EARLY MODERN LITERARY STUDIES

Machines and Humans, Schemes and Tropes

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This paper describes our method of gathering evidence for literary criticism, an outcome that we believed would take the conventional shape of an argument about the uses of a rhetorical scheme (gradatio, or climax) in a corpus of early modern drama by William Shakespeare and his contemporaries. In the process of gathering examples of gradatio to make that argument, however, we learned that our conventional assumptions about how to make literary-critical arguments were wrong. We used an algorithmic method to isolate patterns of language that met our definition of the rhetorical scheme, but found that deviations from its prescribed pattern were more pervasive than we expected. Our computational method has prompted us to rethink our assumptions about literary criticism and its treatment of poetic style, and to offer here a new framework we call augmented criticism: an expansion of traditional literary-critical methods by algorithmic means.[1]

Augmented criticism is a collaboration between human readers and machine evidence-gatherers that leverages each's signal features. Give a machine the quantifiable task of pattern recognition and it will do it faster and more comprehensively than a human can; give a human the qualitative task of pattern interpretation and it will do it more subtly and perceptively than a machine can.

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[1] This paper sets forth a rationale for our method, rather than conducting a comprehensive analysis of its outcomes. That analysis can be found in our paper 'Past Texts, Present Tools, and Future Critics: Toward Rhetorical Schematics', in *Shakespeare's Language in Digital Media: Old Words, New Tools*, ed. by Janelle Jenstad and Jennifer Roberts-Smith with Mark Kaethler (London: Routledge, 2017), pp. 144-156.

Our framework realizes that collaboration in the particular instance of interpreting rhetorical schemes of linguistic repetition and variation in a corpus of early modern drama. We chose this corpus, as critics often do, based on the text where we read it first: William Shakespeare's *Troilus and Cressida*. This paper will describe how our research methods arose from Martin Heidegger's bifold definition of technology as instrumental and anthropological; and from formalist principles in twentieth-century literary criticism, namely to focus attention on words and patterns in the first instance. We then will address how that rationale fed into our search algorithm's parameters, and how we interpreted its outputs: the 112 compiled instances of the scheme gradation in our corpus. We conclude this collaborative test case by returning to the paper-and-pencil work of qualitative interpretation, which reasserts Heidegger's anthropological (imaginative) technology into its more conventional instrumental (rational) definitions and uses.

'As traditionally trained humanities scholars who use computers', writes Michael Witmore, we hold this truth to be self-evident: 'that nothing in literary studies will be settled by an algorithm or visualization, however seductively colorful'. Witmore, with his main collaborator Jonathan Hope, has convincingly demonstrated the potential insights that perceptive critics can identify when they use computational methods to reveal features of early modern texts – not to settle any debate, but to provoke new ones about those newly-revealed features.[2] Witmore defined a 'feature-proxy distinction' between the features of a text (its distribution of conjunctions *if*, *and*, or *but*) and the critical arguments that convert them into a proxy, a more complex understanding of conditional and descriptive language in Shakespeare's genres. Computational evidence allows for what he calls 'a *quantitative redescription* of claims made in the humanities', such as claims for generic distinctions, and 'turns our attention to features of texts that we might nor ever have noticed'.[3]

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[2] Michael Witmore, 'What did Stanley Fish count, and when did he start counting it?' *Wine Dark Sea*, January 27, 2012, http://winedarksea.org/?p=1433. See also Jonathan Hope and Witmore, 'The Hundredth Psalm to the Tune of 'Green Sleeves': Digital Approaches to the Language of Genre', *Shakespeare Quarterly*, 61.3 (2010), 357-90; Hope and Witmore, 'The Language of *Macbeth*', in *Macbeth: The State of Play*, ed. by Ann Thompson (London: Bloomsbury, 2014), pp. 183-208; Witmore and Hope, 'Books in Space: Adjacency, EEBO-TCP, and Early-Modern Dramatists', in *Early Modern Studies After the Digital Turn*, ed. by Laura Estill, Diane K. Jakacki, and Michael Ullyot, pp. 9-34; and Witmore, Hope, and Michael Gleicher, 'Digital approaches to Shakespearean tragedy, in *The Oxford Handbook of Shakespearean Tragedy*, ed. by Michael Neill and David Schalkwyk (Oxford: Oxford University Press, 2016), pp. 316-35.
[3] Witmore, 'Latour, the Digital Humanities, and the Divided Kingdom of Knowledge', *New Literary History*, 47.2-3 (2016), 353-75 (pp. 366 and 368), emphasis in original.

Our attention is on more overt features. We use pattern-recognizing algorithms to detect rhetorical schemes, or formulaic arrangements of language like antimetabole (words repeated in inverse order, as in 'Fair is foul, and foul is fair') or epanalepsis (words repeated at a phrase's start and end, as in 'Nothing will come of nothing'). These examples are formulaic: they each follow an expected pattern (AB|BA; or C…C) and repeat their words exactly. This makes them two of the simplest figures of speech, or rhetorical schemes. We use this term to distinguish them from figures of thought, or rhetorical tropes – those that are too nuanced for current algorithms to detect. Consider paradox, a trope of unexpected verbal co-occurrences ('serious vanity'); or hyperbole, a trope of exaggeration ('His legs bestrid the ocean'); or metaphor, a trope of transferring meaning between words (death as 'the undiscovered country'). Each of these examples departs from conventional language-use, but in ways that presently require human judgement to identify and label.

We offer these examples of schemes and tropes deliberately to contrast simplicity with complexity, but we hasten to add that most figures fall somewhere on the spectrum between speech and thought. Consider antanaclasis, the repetition of a word with different meanings ('Put out the light, and then put out the light'). What makes it more than just parison, or sequential phrases with corresponding structures, is the trope of different meanings for 'put out' and 'light' in their second occurrences. A pattern-matching algorithm can only detect schemes with formulaic schematics, as their name suggests. If tropes can be schematized, there can be algorithms to detect them – but such speculations lie outside both immediate computational abilities and our immediate domain of readily detectable schemes. That is our domain because our machine-assisted process must begin with whatever machines can identify as significant, which is to say formulaic. 'A computer has to be given instructions about what to count, and will always follow the instructions', Witmore writes; if you cannot link 'an implied understanding… to actual words in the text' then it lies beyond the computer's (current) capabilities.[4] However, we will show that these functional constraints generate sufficient varieties of our chosen scheme that our judgement can recognize them also as tropes.

We recognize that distinguishing schemes from tropes is an artificial, sometimes arbitrary, act; they overlap and participate in each other at most points along the spectrum from speech to thought. Gradatio is a scheme near the centre of that spectrum. In its simplest form it is comprised of a series of anadiploses, the scheme that repeats words at the end of one phrase and the beginning of the next ('Featured like him, like him with friends possessed'). Jeanne Fahnestock describes these as themes 'where the new

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[4] Witmore, 'Latour', 357.

information closing one clause becomes the old information opening the next'; the next clause takes the old as given in order to say something new, or offer new comment on the old topic.[5] In poetry like Philip Sidney's opening sonnet of *Astrophil and Stella*, gradatio chains together anadiploses in sequence to tell a story: 'Pleasure might cause her read, reading might make her know, / Knowledge might pity win…'. In a simpler example, the children's song 'There Was an Old Lady who Swallowed a Fly' uses gradatio to layer each successive event on the last: 'She swallowed the dog to catch the cat, / She swallowed the cat to catch the bird, / She swallowed the bird to catch the spider' and so on. In Shakespeare's *As You Like It*, gradatio combines with anaphora (words repeated at the start of phrases, as in 'Mad world! Mad kings! Mad composition!') when the character Celia narrates events that led from two lovers' meeting to their marrying:

> For your brother and my sister no sooner met but they looked; no sooner looked but they loved; no sooner loved but they sighed; no sooner sighed but they asked one another the reason; no sooner knew the reason but they sought the remedy; and in these degrees have they made a pair of stairs to marriage.

Celia's summation ('a pair of stairs') echoes a contemporary definition of gradatio – whose Greek name 'climax' derives from the word for 'ladder' – by the rhetorician Abraham Fraunce: 'a reduplication continued by divers degrees and steps, as it were, of the same word or sound'.[6]

If gradatio overlaps with other schemes of repetition like anadiplosis and anaphora, it also participates in other tropes like amplification or congeries. This trope comprises any method of expanding and accumulating words that refer to a single idea, in order to reinforce both its importance and its multidimensionality. Henry Peacham defines congeries as 'a multiplication or heaping together of many words signifying diverse things of like nature'.[7] Gradatio not only structures this heap in a series of interlinking anadiploses; it also can arrange them in ascending or descending force or importance to convey a sequential change in intensity. This trope, auxesis, does not depend on repetition (consider Ulysses' commitment 'To strive, to seek, to find, and not to yield' in Alfred, Lord Tennyson's poem), but gradatio can give it an incremental structure. Indeed a subcategory of gradatio is the hybrid scheme-trope incrementum, which might simply be defined as any gradatio with the incremental features of auxesis. Consider Stalin's

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[5] Jeanne Fahnestock, 'Series Reasoning in Scientific Argument: *Incrementum* and *Gradatio* and the Case of Darwin', *Rhetoric Society Quarterly* 26.4 (1996), 13-40.

[6] Abraham Fraunce, *The Arcadian Rhetorike* (London, 1588), sig. D3v.

[7] Henry Peacham, *The Garden of Eloquence* (London, 1577), sig. Q2r.

axiomatic claim that '[w]ho controls Berlin, controls Germany; who controls Germany controls Europe; who controls Europe controls the world'; the ascent in geographical scale makes his gradatio an incrementum.[8]

The trope-scheme distinction represents the clearest borderline between human interpreters and machines. Simply put, it is much easier to assign machines the task of identifying linguistic patterns than to require them to find things that are linguistically unpredictable. That is the functional, not fundamental, reason that we regard tropes like auxesis and accumulation as a category apart from schemes like gradatio and anaphora. The former depends on meaningful relationships between words, of qualitative features like intensity of synonymity; the latter depends on the order and arrangements of words, of quantitative features like repetition and common roots. That's why we began with schemes: because they are more readily detectable by machines.

Our first step was to define the scheme's predictable formula, a process we describe below. In essence, we aimed to reduce gradatio in order to expand it: reduce it to a symbolic pattern – of sequential anadiploses – in order to use machines to gather a wide range of examples that would expand our knowledge of where and how it functions. The lattermost section of this paper presents our findings, but only after we question some of the fundamental assumptions we have made thus far: we are humanists, after all.

Can machine processes reduce qualitative arts like poetic style to quantitative formulae, even if we define 'style' as the use of rhetorical schemes? This trouble with this assumption is that no self-respecting writer is deliberately conventional; the very definition of poetic style is the degree to which a poet adapts known conventions to their individual voice or purpose. In our findings, this manifested in a number of gradatios that tested the constraints of the conventional formula (as we defined it) yet still operated recognizably as gradatios. These outliers 'tested' the formula because they technically met its requirements while expanding our sense of the scheme's conventional shape and purpose. If poetic style depends on aberrations from a pattern, or at least from its most straightforward and predictable conventions, then it also tests the limits of any evidence-gathering process that relies on that pattern.

In this way, our process of using machines to gather evidence for literary criticism navigates between opposing disciplinary aims in the field of the digital humanities – which brings traditionally scientific methods (experimentation, data analysis) to the domain of the humanities (human-created artifacts). In our case the data are a corpus of

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[8] Kenneth Burke, *A Grammar of Motives* (New York: Prentice Hall, 1945), p. 57.

400 early modern plays, and the method is an algorithm capable of identifying gradatio's linguistic form. Our process addresses one of the objections to this method, that it flattens or reduces nuanced, multivalent texts into more straightforward, fixed data. These easy dichotomies are too tempting to be trustworthy, and it is our task to dismantle them. We have treated out 400 texts as data, but only for the purpose of gathering instances to complicate that initial assumption. This complication is the aim of literary criticism, which uses a range of instances or quotations from a text to make a plausible, compelling argument about their cumulative imaginative effect. So long as we do not end with a dataset, but take it instead as evidence for and against a set of interpretations, we are doing what literary critics have always done – only with a larger proving ground of evidence.

A challenge of this interdisciplinary method, however, is the difficulty of bridging the discrete yet interrelated epistemologies of literature and scientific inquiry. David N. Wear calls these 'different ways we see the world… our constitutive metaphors'.[9] Northrop Frye identifies them as imagination (for literary arts) and reason (for science):

> Both have to use the entire mind; both have much the same difficulties in getting that very complicated machine to work. But when we consider the finished product only, it is clear that the arts do not stabilize the subject in the same way that science does. . . The stabilizing subject of science is usually identified with the reason; the unstabilizing subject is normally called the imagination.[10]

I.A. Richards distinguishes scientific from literary writing with the same reference to the writer's imagination or feelings:

> [a] man writing a scientific treatise, for example, will put the Sense of what he has to say first, he will subordinate his Feelings about his subject or about other views upon it and be careful not to let them interfere to distort his argument or to suggest a bias.[11]

Both Richards and Frye make these distinctions in order to advocate for more rigorous and regularized methods of textual analysis, a 'science of literature' that compares literary criticism (analysis of texts) to physics (analysis of nature). Frye even posits that '[the poet's] job is not to describe nature, but to show you a world completely absorbed and

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[9] David N. Wear, 'Challenges to Interdisciplinary Research', *Ecosystems* 2.4 (1999), 299-301 (p. 299).

[10] Northrop Frye, *The Stubborn Structure: Essays on Criticism and Society* (Ithaca: Cornell University Press, 1970), p. 46.

[11] I.A. Richards, *Practical Criticism: A study of Literary Judgement* (London: Routledge, 1929), p. 177.

possessed by the human mind'.[12] That mind is particular to each poet, hence the difficulty with stabilizing poetic texts as objects of scientific inquiry, a core difficulty in the digital humanities.

Our flavour of digital humanities recognizes the irreducibility of reason and imagination, and proposes a different constitutive metaphor – one with this duality as its core. Heidegger, in 'The Question Concerning Technology', describes technology as poeisis, a bringing forth of its own existence as both 'as means and a human activity', in both 'the instrumental and anthropological definition of the word.[13] Technology is instrumental when it is a means to an end, or when it fulfils the purpose of its design. A potato peeler has the instrumental purpose of removing potato skins, just as a computer has the instrumental purpose of processing data quickly. Each technology fulfils its purpose by processing its object to reveal it as something we humans can more readily digest or interpret. Heidegger's bifold conception of technology then charges us human agents to move from revelation to interpretation. If we distinguish between reason, an idea that can be associated with instrumentality, and imagination, an idea we can attribute to anthropological interactions (Heidegger's term), it is apparent that digital literary criticism often uses the machine in an attempt to stabilize its subjects, or to appear scientific in its methods. To conflate the instrumental processing of texts with the anthropological interpreting of texts is to neglect the work of the imagination that turns data into knowledge, just as it turns peeled potatoes into an appetizing meal.

That human imagination, constituting Heidegger's anthropological definition of technology, has two ways of turning data into knowledge: by compiling and comparing schemes, as we do below; and by recognizing tropes. The key distinction between the two is that schemes are reducible to formulae, as we have said; while tropes are irreducible to quantification. Consider again Stalin's declaration that '[w]ho controls Berlin, controls Germany; who controls Germany controls Europe; who controls Europe controls the world'. This is both a scheme (gradatio) and a trope (incrementum, or semantic rise), but only the scheme (AB, BC, CD) is quantifiable. The qualitative relationships among possible As, Bs, and Cs are partially quantifiable; we can generate hierarchies of city, country, and continent; or (say) species, genus, and family; or beginning, middle, end; or any other progression or regression we can imagine. The trouble is that literary art, especially, poetic art, is often characterized by creative departures from such orderly rules or hierarchies. More simply, we cannot know what we are looking for until we see a trope

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[12] Northrop Frye, *The Educated Imagination* (Toronto: House of Anansi, 1993), p. 16.

[13] Martin Heidegger, *The Question Concerning Technology, and Other Essays*, trans. by William Lovitt (New York: Harper Collins, 1982), p. 2.

like incrementum. As a category, the trope is irreducible to data unless we know just what kind of hierarchy it uses in a given occurrence. So each occurrence requires a human interpreter to recognize it.

For Heidegger, tropes are the anthropological part of our interpretive techniques, aspects that require human engagement with the text. In *The Technological Society*, Jacques Ellul elucidates how machine-driven techniques may trap humans in purely rational thinking: 'the machine is deeply symptomatic: it represents the ideal toward which technique strives. The machine is solely, exclusively, technique; it is pure technique, one might say'. Ellul's definition of technique is the 'totality of methods rationally arrived at and having absolute efficiency (for a given stage of development) in every field of human activity'.[14] But in domains of inquiry like literary criticism, rational and efficient methods only limit our attention to familiar, conventional, quantifiable language use. Herbert Marcuse warns against these limits: '[r]ationality is being transformed from a critical force into one of adjustment and compliance'.[15] Stalin's trope needs a human reader to realize its meaning, to recognize it as a trope rather than merely a scheme; this is the human activity in Heidegger's poeisis.

And yet human interpreters are required for more than scheme/trope distinctions; we also use critical methods and tools that allow us to investigate our intuitions and hypotheses. Criticism begins with noticing a localized verbal phenomenon – a pattern or word-choice or image – and wondering how it compares to other phenomena in other locations. By gathering them together, we expand and reformulate our first impressions, our intuitions and hypotheses, until we are satisfied that they account for that range of verbal phenomena. When we delegate this gathering to a machine, it must be flexible enough to account for changing critical viewpoints.

It must also allow for what Marjorie Perloff calls 'generalizations' about texts, in her critique of 'empiricist' text-analysis tools that treat texts as data:

> much recent 'empiricist' study allows for little generalization about poetic modes
> and values: the more thorough the description of a given poem's rhythmic and
> metrical units, its repetition of vowels and consonants, its pitch contours, the less

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[14] Jacques Ellul, *The Technological Society* (New York: Random House, 1964), pp. 4, xxv.

[15] Herbert Marcuse, *Technology, War and Fascism: Collected Papers of Herbert Marcuse*, Volume 1 (New York: Routledge, 1998), p. 49.

we may be able to discern the larger contours of a given poet's particular practice, much less a period style or cultural construct.[16]

Perloff's objection to these tools resembles Stanley Fish's, that they invert the usual critical movement from hypothesis to evidence-gathering. Instead, their methods of gathering evidence are fixed, not malleable: 'first you run the numbers, and then you see if they prompt an interpretive hypothesis. The method, if it can be called that, is dictated by the capability of the tool'.[17] Geoffrey Rockwell is more optimistic about tools' support for 'new types of questions' that resources like print concordances could not support: 'We can do so much more now than find words in a string. We can ask about surrounding words, search for complex patterns, count things, compare vocabulary between characters, visualize texts and so on'. Yet he acknowledges that many tools do not meet their promise: 'the logic of the tools… can enhance or constrain different types of reading, which in turn makes them a better or worse fit for practices of literary criticism including the performance of criticism'.[18] As Perloff and Fish claim, the kinds of questions that literary critics ask are often disconnected from the kinds of questions that tools are designed to enable.

We must imagine a method of interaction that is both instrumental and anthropological, that uses machines for the interactions with texts that literary critics need to compile evidence for our interpretations. We are hardly the first to identify these requirements. At a 1996 meeting at Princeton to plan text-analysis software, Michael Sperberg-McQueen called for 'an open, extensible system… [whose] architecture, if we insist on calling it that, will be an emergent property of its development, not an a priori specification. We are not building a building; blueprints will get us nowhere'.[19] Blueprints for a technology that permits the emergent, anthropological interactions of literary critics are more conceivable than Sperberg-McQueen claimed more than two decades ago; one aim of this paper is to advocate for iterative scripting rather than tool-building as a more flexible method for the extensible systems of methods critics use and need. Hard-wiring critical positions into a tool goes against the anthropological nature of language, by applying

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[16] Marjorie Perloff, *The Sound of Poetry / The Poetry of Sound* (Chicago: University of Chicago Press, 2009), p. 2.

[17] Stanley Fish, 'Mind Your Ps and Bs: The Digital Humanities and Interpretation', *New York Times*, January 23, 2012, https://opinionator.blogs.nytimes.com/2012/01/23/mind-your-ps-and-bs-the-digital-humanities-and-interpretation.

[18] Geoffrey Rockwell, ˙What is Text Analysis, Really?', *Literary and Linguistic Computing* 18.2 (2003), 209-19 (pp. 209 and 210).

[19] Willard McCarty, ˙Humanities Computing: Essential Problems, Experimental Practice', *Literary and Linguistic Computing* 17.1, (2002), 103-25 (p. 107).

constraints that can undermine the critical process. Stephen Ramsay reconciles literary-critical with machine methods, if the latter is sufficiently flexible to change its parameters as critics change theirs. '[C]ritical reading practices already contain elements of the algorithmic', Ramsay writes, 'the narrowing constraints of computational logic – the irreducible tendency of the computer toward enumeration, measurement, and verification – is fully compatible with the goals of criticism'.[20] That compatibility depends on flexible parameters.

We advocate for the use of focused, iterative scripts for evidence-gathering, in which the critic has more control over the parameters that gather evidence from a text or corpus of texts. These scripts require the critic to have more technical knowledge (or collaborators) in order to code and recode them, but this knowledge is an essential capability for critics in our time, to ask purpose-built questions of our texts. Fish marvels at critics' potential insights: '[y]ou have at your disposal an incredible computing power that can bring to analytical attention patterns of sameness and difference undetectable by the eye of the human reader'.[21] We share his sense of giddy possibility but disagree on one key point: in order for the initial results to convince the most traditional-minded literary critic, they ought to resemble something that a human reader can recognize. Hence our focus on schemes like gradatio.

This project began the way that many literary-critical projects begin: with our recognition of an interesting pattern in a text, and our search for comparable patterns to formulate an argument about them. The text was Shakespeare's *Troilus and Cressida*, a play remarkable for its characters' cynicism about the value of fighting a war for a devalued prize. They make baseless arguments for debased outcomes, and they use gradatio to make those arguments seems inevitable. Ulysses, arguing in favour of social hierarchies, describes their breakdown:

> Then everything includes itself in power,
> Power into will, will into appetite;
> And appetite, an universal wolf,
> So doubly seconded with will and power,
> Must make perforce an universal prey
> And last eat up himself.

[20] Stephen Ramsay, *Reading Machines: Towards an Algorithmic Criticism* (Chicago: University of Illinois Press, 2011), 16.

[21] Fish, 'Digital Humanities and Interpretation', n.p.

On the other side of the war, Paris describes Pandarus (who gives the word 'pandering' its English root) using gradatio to conflate love with lust: 'He eats nothing but doves, love, and that breeds hot blood, and hot blood begets hot thoughts, and hot thoughts beget hot deeds, and hot deeds is love'. In both cases, somewhere in the progression through these phases the arguments seem to shift their own terms, until the speaker had taken them to an unexpected and untrustworthy conclusion – despite the satisfying structure of their repetitions.

Our next question was whether or not Ulysses's and Pandarus's debased arguments are typical of Shakespeare's use of the figure. To address this question, we sought those other uses, and designed an algorithm to extend our capabilities beyond those we could recall or find quoted by experts in the subject.[22] It relied first on our assembling as long a list as possible of examples of gradatio not only from Shakespeare, but from authors across time writing in a range of forms (drama, poetry, and prose alike). In so doing, we discovered four features of this scheme:

1. gradatio always takes the form of anadiploses in sequence, e.g. 'they appear to men like angels of light: light is an effect of fire, and fire will burn' (*The Comedy of Errors*), where 'light' and 'fire' form two anadiploses in subsequent clauses; and

2. gradatio sometimes repeats multi-word (or -token) units, interchangeably with single-token units (e.g. from *As You Like It*: 'if thou never wast at court, thou never sawest good manners; if thou never sawest good manners, then thy manners must be wicked; and wickedness is sin, and sin is damnation'); and

3. gradatio sometimes repeats either the dictionary head-words (or lemmas), or the stem-words, of those tokens (as quoted already from *Astrophil and Stella*: 'Pleasure might cause her read, reading might make her know, / Knowledge might pity win'); and finally

4. gradatio sometimes places those repeated words (or tokens) at some distance from the end of the clause ('Pardon me father, pardon good Arbaces: that villain, that foul villain;' or the anadiplosis in 'for fear we be descried: / The fearfullest night').

Feature 1 helped us define the superset (the longlist of all instances) that would guarantee the subset (the short list of notable instances). To put it more metaphorically, that we cast

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[22] See in particular Sister Miriam Joseph, *Shakespeare's Use of the Arts of Language* (New York: Hafner, 1947; repr. Philadelphia: Paul Dry, 2005); Brian Vickers, *Classical Rhetoric in English Poetry* (London: Macmillan, 1970) and *In Defence of Rhetoric* (Oxford: Clarendon Press, 1988); and Raphael Lyne, *Shakespeare, Rhetoric and Cognition* (Cambridge: Cambridge University Press, 2011).

a wide net to catch every possible instance, even if that longlist was laborious for our human judgement to review and reduce. Both our training set and our definitions independently confirmed that gradatio would always be two or more anadiploses in sequence. Features 2 and 3 we addressed by tokenizing our texts' words and by lemmatizing or stemming those tokens. But feature 4 required us to determine a limit to the distance between words in order for anadiplosis to obtain. In other words, we asked how far apart the tokens could be from each other before their repetition was characteristic not of anadiplosis but of some other figure of repetition like anaphora, antistrophe, or epanalepsis.

Answering this question first required us to define a clause break, which typically falls between these repetitions. It would be preferable to use tools like the Constituent Likelihood Automatic Word-tagging System (or CLAWS) to define a clause, but our initial results suggested that our corpus's early modern language and dramatic structure obviated reliable results. So we reluctantly elected to use punctuation marks to divide clauses from each other.

Writers might have different motives for placing a word to begin their anadiplosis at some distance from the clause break. Their motives might be rhythmic ('From slumber soft I fell asleep, / From sleep to dream, from dream to deep delight'); or they might be alliterative ('I think she did her pain prevent, / Foregoing pain'); or they might be for semantic elaboration, as in 'way' and 'men' here:

> to fool is nothing
> As fooling has been but to fool the fair way,
> The new way, as the best men fool their friends,
> For all men get by fooling merely fooling.

This lattermost example is an edge case, we decided: no displacement greater than four words (tokens) from a clause division would fit our model of anadiplosis. That distance would, we felt, sufficiently correct for writers' poetic license with the model while maintaining the integrity of that model. Our decision added false positives to our output file, many of which were repeated pronouns that felt like unpoetical accidents of syntax. But this decision and those feelings reinforced our conviction that a long list of false positives is always preferable to a short list that excludes false negatives. It puts a heavier burden on the literary critic's experienced interpretive judgment, as a necessary complement to the machine's inexperienced literalist filtration.

We began with Shakespeare His Contemporaries (SHC), a corpus of 509 texts containing 839,895 lines of dramatic verse from c.1566 to 1647.[23] Our algorithm reduced it to just over 1% of the lines within SHC that included two or more anadiploses in close proximity. Then began our work of reviewing the outputs for false positives. This yielded 112 instances of gradatio in these 400 plays.

Or did it? The assumption that proximate and sequential anadiplosis is the universal formula for gradatio proved false, in some instances. This one is just a cumulative conduplicatio ('repetition of a word…in succeeding clauses'), if not quite a palilogia ('repetition for vehemence or fullness'):

> Beside pounds of gold a thousand and a thousand,
> And a thousand, and a thousand, and a thousand,
> And so to the sum of twenty hundred thousand...

And this is certainly a palilogia, but the intervening proper name feels like it breaks the continuity between anaphoras: 'Pardon me father, pardon good Arbaces: that villain, that foul villain'. That continuity seems to be the minimum requirement to make sequential anaphoras into a gradatio – and in many instances we struggled to define a causal, narrative, symbolic, or other link between them. (Part of that struggle owed to our unfamiliarity with many of these texts, whose speeches we read in mere excerpts.)

Even if we knew the texts well, we were assuming a formal cause for a rhetorical function that might or might not obtain. Authors of literary texts take license with the formal conventions of rhetorical figures; their departures from convention are (we argue) a hallmark of individual literary style. Our task as human critical readers is to judge whether the form is a sufficient and necessary condition for the function. We did this with our 112 outputs in two ways: by semantically interpreting repeated and intervening words, and by situating the form in the larger context of its adjacent lines and sentences. Some outputs asked very little of us: 'Minutes are hours there, and the hours are days, / Each day's a year, and every year an age'. Other outputs seemed to ask little, but further analysis suggested a more complex more extensive form than immediately appeared: 'You three serve three, those three do seek to one, / One shall her find, he comes, and she is gone'.

The interesting feature here is that 'you three' decline to one, who finds none (because 'she is gone'), so there are two functional stages where the form suggests only one or rather, where the form requires semantic parsing ('gone' = 0, a numeral less than 1) to appear. Finally, there were those outputs with an explicit semantic rise or decline, as in this narrative:

> How from our nursery, we have been hurried
> Unto the sanctuary, from the sanctuary
> Forced to the prison, from the prison hauled
> By cruel hands, to the tormentors fury.

The progress from the nursery to sanctuary to prison to torture is clearly a decline in fortunes, signalled by accompanying verbs of rising intensity: hurried, then forced, then hauled. This decline moves us from schemes to tropes, as discussed above; they are the realm that lies beyond the capabilities of machines, and reassert the anthropological alongside the instrumental meaning of technology.

We return to tropes, here, to conclude our argument that literary criticism can be effectively augmented by computational feats of pattern-recognition. The gradatio-incrementum distinction is only one instance where humans alone can recognize a trope when we see one. Another is chiasmus, the trope that is a subset of the scheme antimetabole, in which two or more words are repeated in reverse order; chiasmus repeats two or more ideas in reverse order. So 'Music to hear, why hear'st thou music sadly?' is an antimetabole, but 'Who dotes, yet doubts; suspects, yet strongly loves' is a chiasmus.[24] Or consider paradox, a trope of self-contradiction whose implications are greater than its literal meaning. There are many examples wherein each word's synonyms are sufficiently mutually exclusive to signal the possibility of paradox - and we can conceive an automated system of scores on a likelihood scale for the presence of paradox in a given string. But paradox rarely assumes a standard form; it is entirely a matter of functional interpretation. Moreover, it can easily assume the form of an anadiplosis like the one we found: 'So on us two his soul still fixed, still loving / Was ever constant, by his constant moving'. Here the placement of a single, unassuming word, 'moving', reverses the meaning of constance in its first occurrence.

Few instances illustrate so directly the problem we have addressed as 'ever constant, by his constant moving'. Figures of repetition are constant, in formal terms - or at least they

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[24] Both examples are drawn from the invaluable appendix to Vickers, *Defence of Rhetoric*: "Definitions of Rhetorical Figures and Tropes".

are just constant enough to be recognizable patterns that are computationally addressable. We built a process that found gradatio in our corpus, but the constant movement of its constituent terms and synonyms brought us back to our interpretive work as literary critics, pencils in hand. We set out for identification, and found immense variation; we leveraged the instrumental technology of machines and definitions and ontologies to discover that rhetoric is an anthropological technology. We found variations on a figure to be more prevalent than strict usage, which reinforced our knowledge of literary style. We engaged with the system of language as a technology, following the prompts of Witmore, Jonathan Hope, and Michael Gleicher:

> We can now begin to see the need for interchange between digitally based and more traditional research techniques. There is no basis on which a purely iterative or algorithmic method can distinguish between genuinely interesting outliers (which are significant in a nonstatistical sense) and the expected but meaningless statistical blips any data set includes.[25]

We recognized that only human readers can distinguish between 'interesting outliers' and 'meaningless statistical blips', just as only human writers can determine when and how to deploy instrumental techniques like schemes and other conventions to make them interesting and meaningful. Witmore and Hope also advocate for an iterative method to gather and interpret evidence: '[o]nly traditional reading can identify those outliers with something to tell us about Shakespeare's language. But iterative techniques applied to a digitized text can call attention to outliers, and potentially tell us more than what we already know from our own reading'.[26] 'It makes no sense', adds Adam Kirsch, 'to accelerate the work of thinking by delegating it to a computer when it is precisely the experience of thought that constitutes the substance of a humanistic education'.[27] Thought is what differentiates between the useful and the trivial, the meaningful and the meaningless – and no process that reduces texts to data can make that distinction without a human reader.

The last word on how to reconcile the anthropological with the instrumental, the human with the machines, goes to Willard McCarty. He warns against limiting texts to data, which shifts the critic's sensibilities toward the factual and quantifiable:

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[25] Witmore, Hope, and Gleicher, 'Digital approaches', 357.

[26] Hope and Witmore, 'The Hundredth Psalm', 274.

[27] Adam Kirsch, 'Technology Is Taking Over English Departments: The false promise of the digital humanities', *New Republic*, May 2, 2014, http://www.newrepublic.com/article/117428/limits-digital-humanities-adam-kirsch.

In operational terms, when humanities research is computerized the source materials become data – that is, computable information - and the research methods resolve into some combination of software and markup. What happens intellectually is neither solely computational nor autonomously human but a combination or interaction of both a thinking with, and against, the computer.[28]

Our search for rhetorical schemes exemplifies this interaction: we have relied on computers to find our 112 instances, but relied on our own judgement to identify their meaningful interactions, their interesting outliers, and the verbal connotations that put some just beyond the computer's grasp.

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[28] McCarty, ˙Humanities Computing', 104.