagitica* looks like this after having been tagged:

> They_PPHS2 ,_, who_PNQS to_II states_NN2 and_CC governors_NN2 of_IO the_AT Commonwealth_NN1 direct_VV0 their_APPGE speech_NN1 ,_,

The meanings of the tags are delineated in a glossary on the tool's website.[56] In general, nouns have tags that start with N; verbs have tags that start with V; articles have tags that start with A, etc. The remainder of the tag name adds further precision: NN1, for example, is a singular common noun whereas NN2 is a plural common noun. VVI is an infinitive verb; VVD is a verb in past tense. VV0 is the base form of a lexical verb; AT is an article; APPGE is a possessive pronoun. Punctuation marks are simply tagged as themselves—that is to say, the punctuation mark followed by an underscore and then a repetition of the punctuation mark. The retention of punctuation was important for me because I wanted to parse the tagged text into appropriate seventeenth-century sentence units. Still, the tool is not perfect—notably, the CLAWS tagger has difficulty with old spellings and seems to guess "noun" when it cannot determine otherwise.

Because CLAWS does not have, or need, any understanding of a "sentence," breaking a text into appropriate sentences depends on human skill. Once we understand the seventeenth-century rules, however, we can write computer

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(1.22–26; my emphasis). The bold words are verbs, but none of three POS taggers that I tested—NLTK, TreeTagger, or CLAWS—parses them correctly. Only TreeTagger correctly identifies "illumine" as a verb (NLTK and CLAWS identify it as a noun); only CLAWS identifies "support" as a verb (NLTK and TreeTagger identify it as a noun); and all three taggers claim that "raise" is a noun. I rejected NLTK as a parser because it does not automatically tokenize punctuation separately, which was problematic for my project. Both CLAWS and TreeTagger tokenize punctuation, but I ultimately chose CLAWS for two reasons: in spot tests it seemed to handle archaic words better, and I could choose an output format that made subsequent steps of my project much easier. For more on CLAWS, see the link above. For NLTK, visit nltk.org/; for TreeTagger, visit cis.uni-muenchen.de/~schmid/tools/TreeTagger/.

56. UCREL CLAWS7 Tagset, 23 April 2020, ucrel.lancs.ac.uk/claws7tags.html.

code to divide the text into appropriate units. But retaining and respecting the original seventeenth-century punctuation is crucial. Contemporary editors often silently correct the punctuation, following, or even hiding behind, what Gordon Campbell once chastised as "the stately correctness of Victorian editions."[57] Even Thomas Corns admitted "a certain theoretical inelegance"[58] in his statistical work by re-parsing Milton's sentences into units that were more semantically coherent. And so the question of authentic punctuation is, once again, vexing.

Mindele Treip's classic study, *Milton's Punctuation*, illuminated the shifting practices of punctuating seventeenth-century literature, a practice as equally influenced by the author as by the print house. In Milton, she argued, the

> Semicolon is used to mark introductory but not other dependent clauses; this is as much an oratorical practice as a grammatical one, showing that we have arrived at the main verb and climactic member of the period. The heavier stops, semicolon and more especially colon, are present usually to indicate antithesis, but there also seems to be some attempt to correlate their use with the grammatical importance of the member. More simply, colon introduces antithesis between main members, semicolon between lesser ones.[59]

Further, as editors Orgel and Goldberg have suggested, "a question mark does not invariably indicate the end of a sentence for Milton; to capitalize the lower-case word following the question mark, as most modern editors routinely do, constitutes a grammatical change."[60] To complicate matters even further, Robert Moyles has suggested that "the exclamation and interrogation marks are sparingly and often interchangeably employed."[61] A search through the 1674 text of *Paradise Lost* shows that these marks are followed by lowercase letters

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57. Gordon Campbell, "Text and Textual Notes," in *John Milton: The Complete Poems* (London: J. M. Dent, 1980), x.

58. Corns, *Milton's Language*, 12.

59. Treip, 36.

60. Orgel and Goldberg, xxxi.

61. R. G. Moyles, *The Text of* Paradise Lost: *A Study in Editorial Procedure* (Toronto: University of Toronto Press, 1985), 121, dx.doi.org/10.3138/9781487576653.

about 48 percent of the time. That is to say, question marks and exclamation points end sentences only half the time when they occur.

Grammars of the sixteenth and seventeenth centuries explain very little about the structures of full sentences. Jonson's 1640 *English Grammar*, for example, divided sentences into only two categories, perfect and imperfect, depending upon the type of performative punctuation used. "The distinctions of an *imperfect* Sentence are two," he wrote, "a *Sub-distinction* [a semi-colon], and a Comma. […] The Distinction of a perfect Sentence hath a more full stay, and doth rest the Spirit, which is a *Pause*, or a *Period*."[62] That Jonson saw punctuation as performative, not grammatical, suggests that paratactic sentences posed no special difficulty for seventeenth-century readers. These are the kinds of factors that affect our ability to measure periodic style.

The corpus preparation, then, for this project was long and laborious: the ideal text for this project is one that has modernized spelling but that retains original punctuation. To create such a hybrid text, I began with the electronic text at paradiselost.org (paradiselost.org/novel.html; a text that needs some significant correction) and then integrated the original seventeenth-century punctuation as delineated by Richard Cunningham's diplomatic transcription of the 1674 edition.[63] I followed a similar procedure for *Areopagitica*—using the text at gutenberg.org (gutenberg.org/cache/epub/608/pg608.txt) and integrating the punctuation from the Milton Reading Room's online edition.[64] The Python scripts I wrote are available at the GitHub site for this project.[65]

To create a data visualization of periodic style, then, I opted for a simple line graph. Starting from the part-of-speech tagged text, I could divide the text into appropriate seventeenth-century sentence units, and could then calculate the locations of the verbs within those sentences. I chose to calculate a verb's position within a sentence by counting the number of words occurring before

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62. Jonson, 83.

63. At the time of publication, this site remains private.

64. "Areopagitica; a Speech of Mr. John Milton," The John Milton Reading Room, 14 March 2020, dartmouth.edu/~milton/reading_room/areopagitica/text.html.

65. See hquamen/stylometry, 6 July 2021, github.com/hquamen/stylometry. My approach to reconciling texts was to tokenize the corresponding lines from the two texts and to calculate the Jaccard similarity between the two sets. If the score fell below an arbitrary threshold (I chose 0.9), my script stopped and I reconciled the two lines by hand. Otherwise, the Python script simply eliminated the punctuation from the modern spelling's text and replaced it with the punctuation from the original spelling's text.

the verb as well as the number of words following the verb. If the two numbers were equal, then I identified the verb as occurring 50 percent of the way through the sentence. Similarly, if a verb occurred at the very beginning of a sentence, then 0 percent of the sentence's total words preceded it. And if a verb occurred as the very last word of a sentence, then 100 percent of the sentence words preceded it. By normalizing verb positions as percentages rather than as raw word counts, every sentence becomes commensurable—that is, we can graph every verb's location on a chart whose x-axis ranges from 0 to 100 percent of each sentence's total length.[66]

Furthermore, because long documents will contain more verbs than short documents, raw verb counts will not be, by themselves, commensurate. I normalized those numbers as well. One common practice, for instance, is to register the number of occurrences per thousand words ("per mille" rather than "per centum")—in other words, count the number of verbs but then scale the result, pretending that each document is one thousand words long. For example, if a document is two thousand words long, then the final verb counts should be halved. And if a document is only five hundred words long, then the counts should be doubled. The y-axis, then, will tally the number of occurrences per thousand words of original text.

All this preliminary corpus work and analysis is designed to answer one question: does *Paradise Lost* use more periodic sentences than *Areopagitica*? We may have preliminary guesses based on our reading, but quantification has the added benefit of bringing objective data to our subjective impressions. The final data visualization was produced in R[67] using Hadley Wickham's popular data visualization library, ggplot2.[68]

66. It seems reasonable to assume that short sentences might seriously distort verb locations and therefore that short sentences and long sentences are not really commensurable. Surprisingly, the results were nearly identical no matter whether I eliminated sentences under five words long, or sentences under ten words long, or sentences under twenty words long. The comparative graphics can be seen on GitHub: github.com/hquamen/stylometry/tree/main/images/working.

67. R Core Team, *R: A Language and Environment for Statistical Computing* (Vienna, Austria: R Foundation for Statistical Computing 2018), r-project.org/.

68. Hadley Wickham, *ggplot2: Elegant Graphics for Data Analysis* (New York: Springer-Verlag, 2016), dx.doi.org/10.1007/978-3-319-24277-4. See also ggplot2.tidyverse.org.

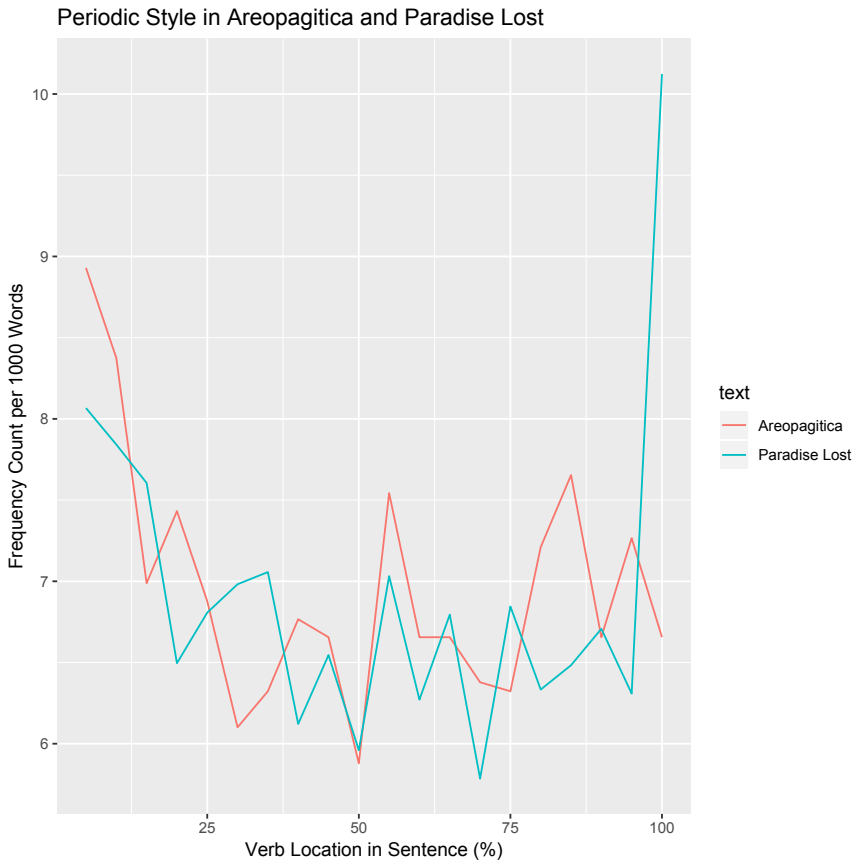Periodic Style in Areopagitica and Paradise Lost

Figure 1. Verb locations in *Areopagitica* and *Paradise Lost* (based on sentences of ten words and longer).

The results show us quite definitively that *Paradise Lost* employs periodic style much more often than does *Areopagitica*. The frequency of verb locations appearing in the last 5 percent of a sentence is dramatically higher in the poetry than in the prose (10.1 per mille versus 6.6 per mille). The data visualization illustrates the dramatic difference. Indeed, even if we narrow our band of focus to identify only those sentences having a verb in the last 2 percent of sentence tokens, almost one in every five sentences of *Paradise Lost* is periodic (19.0

percent), whereas only one in ten of *Areopagitica*'s sentences is periodic (10.7 percent).[69]

Of the more than 2,100 sentences in *Paradise Lost*, 407 of them are periodic—that is, having a non-infinitive verb located in the last 2 percent of a sentence's words.[70] But within those four hundred sentences, Milton also demonstrates a wide array of subtle stylistic variations. The postponement of the verb at times demonstrates the narrative's description of someone or something waiting; or it might mirror a sequence of actions, or might underscore a thematic goal or telos. For example, in book 1, Satan first surveys his battalions and then, afterward, counts their number. The postponement of the verb emphasizes the order of operations:

> He through the armed files
> Darts his experienced eye, and soon traverse
> The whole battalion views, their order due,
> Their visages and stature as of gods,
> Their number last he **sums**. (1.567–71; my emphasis)

At times the waiting itself is the point:

> As if . . .
> Man had not hellish foes enough besides,
> That day and night for his destruction **wait**. (2.503–05; my emphasis).

Other sentences promise arduous arrival:
And I will place within them as a guide

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69. An anonymous reviewer of an earlier draft of this article helpfully noticed that I was counting as periodic those sentences that ended with infinitives, such as the one in *Areopagitica* in which bad books "to a discreet and judicious reader serve in many respects to discover, to confute, to forewarn, and to illustrate" (*Major Works*, ed. Orgel and Goldberg, 246). The main verb there is "serve," which occurs midway and so the sentence is not, in fact, periodic. Consequently, I revised the code to ignore sentences that end with infinitives (signified by CLAWS part-of-speech tags that end in "i" such as **VVI**, **VBI**, **VHI**, etc.). The change was striking: the differences between *Areopagitica* and *Paradise Lost* are, as the data visualization shows, even more pronounced now.

70. In calculating these statistics about periodic sentences, I have, unless otherwise specified, ignored sentences shorter than twenty words.

My umpire Conscience, whom if they will hear,
Light after light well used they shall attain,
And to the end persisting, safe **arrive**. (3.194–97; my emphasis)

Another of Milton's stylistic tricks is to construct complex sentences of multiple, even paratactic clauses, and over the sequence of those clauses to displace the verbs gradually toward the end. The poetic rhythm begins with a strong emphasis on a short clause, but one that transitions into almost paratactic sections that displace the verb variously, and finally lengthen into more recognizable periodic clauses. The subtle effect is more noticeable if we break the lines somewhat artificially:

The angel **ended**,
and in Adam's ear / So charming **left** his voice,
that he a while / **Thought** him still speaking,
still stood **fixed** to hear;
Then as new waked thus gratefully **replied**. (8.1–4; my emphasis)

Or:

She **disappeared**,
and **left** me dark,
I **waked** / To find her,
or for ever **to deplore** / Her loss,
and other pleasures all **abjure**: (8.78–80; my emphasis)

Or:

He **ended**,
and they both **descend** the hill; /
Descended, Adam to the bower where Eve / Lay sleeping **ran** before,
but **found** her waked; /
And thus with words not sad she him **received**. (12.605–09; my emphasis)

If we can compare verb placement to the patterns of poetic metre, the effect is not unlike rhythmic variations in a classically iambic line: variations

that may open with the occasional trochee or finish with a longer, drawn-out anapest. So, too, can the verb placements alter the rhythm of a whole sentence.

But the occurrence of periodic style does not remain consistent throughout the poem—the total averages one sentence of every five, as we have seen—but books 1 and 7 contain the fewest periodic sentences, as we can see in Figure 2.

Periodic Sentences by Book in Paradise Lost
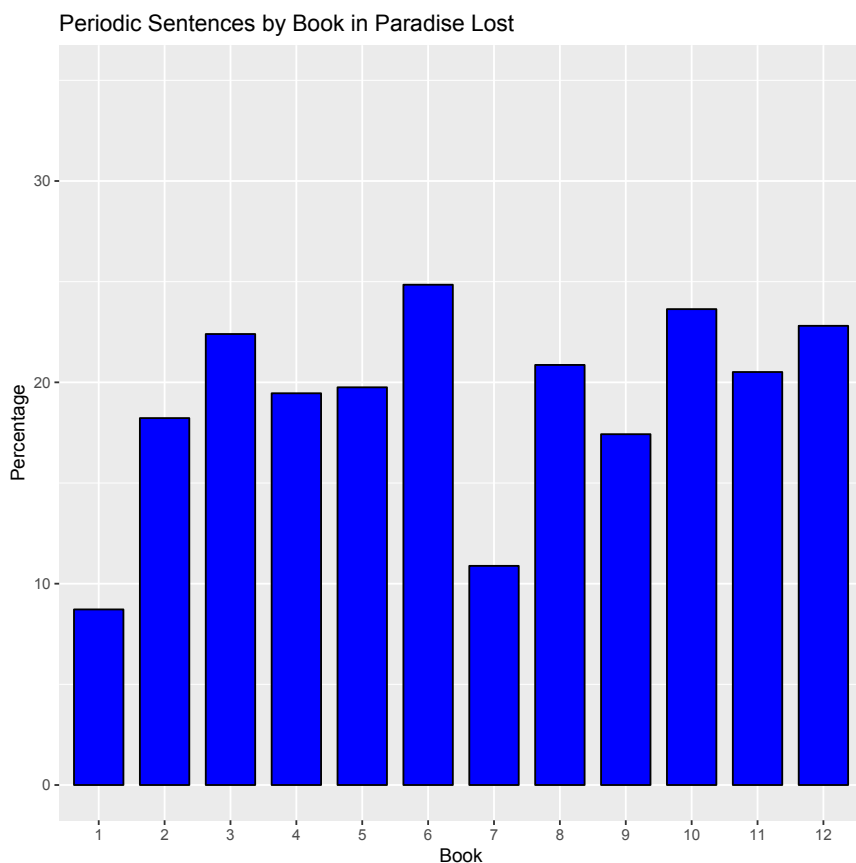

Figure 2. Frequency of Periodic Sentences by Book in *Paradise Lost*.

Milton significantly limits his use of periodic style in two places: at the beginning of the poem and at its midpoint. These books contain two of the four invocations, but the stylistic shifts provide more evidence for those who see in the epic poem two grand movements. Scholars like Jeffrey Shoulson, for

example, have clarified why book 7 in particular exemplifies a change of style: it is especially indebted to biblical passages. "Raphael's hexameral account of the creation in Book 7," he explains, "is the site of many (though by no means all) of the poem's most explicit and direct quotations from the Bible."[71] Ernst Häublein has tracked in precise detail Book 7's stylistic borrowings from three bibles (the Authorized Version, the Geneva Bible, and the Vulgate), noting that, among a variety of stylistic touches, Milton "frequently changes the word order for emphasis, most notably by placing certain words at metrically prominent positions or postponing the verb, a typically Miltonic habit."[72] The poet borrows more than just content from Genesis. Only 3.5 percent of the sentences in the Authorized Version's Genesis are periodic (one out of every twenty-eight sentences, roughly), and 2.7 percent of the Geneva Bible's Genesis are periodic (one in every thirty-seven sentences). Book 7's lack of periodic sentences demonstrates, in part, just how closely Milton is adhering to the style of his biblical sources.

Shore has pointed to another of Milton's techniques of grammatical word inversion: depictive adjectives—adjectives whose positions have been postponed to reside behind the nouns they properly modify. Defined by unorthodox or inverted word order, both depictive adjectives and periodic verbs might be seen as stylistic cousins, inhabiting the same branch of the stylistic family tree. Although depictives do not always occur alongside periodic verbs, the stylistic technique of deferral is similar. Shore points out passages such as "to their general's voice they soon obeyed / **Innumerable**" (1.337–38)

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71. Jeffrey Shoulson, "Milton's Bible," in *The Cambridge Companion to* Paradise Lost, ed. Louis Schwartz (Cambridge: Cambridge University Press, 2014), 68–80, 71.

72. Häublein, 110. Häublein asserts that Milton is paraphrasing passages from the King James, Geneva, and Vulgate editions of Genesis. In addition, he identifies Milton's use of "zeugma," a rhetorical figure that, like periodic sentences and depictive adjectives, also challenges conventional grammatical rules and in which, according to *The Oxford Dictionary of Literary Terms*, "one word refers to two others in the same sentence. […] However, the term is frequently used as a synonym for syllepsis—a special kind of zeugma in which the yoking term agrees grammatically with only one of the terms to which it is applied, or refers to each in a different sense. In the confusion surrounding these two terms, some rhetoricians have reserved 'zeugma' for the ungrammatical sense of syllepsis." Chris Baldick, *The Oxford Dictionary of Literary Terms*, 4th ed. (Oxford: Oxford University Press, 2015), dx.doi.org/10.1093/acref/9780198715443.001.0001.

or "the great Creator from his work returned / **Magnificent**" (7.567–68),[73] but the part-of-speech tags help us to find more examples fitting the pattern. For example, in book 5's "song and dance about the sacred hill":

> And in their motions harmony divine
> So smoothes her charming tones, that God's own ear
> Listens **delighted**. (5.625–627; my emphasis)

Or describing Abdiel, at the close of book 5: "From amidst them forth he passed, / Long way through hostile scorn, which he sustained / **Superior**" (5.903–05; my emphasis).

Milton's ability to work "on the blurry edge"[74] of grammatical rules is on prominent display in *Paradise Lost*, showing the poet confronting what is most recalcitrant about English, its dependance on word order, flirting with a line beyond which meaning and sense can be lost. Grammar can be strained only so far. But Milton, fluent in other languages, deployed still other kinds of grammatical constructions that have discomfited generations of readers. Analyzing an English grammar in flux has its own difficulties, but working across the grammatical constructions of two different languages poses other challenges entirely.

Latinate constructions: ablative absolutes

John Hale points to Milton's use of the Latin grammatical construction "ablative absolute," a structure often translated into colloquial English as "with the noun having been verbed." The ablative absolute may have been familiar to Milton's contemporary readers via Latin or, albeit to perhaps fewer readers, through Old English, two of the languages that use the construction. The "absolute" part of an ablative absolute means that it always stands apart from the main clause of the sentence, never functioning as the subject or the object. In Latin, it provides an enveloping context for part or all of a sentence: it may "scope over the [main]

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73. Shore, 154.

74. Shore, 170.

clause [...] or over the predicate,"[75] often expressing a causal or a temporal relationship within which to situate the sentence. In Latin, the ablative case is one of the six common declensions of nouns and adjectives, and so Latin expresses such phrases extremely economically, usually without the need for any prepositions at all. One online commentator suggests that the "construction is particularly common in Latin as it readily supplies a curious want in Latin, namely the absence of a passive past participle," but that, in English, as a general rule, "one can replace the nominative absolute with a subordinate clause."[76]

In English, then, the Latin construction can be construed in a wide variety of ways, including clauses introduced with words like "when," "after," "as," "since," "because," or "although."[77] And so what one might elegantly express in Latin as an ablative absolute may easily lose its "absolute" nature by being rendered into English as a subordinate clause. We would not expect the syntactic correlation between Latin and English to be straightforward, but it is especially blurry here. Despite these imprecisions, however, Hale has identified a likely ablative absolute in book 7 of *Paradise Lost*:

> At least our envious foe hath failed, who thought
> All like himself rebellious, by whose aid
> This inaccessible high strength, the seat
> Of Deity supreme, **us dispossessed** [...] (7.139–42; my emphasis)

The meaning here is not wholly obvious, and most editors take some pains to paraphrase for readers. Merritt Hughes glosses the italicized passage as meaning "after dispossessing us,"[78] which subordinates with "after" to clarify the meaning. *Major Works* editors Stephen Orgel and Jonathan Goldberg gloss it as "Once he had dispossessed us,"[79] which also subordinates the clause. Both glosses retain the phrase's candidacy as a viable ablative absolute, but Richard

75. A. M. Devine and Laurence D. Stephens, *Latin Word Order: Structured Meaning and Information* (Oxford: Oxford University Press, 2006), 77, dx.doi.org/10.1093/acprof:oso/9780195181685.001.0001.

76. Will Scathlocke, "What Is Absolute Construction in Grammar?", *Quora*, 21 May 2019, qr.ae/pG4rYH.

77. "Ablative Absolutes," *latintutorial*, 8 February 2013, youtube.com/watch?v=1_BUn1zH7IM.

78. Merritt Hughes, ed., *Complete Poems and Major Prose* (New York: Macmillan Publishing Company, 1957), 349.

79. Milton, *Major Works*, 895.

Cunningham glosses the passage differently: "He thought that by his agency he could take from us the throne of heaven."[80] This interpretation renders the phrase as the object of the sentence and, therefore, not a good candidate to be an ablative absolute. David Gay, however, reads it in a fashion much more as an ablative absolute: "He thought everyone rebellious, like him, and expected to seize this inaccessible high strength, the seat of Deity Supreme, after *dispossessing us*."[81] Depending on how one reads the passage, then, the italicized words parse differently, sitting as they do on the fuzzy edge of grammatical rules. Even an expert reader like Hale has trouble navigating the grammatical parallax of passages like this:

> So the question arises whether in Milton they are felt as Latinate or native, or indeed both. I submit that it is an open question which way Milton himself would vote if he had ever had to; but that for his readers it depends whether they have read the absolute construction most in English or another language.[82]

Part-of-speech taggers do not understand ablative absolutes, of course, but given a suitably tagged text we can search the tags to find similar linguistic patterns. The CLAWS tagger renders the *Paradise Lost* passage given above like this:

At_RR21 least_RR22 our_APPGE envious_JJ Foe_NN1 hath_VHZ
  failed_VVN ,_, who_PNQS thought_VVD
All_DB like_II himself_PPX1 rebellious_JJ ,_, by_II whose_DDQGE
  aid_NN1
This_DD1 inaccessible_JJ high_JJ strength_NN1 ,_, the_AT seat_NN1
Of_IO Deity_NN1 supreme_JJ ,_, ***us_PPIO2 dispossessed_VVD*** ,_,

The CLAWS part-of-speech tagset annotates "us" as a **PPIO2**: a "first person plural objective personal pronoun." It identifies "dispossessed" as a **VVD**: the "past tense of a lexical verb (e.g. gave, worked)." As it determines

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80. Richard Cunningham, email message to Harvey Quamen, 7 March 2020.

81. David Gay, email message to Harvey Quamen, 7 May 2020.

82. Hale, 110.

parts of speech, the CLAWS algorithm does not begin with a grammatical structure and work its way downward to individual words. Rather, it simply knows, for example, that "we" is a pronoun in the subjective case and that "us" is a pronoun in the objective case. It cannot identify larger, composite structures like phrases or clauses or Latinate syntaxes. But humans can write computer programs to search for these larger patterns and we can instruct Python to look for—to take this one example as a template—a **PPIO2** tag followed by perhaps some other modifiers and closed with a **VVD** tag.[83] There are a number of these constructions in *Paradise Lost*, but not all qualify as ablative absolutes and they still require some subjective human interpretation in order to weed out the false positives and to determine whether the grammatical pattern matches our definition. A few seem like good candidates, such as Satan's speech in book 5:

> Thrones, dominations, princedoms, virtues, powers
> If these magnific titles yet remain
> Not merely titular, since by decree
> Another now hath to himself engrossed
> All power, and **us eclipsed under the name**
> **Of king anointed**, for whom all this haste
> Of midnight march, and hurried meeting here,
> This only to consult how we may best
> With what may be devised of honours new
> Receive him coming to receive from us
> Knee-tribute yet unpaid, prostration vile,
> Too much to one, but double how endured,
> To one and to his image now proclaimed? (5.772–84; my emphasis)

With us having been subjected to a newly anointed king, how should we respond? Or this:

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83. My Python code looks for many more POS tags than these—generally, I searched for a noun or a pronoun followed by an adjective or a participial verb. Interested readers are invited to look to GitHub (github.com/hquamen/stylometry) for the details. In general, however, I avoided looking for phrases or clauses introduced by any of the prepositions or subordinators listed above because the code generated too many false positives.

> Nor that which on the flaming mount appeared
> In Dothan, covered with a camp of fire,
> Against the Syrian king, who to surprise
> One man, assassin-like had levied war,
> **War unproclaimed**. (11.216–20; my emphasis)

The grammar here is especially knotted but can be untangled by referencing the biblical narration in 2 Kings 6. The appositive "assassin-like" applies to the Syrian king, not to the "one man" (who is the prophet Elisha, about to come under a surprise attack). The Syrian king, assassin-like, had levied war (war unproclaimed) in order to surprise one man. Or with a more Latinate ablative absolute: with war having been unproclaimed, the Syrian king, assassin-like, levied a surprise war against the prophet Elisha.

Or this narration of Noah:

> […] the floating vessel swum
> Uplifted; and secure with beaked prow
> Rode tilting o'er the waves, all dwellings else
> Flood overwhelmed, and them **with all their pomp**
> **Deep under water rolled**; sea covered sea,
> Sea without shore; and in their palaces
> Where luxury late reigned, sea-monsters whelped
> And stabled; […]. (11.745–52; my emphasis)

The great flood overwhelmed everything, all peoples, notably those whose prideful worldly trappings have all been rolled (or "rowled") under the deep waters.

The difficulties here are manifold: first, because there is no one-to-one translation from a Latin ablative absolute into English, the part-of-speech tags that might signify a Latinate construction like this are multiple and varied. English is far less inflected than Latin and, while nouns and pronouns in the objective case seem to be the norm in ablative absolutes, many nouns in English are not inflected. With few word case indicators to rely upon, and without any semantic sense of "meaning" to guide it, a pattern matcher returns many false positives. Second, it is rarer in English to have a clause stand apart from

the sentence in an absolute relationship. The grammar of English seems to encourage the formation of cause-and-effect relationships; obviously, not every subordinate clause can qualify as an ablative absolute. Last, of course, readers unfamiliar with classical languages may simply pass over such constructions, not recognizing them for what they are. Hale notes, for example, the phrase "divine of," which is rare in English but is a genitive construction that is common in the works of Horace.[84] It is also found in Milton: "Yet oft his heart, divine of something ill, / Misgave him" (9.845–46). Similarly, the verb "to inhabit" (*inhabitare* in Latin) requires an object in English but can be used intransitively in Latin, which is how Milton uses it: "Meanwhile inhabit lax, ye powers of heaven" (7.162).[85] These sorts of interpretive difficulties surface everywhere, even in places that seem unproblematic: according to Hale, "Milton's own title means 'the losing of Paradise,' not 'the lost Paradise'; thus declaring itself in a Roman tradition by its grammar."[86] One might even be tempted to construe it as an ablative absolute—standing grammatically outside of, but yet giving scope to, the entire poem.

Visualizing sentence structure

Some of the most interesting data visualizations of Milton's style are the sentence diagrams in Thomas Corns's *Milton's Language*, published in 1990. Grappling with Milton's labyrinthine style, Corns diagrammed by hand the clausal structures of three select sentences in *Paradise Lost*. The result, rendered as ASCII art, beautifully demonstrated both the complexity of Milton's grammar and the difficulty of reading him. To generate his figures, Corns divided complex passages into lettered clauses and then diagrammed by hand the relationships between the clauses. For example, Figures 3 and 4 demonstrate one such passage from book 12 and its corresponding diagram:

84. Hale, 109.

85. Hale, 113.

86. Hale, 111.

A
[so shall the world go on,

A
To good malignant, to bad men benign,]

B   **C**
[Under her own weight groaning] [till the day

C
Appear of respiration to the just,

C
And vengeance to the wicked, at return

C   **D**
Of him] [so lately promised to thy aid

D   **E**
The woman's seed,] [obscurely then foretold,

F
[Now amplier known thy saviour and thy Lord,]

G
[Last in the clouds from heaven to be revealed

G   **H**
In glory of the Father,] [to dissolve

H   **I**
Satan with his perverted world,] [then raise

I   **J**   **K**
From the conflagrant mass, [purged] and [refined,]

I
New heavens, new earth, ages of endless date]

L
[Founded in righteousness and peace and love]

M
[To bring forth fruits joy and eternal bliss.] (12.537–51)

Figure 3. Corns's clausal annotation of *Paradise Lost* (12.537–51) from *Milton's Language* (27–28).

Figure 4. Corns's clausal diagram of *Paradise Lost* (12.537–51) from *Milton's Language* (29).

"The structure is formally gratifying," wrote Corns. "At each level of subordination, clauses cluster, but only the last acts as a node for further dependent material. […] The reader's concentration, taxed to its limit, struggles toward that final clause, dependent as it is, at sixth remove, on the main clause with which the sentence opened."[87] The diagram itself is a tree visualization that is placed upon two implicit axes: the tacit x-axis maps the act of reading, moving temporally from the beginning of the sentence on the left toward the end of the sentence on the right; the y-axis locates levels of subordination and embeddedness: main clauses appear toward the top and increasingly nested clauses extend below them toward the bottom.

My question here is whether we can, given current natural language toolkits and visualization libraries, easily replicate Corns's experiment. If we can automate this process of diagramming sentences, then each sentence should have its own unique visualization, its own particular shape, an image that represents its grammatical style. Given that, we could scale up the process: an entire text like *Paradise Lost* might be visualized as a long sequence of shapes, shapes that would undoubtedly cluster into groups of shared similarities, clusters that would, in turn, represent repeated stylistic markers. Scale up again: we could diagram entire corpora that would allow us to witness the development of any author's style throughout a lifetime, or to visualize the stylistic kinships between groups of contemporaries, or, on a grander scale, the dynamic changes that define any historical period's literary style. But the immediate question at hand is more pragmatic: are contemporary tools robust enough even to begin this project?

A few tools already exist to help contemporary DH scholars draw tree diagrams such like Corns's. One is the popular Natural Language Toolkit (NLTK), an open-source library of powerful tools first developed by the University of Pennsylvania in 2001.[88] NLTK's wide range of tools includes part-of-speech taggers, built-in corpora, some machine learning algorithms, and even a tool to draw these diagrams, called "parse trees." Given Corns's sentence from book 12, the NLTK tree diagrammer draws this remarkably detailed and virtually unreadable tree:

87. Corns, *Milton's Language*, 29.

88. Natural Language Toolkit, 30 April 2020, nltk.org/. See also Steven Bird, Edward Loper, and Ewan Klein, *Natural Language Processing with Python* (Sebastopol, CA: O'Reilly Media, 2009).
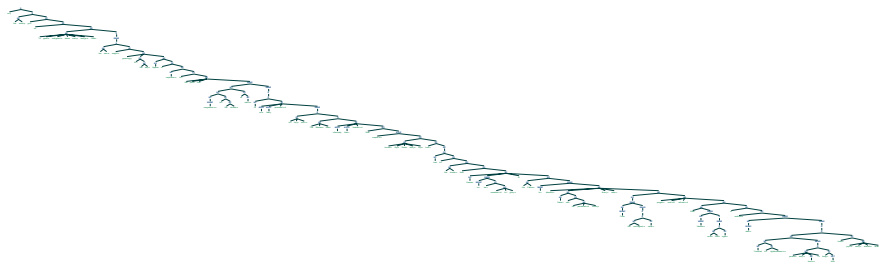
Figure 5. *Paradise Lost* (12.537–51) diagrammed by the
Natural Language Toolkit.

We can see that the overall shape of the tree generally resembles Corns's,
but there is simply too much detail. The parser diagrams each word, not each
clause as Corns did, and it even inserts new "empty" nodes so that no node
can ever have more than two branches. Mapping this tree differently—using
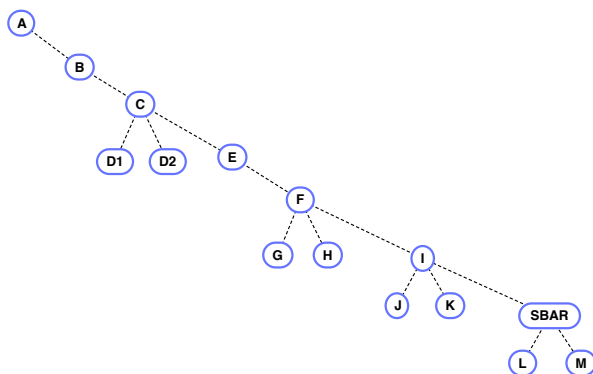Corns's labelled clauses, for example—helps to simplify the diagram:

Figure 6. Simplified diagram of Figure 5, using Corns's clausal labels.

The parser clearly sees something remarkably similar to Corns's
interpretation. It posits a different relationship between clauses F, G, and H,
and it sees the final clauses L and M in a more paratactic than subordinate
relationship,[89] but the diagrams are strikingly comparable.

89. The **SBAR** node is introduced to prevent nodes from having more than two descendants. **SBAR**
represents a "clause introduced by a (possibly empty) subordinating conjunction." The next diagram

Corns's selection from book 4 is more periodic in style and so presents special challenges:

B
[As when a prowling wolf,

D   G
[Whom hunger drives**]** **[**to seek new haunt for prey,**]**

E   H
[Watching**]** **[**where shepherds pen their flocks at eve

H
In hurdled cotes amid the field secure,**]**

B
Leaps o'er the fence with ease into the fold:**]**

C   F
[Or as a thief bent **[**to unhoard the cash

F   I
Of some rich burgher,**]** **[**whose substantial doors,

J   K   I
[Cross-barred**]** and **[**bolted fast,**]** fear no assault,**]**

C
In at the window climbs, or o'er the tiles;**]**

A
[So clomb this first grand thief into God's fold**]**. . . . (4.183–92)
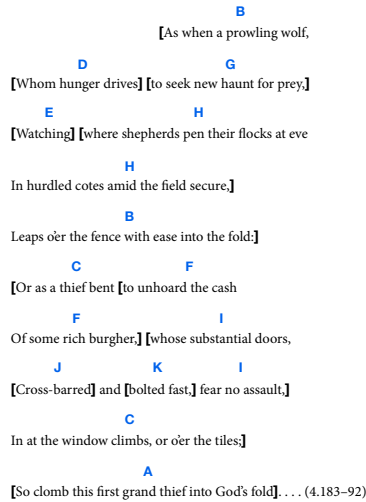
Figure 7. Corns's clausal annotation of *Paradise Lost* (4.183–92) from *Milton's Language* (26–27).
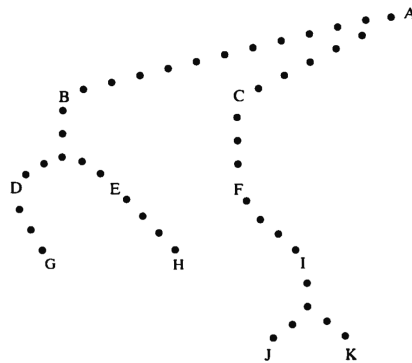

Figure 8. Corns's clausal diagram of *Paradise Lost* (4.183–92) from *Milton's Language* (28).

will also add a **WHNP** node, which "contain[s] some wh-word, e.g. who, which book, whose daughter, none of which, or how many" (Penn TreeBank II Tags, accessed 26 September 2021, gist.github.com/nlothian/9240750).

Although clause A ("So clomb this first grand thief into God's fold") closes the sentence, Corns assigns the letter "A" to the top of the diagram, signifying that all other parts of the sentence are subordinate to it, and to the righthand side, signifying that proper sense and meaning can be determined only after the reader has already made preliminary decisions about how to parse the other clauses in the sentence. Therefore, clause A is located spatially on the right, the area of the diagram that represents the last temporal stages of the reading process. This diagram, asserts Corns, represents the "most coherent interpretation of the relationship of the constituent clauses"; all the subordinate components, the "touchstones for Satanic conduct," must be "imaginatively realized before the reader is led to make the proper connection with the 'Author of evil.'"[90]

In this sentence, NLTK presents us with a radically different visualization:
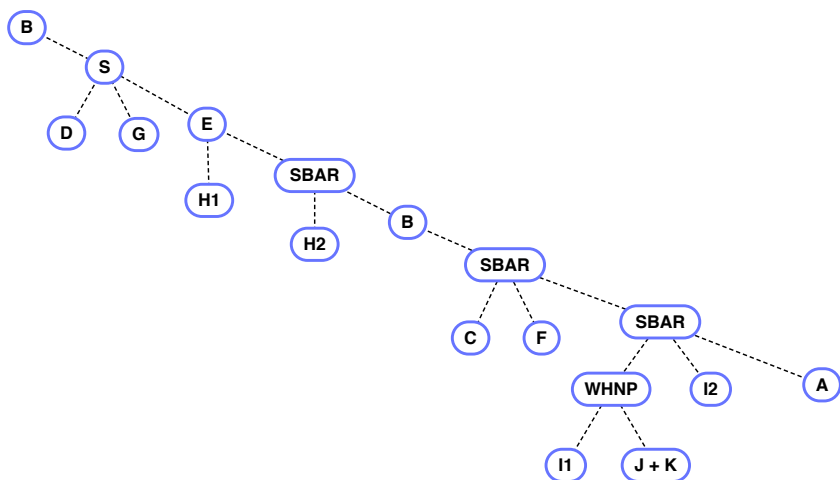

Figure 9. Simplified NLTK tree diagram of *Paradise Lost* (4.183–92).

This is not a "left-branching" diagram as Corns's was, and, while clause A does appear on the right (as we would expect from its terminal placement), the tree parser sees it as subordinate to everything else in the sentence. Additionally, the parser now introduces some so-called "empty" nodes in an

90. Corns, *Milton's Language*, 27.

attempt to retain the binary properties of the tree, a quality that did not concern Corns. Additionally, the parser splits a few components (namely, both H and I) that Corns interpreted as monolithic units, and the parser combines a few units (J and K) that Corns found to be distinct.

This visualization experiment is tantalizing, but it is not yet an unqualified success. Importantly, however, it reveals clearly that both Corns and the NLTK parser make very different assumptions about the structural relationships of a sentence's constituent parts. While Corns creates units that make thematic and logical sense (clauses, similes, detailed narratives, cause and effect relationships), the NLTK parser interprets more literally, identifying relationships only between words and, in order to preserve the requisite properties of the binary tree itself, it will insert new nodes whenever necessary.

In both approaches, however, the creation of these tree diagrams is neither straightforward nor automatic. To arrive at his visualizations, for example, Corns admitted to taking a few necessary shortcuts—namely, re-parsing Milton's sentences in order to bring them more into line with contemporary grammar:

> I consider a unit of text to be a sentence if it is grammatically complete, can be terminated without leaving grammatically incomplete fragments in residue and makes good sense. The final semantic requirement introduces a certain theoretical inelegance, in that it invokes the semantic level in analysis of syntax, and it points, too, to the inevitable introduction of a certain limited subjectivity and the possibilities for disagreement. In some cases, a semantic criterion must be invoked.[91]

The methodology here is pragmatic, but it does not easily scale to hundreds or thousands of sentences (or more). It does remind us, though, of the unruliness of seventeenth-century literature and the difficulty of bringing contemporary techniques to historical texts. The salient point, once again, is the distinction between a paratactic sentence of loosely related phrases and clauses, and the hypotactic sentence of neatly nested subordinate parts. To graph his sentences as a tree, Corns must, almost by necessity, privilege the hypotactic sentence, wrangling one into existence even if it does not exist. The NLTK

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91. Corns, *Milton's Language*, 12.

parser, on the other hand, diagrams paratactic relationships more easily—but at the cost of inserting new, "empty" nodes that can serve as parents to two parallel, equal parts.

To study seventeenth-century literature is to remember something of English's paratactic roots. And yet, it is clear that sentence diagramming—either by hand or by the computer—assumes sentences to be hypotactic. Although Noam Chomsky did not invent the concept of the hypotactic sentence, his work on transformational grammars in *Syntactic Structures* (1957) and *Aspects of the Theory of Syntax* (1965) solidified the theory of them, and they have formed the foundations of much subsequent linguistic research.[92] According to this still controversial theory, the semantic meaning of a sentence is present in its deep structure, which is then re-informed by increasingly more syntactic, recursively nested surface structures that eventually result in the linear, word-laden sentences that we read. The trees, as we have already seen, appear upside-down, starting with the deep structure at the top of the diagram and labelled by the root-level "S" (always present in the NLTK trees) and proceeding downward to increasingly nested surface structures by repeated substitutions of syntax. As Chomsky explained, "The central idea of transformational grammar is that [sentences] are, in general, distinct and that the surface structure is determined by repeated application of certain formal operations called 'grammatical transformations' to objects of a more elementary sort."[93] These substitutions, recursive replacements by smaller or more complex units, give particular shapes to the sentences themselves. "Consequently," he wrote, "the syntactic component of a grammar must specify, for each sentence, a *deep structure* that determines its semantic interpretation and a *surface structure* that determines its phonetic interpretation."[94]

These so-called "transformational" or "generative" grammars have spawned much controversy in linguistic circles.[95] Not all DH scholars will agree with the choice to use them, and these grammars may not be compatible with

92. Noam Chomsky, *Syntactic Structures*, 2nd ed. (Berlin: Mouton de Gruyter, 2002), dx.doi.org/10.1515/9783110218329; Noam Chomsky, *Aspects of the Theory of Syntax*, 50th Anniversary Edition (Cambridge, MA: MIT Press, 2015).

93. Chomsky, *Aspects*, 15.

94. Chomsky, *Aspects*, 15.

95. For an overview, see Albert C. Baugh and Thomas Cable, *A History of the English Language,* 6th ed. (Boston: Pearson, 2012), 392–93.

the written language use of all historical periods. Still, it is difficult to think about literary style at levels underlying word choice without automatically invoking the deep structures of transformational grammars. Even so, these tree diagrams do yield evocative visualizations about literary style that invite further speculation and debate.

Conclusion

Literary style, as we have seen, is more than just an author's word choices. The digital humanities now offer productive new avenues of research that can reinvigorate our conversations about literary style, focus stylometric analysis on structures other than word frequency lists, incorporate interesting tools like tree parsers, and employ illuminating and creative genres of data visualization. Re-situating literary style to accommodate the deeper structures of language also elicits new challenges, however—challenges that raise the degree of scholarly difficulty but that also invite editors to produce diverse forms of new authoritative textual corpora that can stand beside the classic annotated scholarly edition. Still, despite the challenges, there are a few strategies that can help other digital humanities scholars move toward this kind of analysis:

1. Creating new, well-edited corpora, and in types other than our familiar scholarly editions, will lead to stronger DH projects. Diplomatic transcriptions that respect original punctuation and orthography would simplify projects like the ones described here. "Correcting" a text—that is, making it more amenable to a contemporary reader— will not always produce the best text for scholarly DH work. Projects like the Early English Books Online-Text Creation Partnership (EEBO-TCP)[96] and the Early Modern OCR Project (EMoP)[97] are promising starts to building even more useful corpora.

2. Supplementing these corpora with correct and authoritative part-of-speech tags will help scholars to understand historical language and

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96. Early English Books Online-Text Creation Partnership, 2 May 2020, quod.lib.umich.edu/e/eebogroup/.

97. Early Modern OCR Project, 2 May 2020, emop.tamu.edu/.

will simplify the process of future DH work. Contemporary part-of-speech taggers logically assume contemporary sentence structures, making these tools both brittle and naive when faced with language from earlier historical periods. Accurate part-of-speech tagged corpora, like that promised by Anupam Basu's Early Modern Print project, will be a tremendous boon.

3. Embracing different facets of stylometry will expand our research. Contemporary stylometry has made significant progress using word frequency lists. But if style is more complex than this—if it is deeper, denser, more dimensional, more indebted to rhythm and sound—then our tools and analytical techniques must shift as well. Grammar, the topic of this article, is only one such avenue. Writers' uses of themes and metaphors are another, as are intertextual allusions, the kind of relationships starting to be found by tools like the Google N-Gram Viewer[98] and the Linguistic DNA project.[99]

4. Experimenting with humanities-centric data visualization will communicate research results more effectively. Dataviz is already a favourite technique in the sciences and social sciences, and has a rapidly growing popularity in the humanities. Arguably, however, data from the humanities are often less well-represented by two-dimensional line charts and scatterplots, so experimenting with new types of visualizations, like the tree parser used here—and finding visualizations perhaps unique to the humanities—will become an increasingly important avenue of discovery. Visualization is just one more way to find patterns that reside either above or below the usual threshold of human perception. Stephen Few has suggested that data visualization alters the inherently textual nature of much of our data: "Tables encode information as text (i.e., words and numbers)." By visualizing our data, we shift the encoding, simplify

98. Google N-Gram Viewer, 2 May 2020, books.google.com/ngrams.

99. Linguistic DNA, 2 May 2020, linguisticdna.org/.

the communication, and "reveal patterns of various types, including changes, differences, similarities, and exceptions."[100]

The way forward has a number of promising paths. At the very least, we should simply encourage both humanists and DH scholars to play with their data. It is, after all, a time-honoured tradition and one that Hale used in *Milton's Languages* to describe Milton's own strategy: "'Playing' is our best heuristic metaphor for what is going on: a playful, strenuous, competitive game, played with the living and the great dead alike."[101]

100. Stephen Few, *Show Me the Numbers: Designing Tables and Graphs to Enlighten*, 2nd ed. (El Dorado Hills, CA: Analytics Press, 2012), 155, 49.

101. Hale, 50.