

Sounding the Surfaces: Computers, Context, and Poetic Consequence

*Are you alive?
I touch you.
You quiver like a sea-fish.
I cover you with my net.
What are you—banded one?
—H.D.*

The brevity and simple vocabulary of H.D.'s 1915 poem "The Pool" belie profound questions about the environment, society, art, technology, the self, and the ways these interact. Just who or what is—or are—"you"? In what sense is—or are—she / it / we "banded"? How might art and technology, in the form of the net, affect the speaker's understanding of and relationship to "you"? Does the net support or suppress those connections?

In our subsequent century, innovations in hypermedia, cyberspace, and information discovery, accumulation, design, analysis, and storage have charged H.D.'s poem with even more potential meanings than were available at the time of its initial publication. The Internet and other digital tools—contemporary analogues of H.D.'s speaker's net—have significantly expanded the variety, nature, and number of things we may (dis)cover, tenuously capture, and touch, if only virtually. How might using a digital net, rather than a hand-woven or mechanically produced one, affect relationships among the speaker, reader, and "you"—however we interpret that pronoun? What does such a net turn up within a poem and in our associative readings? Might computers and quantified data participate in these dynamics in ways distinct from the net itself? (Could they even be aspects of "you"?) Changed context changes relationship; the possibilities for "you" have shifted, and we are only beginning to discern and assess the consequences (both the significances and temporal interactions) that these recent shifts suggest.

In this endeavor, the Digital Humanities (DH) are helping to frame and study not only what it means to be human in our digital age, but also how this context affects our understanding of the humanities in previous eras. That tension among commitments—to explore unique new capabilities and perspectives while also honoring previous historical contexts and upholding the values, practices, and texts that connect us—may reflect differing emphases among the various academic disciplines contributing to this emerging field. But it's a tension I have also experienced in my own thinking and found to be both challenging and productive in my collaboration

with Katharine Coles and our data visualization colleagues at Oxford University and the University of Utah's Scientific Computing and Imaging (SCI) Institute. During our work to design and develop the poetry visualization programs Poem Viewer and Poemage, I have been struck over and over again by a sense of Dickinsonian "superb surprise" that has led me to poetic readings and ideas about poetic time that I otherwise likely never would have experienced.

Of course, one attraction of DH research, and all interdisciplinary work, is its tendency to provoke questions and promote insights even about what we already know: exploring the unfamiliar, unfamiliarly, leads us to perceive the familiar anew. While I feel dedicated to and passionate about interdisciplinary thinking and writing, before participating in the projects Katharine outlines in her essay ("Slippage, Spillage, Pillage, Bliss: Close Reading, Uncertainty, and Machines," this issue), I'd nevertheless envisioned established disciplinary boundaries as relatively permeable, though still limiting, borders between fields such as philosophy, science, and the study and practice of poetry. The intensity of these new collaborations initially unmoored me. I felt overwhelmed by the most basic concepts and terminology of advanced data visualization (What is a *clustering algorithm*? How to make sense of *Radial Placement* or *Parallel Coordinate* images?), and our new colleagues' questions challenged my understanding of what I'd come to accept as presumably elementary literary terms such as *rhyme* and *poetic time*.

Still, as I learned, and hope to show in this essay, collaborative DH research can have significant value for individual writers and scholars not only because of its potential to enrich specific encounters with literary texts—whether or not those encounters include computer input—but also because the practical demands of DH oblige us to rethink our broader intellectual and artistic positions. Rather than borders and boundaries (permeable or not), with respect to DH's interdisciplinary encounters it may be better to speak in terms of connecting, overlapping, or mutually enfolding *surfaces*: a rich geometrical term that's been adopted relatively recently both by commercial technology giants and academic literary critics, but whose cultural influences actually have been millennia-long.

Epiphaneia

In their much-discussed introduction to a 2009 special issue of *Representations* devoted to "surface reading," Stephen Best and Sharon Marcus seek alternatives to the various kinds of "symptomatic reading" inculcated in literary scholars over the past several decades. We are accustomed to plumbing textual depths, to interpreting literature through layers of

theory. In contrast, Best and Marcus encourage critics to attend to “what is evident, perceptible, apprehensible in texts; what is neither hidden nor hiding: . . . what insists on being looked *at* rather than what we must train ourselves to see *through*” (9, emphasis original). This stance takes language and literature on its own terms, “accepting texts, deferring to them instead of mastering or using them as objects” (10); it carefully describes what “the text says about itself” and how (11); it invites, requires, and celebrates sustained “immersive” attention (14, 16); it “sees ghosts as presences, not absences, and lets ghosts be ghosts, instead of saying what they are ghosts *of*” (13, emphasis original). Surface reading may sometimes be, as Marcus puts it, “just reading” (12)—a phrase Katharine and I have also invoked, though in a different sense, throughout our research. Whereas Marcus uses the phrase to commend literal, explicit, ostensive textual meanings, we have been using it to refer to our familiar reading practices unmediated by the computer: direct contact with poems, where a reader attends closely to specific arrangements of words and sounds but nevertheless simultaneously revels in manifold indirections, including associative leaps and subjective, unfolding discoveries. In our ongoing pursuit of developing visualization software that will preserve and enhance the qualitative contact between reader and poem, we continually challenge our computer scientist colleagues with the skeptical question, “Why not just read the poem?”

Ironically, one of the arguments against “just reading” in our skeptical sense supports “just reading” in Marcus’s sense: computers can help us perceive aspects of a text’s surface that we might otherwise overlook—not because they are too deep or disguised but because they initially escape the frame of reference we apply to the text. To be sure, our frames of reference are significant, essential, and inescapable: they help shape our collective and individual perspectives (as humans and humanists, as readers); they enlarge, narrow, and shift focus according to particular personal or environmental interests and concerns. Through these frames we connect our reading experiences with other aspects of our lives. They help draw us to literature, sometimes to the same poem over and over again through many decades as our frames of reference—and our various contexts—shift, revealing and shaping our subjectivity. Still, as Best and Marcus conclude, “[s]ometimes our subjectivity will help us see a text more clearly, and sometimes it will not” (18). One value of DH, then, is its potential to use computers not only to “see a text more clearly,” but, via those revelations, to see ourselves more clearly. In this way, even the machine has the capacity to participate in that ancient literary charge to delight and instruct.

Research in DH can also foster more wide-ranging exploration of subjects traditionally valued and studied in the humanities. Immersion in and response to the text can characterize the relationship between critic and liter-

ary language, as Best and Marcus observe; they also describe qualities of the poet’s relationship to language while composing a poem, and aptly articulate desired qualities in the interplay between humans and computers as they engage with poetic texts. In our research we have begun to ask what assumptions and values are implicit in “just reading” and how they might not only influence our software design but also enhance our own disciplinary understanding. The practical requirements of interdisciplinary collaboration, in other words, have made us articulate and reconsider what we believe reading is or could be. As with so many other seemingly simple questions arising from this process, the question of reading, even “just” reading, is more complex than it first appears.

In fact, the very first thing my computer taught me about poems was that it reads differently than I do—that it probably doesn’t even know what a poem is or that poems differ from, as our computer scientist colleague Miriah Meyer put it, the “bags of words” most existing text analysis programs assume in their encounters with text. The question of what or how a computer “reads,” and in that reading “remakes” a poem, is one I continue to ponder and that is leading me toward new ideas about what reading entails even for a human being. These theoretical developments fall outside the scope of this essay; however, one practical consideration we had at the outset of our project was that, before we could expect a computer to teach us anything new about specific poems, our team would need to teach it how to shape and communicate its readings in ways that we would find interesting—ideally, even delightful. The first step in that process, as Katharine also attests (see Coles, this issue), was to articulate as precisely as possible what we consider interesting and how such elements operate in “just reading.” (Hence our colleagues’ questions regarding rhyme and poetic time.) Another challenge was how to translate interests into computational terms. Pursuing each of these directions together has been a recursive and reciprocal balancing act, one common to DH and that we have, since 2013, been approaching through the formalized “design study” visualization strategy articulated by Meyer and fellow computer scientists (Sedlmair, Meyer, and Munzer).

Alan Liu portrays the “digital humanities method” in terms reminiscent of poetic composition and critical reading processes:

repeatedly coadjusting human concepts and machine technologies until . . . the two stabilize each other in temporary postures of truth that neither by itself could sustain. Knowledge is an ice-skater’s dance on a slippery epistemic surface, on which neither the human nor the machine—the dancer nor the skates—alone can stand. (416)

Truth and beauty, knowing dancer from the . . . skates—it’s Keats and Yeats, with a technological twist on a different surface: ice, that frozen pool whose depth is unknown, irrelevant.

But here's another take: immersion in a text, as in a substance, at every depth is a continual negotiation among *multiple* surfaces—for instance, the changing edges where skin and water and air meet. Bruce Holsinger, responding to Best and Marcus, historicizes the concept of the surface this way:

In Aristotle's *Categories*, . . . surface is one of the seven species of quantity, or, more specifically, one of the five components of continuous quantities, along with line, body, time, and place. The word Aristotle uses for surface, *epiphaneia*, denotes both the visible surface of physical objects and the conceptual, imagined surfaces of forms. For Euclid, too, the surface was not so much a species as a limit: the boundary of shape and solidity. (602-603)

Holsinger goes on to explain how *epiphaneia*'s etymological development comes to connote divine appearances among mortals and "blinding moments of spiritual insight" (603) that exercise "tense interplay of inquiry and belief" (604). It is this rich sense of *epiphaneia*—as quantitative and qualitative, measurable and unpredictable, site and experience of revelatory knowledge that invites thoughtful exploration as well as sublime surrender—that we hope our software will offer. The mingling of physical and imaginative spaces in *epiphaneia*, for instance, approximates the double registers of "poem space" Katharine describes (see Coles, this issue). If our visualization programs support "surface reading," they will present this multidimensional sense of a "surface": immersive, continuous, and liminal.

Sound and Poetic Time

In the earliest stages of our research, daunted by what lay before us, I searched myths, canonical poems, and etymological connections for potential relationships to the challenges of definition we faced, hoping the (re)combination of all of these could help create portals to the new space, the new environment of DH into which we were embarking.

Yet, as I ruminated about relationships between poetic sound and poetic time, I provisionally set aside the ways time might be represented or thematized in literature to focus on how we experience it. If, as physicists tell us, time emerges through movement and rest, our most basic, visceral perception of this dynamic in literature—before syntax, before verb tense, before even semantic meaning—might occur through sound. Explicitly sonic and percussive features may formally mark (and thereby create) distinct patterns and exchanges of movement and rest that listeners and readers enter into as participants, together with texts co-constructing the qualitative experience we call poetic time. If this is so, poetic time is distinct not only from dramatic or

narrative time, but from poem to poem depending on texts' unique sonic and percussive features—features that may also contribute to and help characterize poems' other literary qualities, such as mood or tone.

These thoughts developed further while I was swimming one day shortly after our first team meeting at Oxford. I observed that even as my movement across the pool generated waves, or turbulence, on the water's surface, fellow swimmers and the water's rebounding from the pool's edge created additional turbulences through which I moved and which I felt on the surface of my skin. This led me to question the common assumption that lyric time embodies or reproduces a single moment isolated from sequential time. I wondered, then, whether a poem might be more like a body of water containing multiple, overlapping and interacting waves or flows of time and sound; whether the sensation of suspension we experience in reading a lyric poem arises not because the poem is temporally simplified, hyper-focused, or detached, but, on the contrary, because its temporal complexity floods our generally sequential consciousness and experience of time. Maybe in poetic time the reader, immersed in the fluid space of a given poem, experiences at every "single" moment multiple sonic-temporal patterns of varying direction, amplitude, speed, and shape developing simultaneously and in response to her encounter with the text.

I surmised that each pattern of movement and rest—repeating phonemes or sonic clusters, pauses from line breaks or punctuation, etc.—creates a unique temporal flow, some more or less (and differently) forceful than others. Regular meters and set rhyme schemes, for instance, may dominate because they help structure individual lines and create anticipation. Subtle departures (an inverted metrical foot, a slanted rhyme or modulated vowel, an irregular line length) increase aesthetic interest partly because they *add dimension* to those strong divisions of time. Moreover, devices like anaphora, alliteration and internal rhymes can create rhyme-based temporal flows distinct from a main end-rhyme scheme. These features might exist as notable but fleeting anomalies or they might build into recognizable patterns in their own right that move with or against other temporal structures: bending currents, forming eddies, sending us back to earlier passages, driving us urgently forward, blocking (and so reducing or diverting) that forward push.

I must emphasize that what I have in mind here is more than sonic patterns changing over the course of a poem (a series of long vowels shifting to shorter ones, for instance), or even a collection of such patterns. Crucially, I would argue that it is the *interaction among* these several distinct flows that helps create a poem's complex form as it lives in dynamic time, some parts moving faster or slower, amplifying or undercutting regular rhythms, converging or diverging in passages of particular turbulence. Then, too, a reader motivated by her particular context might linger on a given phrase or return

to the same lines again and again, adding her own patterns of attentive movement and rest that interact with those in the text. Subsequently, for the purposes of our visualization design, our team adopted the guiding metaphor of flow, approaching poems as “a fluid (or fluids) moving via its linguistic devices and figures through a defined space” (see Coles, this issue). As our assessment of successive prototypes has also borne out, it’s not detection of the most obvious patterns that is most important or revealing, but recognition (and then interpretation) of the changes that emerge through the turbulent interaction among patterns both obvious and subtle.

My epiphany in the pool having changed my frame of reference, I proceeded to look for ways to connect that experience with a broad literary landscape. In part because of her particular attention to both sound and time, I reached for Dickinson very early in hopes that I could tether myself and my developing ideas to her words. I resonated immediately with the sense of ungroundedness, of mental “Cleaving” expressed at the beginning of this well-known poem:

I felt a Cleaving in my Mind—
As if my Brain had split—
I tried to match it—Seam by Seam—
But could not make them fit.

The thought behind, I strove to join
Unto the thought before—
But Sequence ravelled out of Sound
Like Balls—upon a Floor.

Taking more enduring hold in my imagination, the poem’s concluding lines¹ have continued to compel my attention long after my initial sensations of mental dissonance and straining toward new syntheses subsided.

The phrase “Sequence ravelled out of Sound” in many ways expresses the kind of poetic sonic-temporal complexity I have been trying to describe. Inherently ambiguous, the phrase articulates multiple activities and orientations simultaneously. As with “cleaving,” “raveling” both separates and joins. According to the OED, “to ravel” means “[t]o entangle or disentangle”; it carries connotations of weaving as well as fraying, of careful explication but also attentive puzzlement, of performing a meticulous activity and experiencing a qualitative state. Historically it identified elements of a

¹ Dickinson repeats these lines, with some variation, in another, single-stanza poem: “The Dust behind I strove to join / Unto the Disk before— / But Sequence ravelled out of Sound / Like Balls upon a Floor—”

bridge, stair rail, or boundary marker. These ambiguities in “ravelled,” a linking term in Dickinson’s phrase, in turn generate several shifting potential relationships between “Sequence” and “Sound.” For example: that strands of linear order pull out or unwind, at potentially many places, from sound; that sound is both a material out of which sequence is made and an instrument of its undoing; that sequence and sound might be used to help distinguish each other even as they remain (a) complex. Poetic time is not *simply* sequential: sound ramifies a poem’s read or spoken word-by-word order.

As I began to explain above, sound’s means of accomplishing this temporal “ravelling” are many. They include the several kinds and degrees of rhyme and repetition within the formal structure of a poetic text: for instance, full end-rhymes (“split”/“fit,” “before”/“Floor”) and repetitions (“Seam”/“Seam,” “thought”/“thought”); but also more complex arrangements like “Mind”/“behind” and their bends toward both “Sound” and “Brain”/“join.” Smaller units of assonance and consonance also interact with these patterns in interesting ways. What might we “see” (or hear) in the echoes among “Seam”/“Seam”/“Sequence,” for instance? This last example shows how sonic-temporal “raveling” can occur not only in rhymes explicitly enacted through multiple words within a poem (couplets, slant rhymes, assonance, etc.) but also via broader contexts provided by text or reader. In this way, additional rhymes might be embedded in or potentially heard within individual words.

Etymology (i.e., meaning connected and shaped through sound over time; historical resonance) accounts for some of this. So, too, do the associations of individual readers, whose specific linguistic and historical contexts may prompt new aural associations that potentially trace and/or advance ongoing etymological development. Consider for instance how the preceding discussion of ambiguous denotative meanings and syntactical functions of “ravelled” in Dickinson’s poem might be enlarged even further by this sonic-temporal sensibility. In imagining time *raveled*, we might then also hear time revealed as raving; time revealed in by speaker and reader; we might perceive more aspects of active, ecstatic poetic time made and unmade by poetic sound. In fact, the idea that poetic time can be expanded through complex “raveling” has a powerful and ancient poetic precedent: again according to the OED, it is the word at least one translator used to convey Penelope’s recurrent work, her artful weaving and unweaving while awaiting Odysseus’s return.

This idea of making and unmaking—especially via rhymes connected through the poem by etymology or reader association—may well unsettle some traditional conceptions and conventions of literary critical practice. But it corresponds nicely with an approach to textual interpretation popular within (but by no means limited to) DH: a manner of performative literary

engagement known as “deformance” whereby readers deliberately filter or reorder a text to experience it from a different angle. As Lisa Samuels and Jerome McGann, who coined the term, explain:

A deformative procedure puts the reader in a highly idiosyncratic relation to the work . . . since deformance sends both reader and work through the textual looking glass. On that other side customary rules are not completely short-circuited, but they *are* held in abeyance, to be chosen among . . . to be followed or not as one decides. Deformative moves reinvestigate the terms in which critical commentary will be undertaken. Not the least significant consequence . . . is the dramatic exposure of subjectivity as a live and highly informative option of interpretive commentary. (36, emphasis original)

Samuels and McGann acknowledge that these methods will yield unpredictable results. Part of the measure of such dramatically enlivening interpretive moves will be the degree to which they productively and mutually illuminate both text and reader, developing further contexts for each.

Stephen Ramsay argues that deformative techniques, including techniques that involve computational manipulation of texts, are not all that different from our familiar critical practices. In fact, he reminds us, “all interpretive actions . . . create an alternative version of the text itself” (40). Self-conscious deformance, though, intensifies questions about the influences text and reader exert on each other, and how those influences might be affected (productively or not) by error and uncertainty. As Ramsay sees it, while in one sense “‘deformance’ suggests nothing more than the basic [value-neutral] textual maneuvers by which form gives way to form . . . any reading that undertakes such change (as all reading must) remains threatened with the possibility that deformation signals loss, corruption, and illegitimacy” (56). Responding to that anxiety, he asserts that “Our fear of breaking faith with the text may . . . need to give way to a renewed faith in the capacity of subjective engagement for liberating the potentialities of meaning” (57). Still, in supporting “subjective engagement” we do well to continue trying to honor that which (and those whom) we engage. These are issues Katharine and I and our colleagues continue to wrestle through as a research team: issues touched on, too, by Dickinson.

In her same poem quoted above, the prepositions “behind” and “before” (like “Sequence”) carry both spatial and temporal meanings. This ambiguity in individual terms multiplies possibilities for larger structures: depending on how we read it, “before” may place “the thought” earliest or latest in the sequence (“prior” / “farther back” or “after” / “in front of” that which falls “behind,” according to the speaker’s perspective). In other words, the sequence may be rendered Xbehind-speaker-Xbefore or Xbefore-Xbehind-speaker. This uncertainty is consequential. It matters in part because of the questions it raises about that speaker’s perspective and how it operates in the

poem. To what extent is she part of the interrupted and ambiguous sequence she describes, imbricated (“joined”) in its turbulent unfolding? The phrase “I strove to join” may be testimony of a would-be manipulator of the abstract, who laments futility (at least difficulty) in trying to order connections from outside. But it may also express her intentional, rigorous, hopeful efforts to immerse herself as a full participant in that dynamic order: the comma may transform “The thought behind” from direct object into an absolute phrase. Thoughts, like language, are not merely things to be examined and manipulated as external objects; they enfold the thinker (and the speaker, the poet, the reader). Both us and not-us, they offer a paradox of self-reflection. “Like Balls upon a Floor,” these are slippery surfaces—and moving ones, even as they disorient and reorient.

Such unresolvable interplay between insight and uncertainty recalls again ancient aspects of *epiphaneia* noted by Holsinger. It is also one of poetry’s powerful pleasures—and pleasurable powers—whose dynamics are shaped not only by the particular features of a poetic text and the individuals who read and write them, but also by their various respective contexts. Our research seeks to heighten both poetic power and poetic pleasure by asking how a computer might uniquely and meaningfully contribute to that ongoing process of discussion and discovery. What can it offer a human reader that she is unlikely to find in her direct encounter with the poem alone? How might interaction with poetry visualization software generate meaningful exchange, rather than mere intrusion or distraction? How, in short, might a human read a poem collaboratively with her computer?

Cum Machina: Close Reading with Poem Viewer and Poemage

The theoretical apprehension of poetic time as active, dynamic, fluctuating, unique and context-responsive has been one of the greatest, if indirect, things my computer taught me about poems. Our team has been working to describe how our flow metaphor might play out in particular poems, and so to teach the computer how to recognize similar features in other poems. In addition to detecting and visualizing relationships among distinct sounds and clusters of sound, a computer can also automatically display further information about those sounds that readers may not know or keep consciously in mind. Our recent paper in *Computer Graphics Forum*, for example, discusses how Poem Viewer, our visualization tool developed with our colleagues at Oxford, designed vowel and consonant pictograms derived from the International Phonetic Alphabet. Using spatial position, shape and color, these glyphs provide a unique, non-animated way to reveal connection with human readers and sonic changes over time—crucial aspects of poetry often neglected by other existing poetry visualization and text analysis software.

Poem Viewer's innovative approach to revealing these complex sonic relationships relies on abstract grids to show, generally, where in the mouth a sound is produced, whether vowels require rounded or relaxed lips, and whether or not consonants engage the larynx.

Even for poems not read aloud, this attention to oral anatomy foregrounds and elevates to meaningful importance dynamic relationships among poetic text(s), human reader(s), and visualization technology. Through color gradation, Poem Viewer's phonetic glyphs show temporal dimension and development, each pictogram displaying the previous vowel or consonant mouth position in a lighter shade than the current phoneme's. In this way, viewers can quickly discern how much turbulence the mouth experiences as it moves from consonant to consonant or from vowel to vowel throughout a poem.

Visualizing locations and degrees of sonic turbulence helps us see poetic qualities like relative intensity and dynamism, characteristics that contribute to literary experience and inform critical interpretation. We believe sounds generated through similar oral movements are related, and so have wanted to look not only at where and how specific sounds appear in a poem but also at whether phonetic positions in a given poem remain in a specific region of the mouth, evolve slowly (moving by degrees from one region to another), or shift more often and abruptly.

Take again, for example, H.D.'s "The Pool":

Are you alive?
I touch you.
You quiver like a sea-fish.
I cover you with my net.
What are you—banded one?

Poem Viewer shows that by far the most frequent sonic movement in this poem is from the bottom to the top of the mouth. In fact, nearly all of the poem's words perform this surfacing, interrogative rise, emphasizing the speaker's questioning sense of wonder. The exceptions are notable: "touch," "sea-fish," "cover," "net," and "banded" all hover at the top of the mouth and (excepting the hard "c" in "cover") all of their consonants are generally at the top-front of the mouth. It is as if each attempt to catch the poem's elusive mystery through physical connection ("touch") or other means of capture ("cover"; "net"; "banded") momentarily quells the sonic "quiver" of poetic life, only to have it escape again. Poem Viewer's pictograms reveal granular-level distinction between the rhymes "quiver" and "cover": on the order of the phoneme, enunciated sound enacts the difference between these related but opposed actions.

As Katharine suggests in her description of our brief comparison of "lyric" and "imagistic" poems (see Coles, this issue), Poem Viewer's pictograms might also be used to compare sonic turbulence with other poetic devices and qualities. For example, sonic turbulence seems to operate inversely to visual intensity and transformation in William Carlos Williams's "Between Walls":

the back wings
of the

hospital where
nothing

will grow lie
cinders

in which shine
the broken

pieces of a green
bottle

The first two and a half stanzas of the poem relay a visually nondescript scene through exquisite sonic movement: nearly all of the words in this part of the poem engage more than one part of the mouth, and a few engage even more, touching front, back, top, and bottom of the mouth. This sonic energy dissipates beginning with "cinders." The first concrete visual detail of the poem, it becomes (as Pound puts it) a "luminous detail"—in this case literally so—shining with bits of glass and moving the poem clearly into imagist terrain. With the exception of the "k" in "broken" and the hard "g" in "green," this visually vibrant second half of the poem lingers toward the front of the mouth in diminished sonic activity.

Beyond this roughly inverse correlation between sonic and visual intensities, the pictograms also reveal corresponding enunciation movements in "hospital" and "green / bottle": beginning at the back of the throat (h/g), moving to top-front consonants that continue the breath (s/n), they burst in top-front plosives (p/b) before subsiding in identical "t-l" depressions of the tongue. These final syllables connect "hospital" with "bottle" through rhyme: a connection perceived relatively easily without the aid of a computer. But through the visualized mouth movements, we can also see emphatically that "green" is part of that relationship as well—an important inclusion that otherwise might be missed, especially because of the intervening line break.

Alone, both hospital and bottle might be considered decrepit, even useless containers. But “green,” whose lively color and rhymed connection to active light (“shine”) transforms that sonic relationship, deepens potential readings. In fact “green” is the only color in the entire poem, its visual conspicuousness joining multiple sonic-temporal flows and semantic resonances to create one of the most intensely dynamic places in the poem. Its inclusion in the enunciation pattern—along with the line break that might have obscured that pattern—thus enlarges and opens more hopeful tonal possibilities not only for “hospital”::“bottle,” but for all the “broken//pieces” within the many structured spaces described (both geometrically and poetically) here “Between Walls.”

Consider, too, Louise Bogan’s “Night,” which, as Katharine mentions, has become a touchstone poem for us (see Coles, this issue). The “oo” in “estuaries” repeats and strengthens the vowel sound from the previous word, “blue,” together pulling the long double “o’s” from the earlier phrase “cold remote” forward to the narrowed front of the mouth. At the same (dynamic) time, “estuaries” connects through its ending “-ies” with the eddied phrase “breathes, breathes” in its progress toward becoming a source of many distinct sonic-temporal flows (see fig.1).

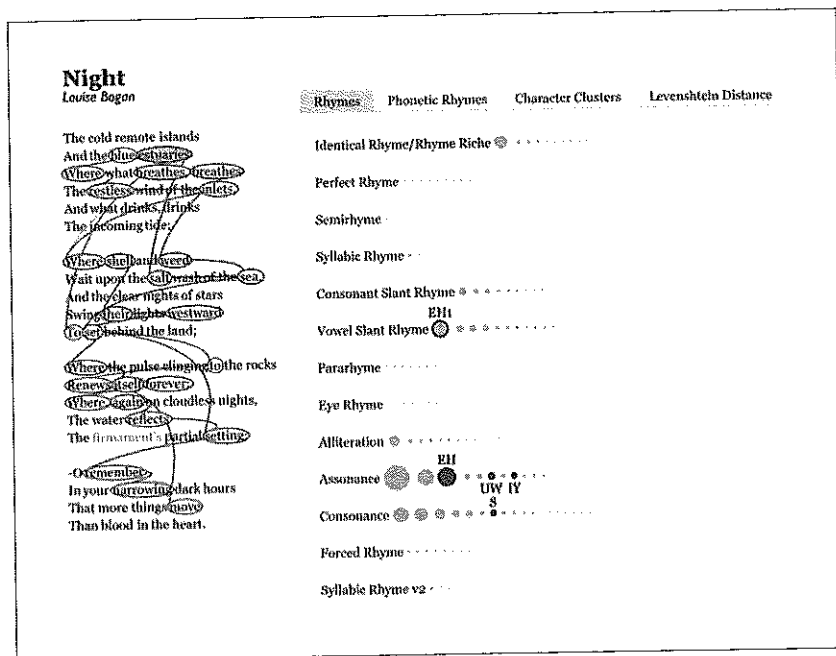


Fig. 1. A sketch version of Poemage tracks sonic-temporal flows in Louise Bogan’s “Night.”

Among these is an “e/s/t” cluster that beguiles us as it gets picked up and tumbled around in an especially lively flow, its phonemes switching order and syllables in “restless,” “itself,” “inlets,” and elsewhere—persisting (as we notice, though this is not captured in our software) when a stray phoneme momentarily separates them, as in “reflects” (see fig. 2).

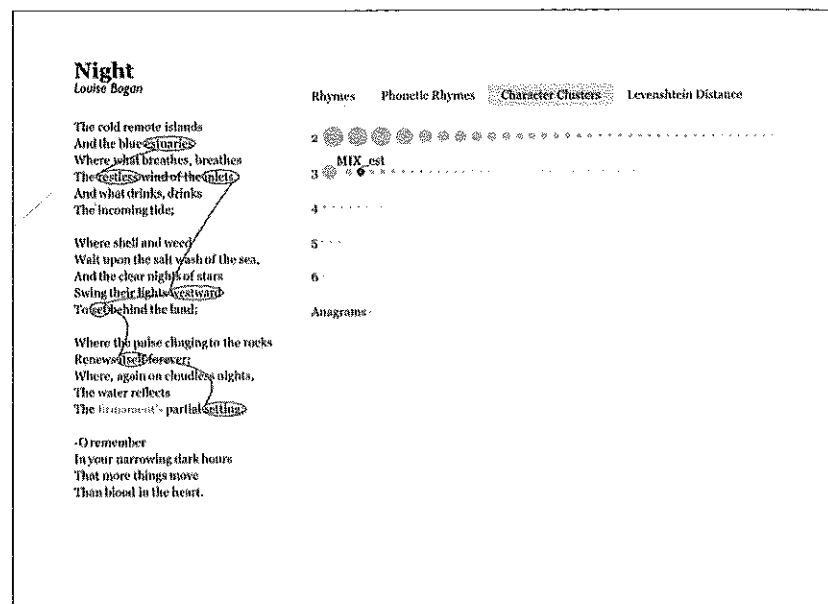


Fig. 2. Isolating the “e/s/t” group in “Night.”

It is interesting to see multiple sonic-temporal flows interacting in a word like “estuaries,” whose denotative meaning also calls to mind places where river and tidal waters meet in bubbling, energetic exchange. In this example, resonances between sonic-temporal activity and interpretive meaning are especially clear. In fact (especially considering Katharine’s observations of the poem’s occluded visual aspects [see Coles, this issue]), the landscape here may be rendered most explicitly by its sonic topography rather than through imagistic detail. It may be that “Night” exhibits the general inversion between visual and sonic vitality we’ve noted elsewhere. In the future we would like to be able to visualize how patterns of sonic and visual turbulence relate to each other, across sensory categories, in specific poems. There may be places or entire poems where sound and image intensify each other—for instance where sonic energy and strong visual detail converge, as

in the word "green" in Williams's poem above. In the meantime, though, and regardless of a poem's subject matter, we believe it will be useful for readers to visualize where and how sonic-temporal flows overlap—or do not. With those structures made more discernible, their relationship to the poem as a whole may suggest new interpretations that might not otherwise be possible.

Poemage, the poetry visualization software program we are currently developing with computer scientists Miriah Meyer and Nina McCurdy at the University of Utah's Scientific Computing and Imaging Institute, will allow readers to explore a poem's sonic-temporal structure spontaneously and interactively, whether through the text (focusing on a particular word or set of words), or through its detected sonic patterns (highlighting individual or multiple types of sonic relationships). Although Poemage has not yet been publicly launched, and continues to undergo visual and programming changes, it has already powerfully contributed to our readings. Another three-character cluster in Bogan's poem, for example, reveals an embedded relationship among such words as "incoming," "nights," "Swing," "clinging," and "narrowing" (the "g/i/n" cluster, more nuanced than the "-ing" rhymes it also contains). More is happening here than novelty alone: sets of words, grouped uncapriciously by Poemage using quantifiable, computational traits, suggest new associations and potential interpretive angles, new openings and paths of poetic pleasure and engagement. Like end-rhymes or the group of words inhabiting any given poetic line (but often less immediately apparent to human readers), these sets form distinct yet variable poetic units and organizational structures that invite us to attend to them as such.

The requirements of this project have revealed, moreover, ways the "e/s/t" flow's internal turbulence also responds to and helps generate others. That apparently stray "c" in "reflects," for instance, might emerge in part due to the brunt of a pronounced hard "c" consonance flow elsewhere in Bogan's poem. The prominence of short "ah" vowels likewise creates a distinct assonance flow whose own momentum and shape I suspect draws the "e/s/t" towards "a/s/t" in "stars" and "salt." Similarly, the long "e" assonance flow may influence these other two, reverberating in the combined "ah-ee" (i.e., the long "i") vowel sound and "i/s/t" cluster heard in "nights" and "lights." A poem's complex sonic-temporal structure, then, is created not only through the interaction among distinct intersecting and overlapping patterns, but also through the influence that *surrounding* flows exert on and exact from those patterns. In this way, the "e/s/t" flow evolves, through vowel shift, inserted phonemes, and word break, even to "cloudless nights."

Again, our current software cannot detect that degree of sonic-temporal warping or dissipation. But neither do we need it to: once aware of that strong but subtle structure, individual humans reading poems collaboratively

with computers via Poemage can choose to delve further into the poem to see whether and how a visualized pattern extends in ways undetected by the computer. Also, perhaps, in ways not consciously realized by the poet. For as much as we rightly celebrate the focused effort poets devote to precision in their craft, as much as we might appreciate and admire, and even sympathize with, Pound's and Wordsworth's years-long "obsessive fiddling" with poems noted by Katharine (see Coles, this issue), as much as we attend to the ways poets deftly work with the material(ity) of their art—namely, language—we also know that language itself works with and on us humans who engage it. Its syntactic, semiotic, and, yes, sonic structures and relationships exist and operate in co-evolutionary relationship with each other and with us readers, constantly shaping and re-shaping our several shared contexts. Thus we see, for example, the blurring of clear subject-object distinctions in the H.D. and Dickinson poems noted above, or the (possibly unconscious) interplay between Bogan's sensitive ear and the developing sonic patterns in "Night" that together lead to the presence of words like "reflects" and "estuaries" in that poem. For these reasons, while I am not at all sure language is ever really inert, it may well be most "alive" in those poetic activities where its co-evolutionary dynamic is most intense and explicit: where the mutual influences of humans and language are most powerful and apparent.

A computer can help reveal more dimensions of these relationships as they take shape over time. Poemage users, for example, can move the cursor along a poetic line to visualize what patterns the reading process enacts and activates to create a poem's unique sonic-temporal topology/topography, word by word. Using a preliminary software experiment to read Williams's poem "This Is Just To Say," I was astonished to see that none of its sonic-temporal flows involves the pronoun "you":

I have eaten
the plums
that were in
the icebox

and which
you were probably
saving
for breakfast

Forgive me
they were delicious
so sweet
and so cold

Every word except “you” in this poem participates in sonic-temporal patterning, making the absence of any word-to-word or sound-to-sound connection with “you” very stark indeed. An image showing all detected sonic “raveling” in this poem reveals the second-person addressee and recipient of the apology as sonically and temporally (relationally) separate from the rest of the poem, isolated in its own stillness (see fig. 3). This is the kind of discovery I might not have made without computer visualization and that enriches my poetic experience, drawing me more closely into the poem while also causing me to circle back to questions about reading and subjectivity.

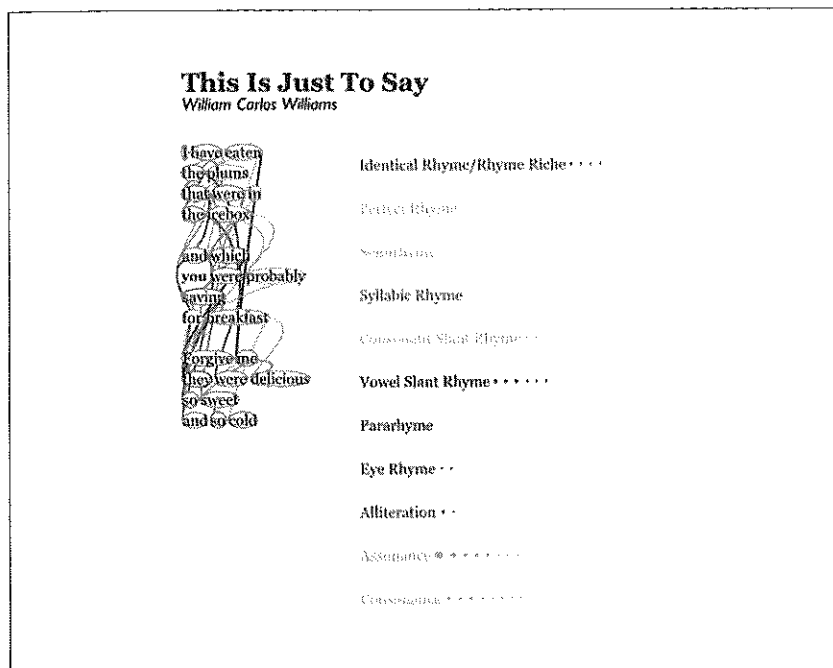


Fig. 3. A sketch version of Poemage reveals the isolation of “you” among rhyme relationships in Williams’s “This Is Just To Say.”

To speculate, as I did above, that the momentum of a particular assonance pattern might contribute to the inclusion of certain other words in the poem is not (or not necessarily) to attribute agency to letter, phoneme, word, or verbal pattern. Certainly I do not ascribe to those literary elements the kind of subjectivity that implies self-awareness or choice. Instead, I merely re-state a claim made otherwise many times before: that humans, writing and reading, participate in linguistic and literary ecologies on orders both large

and small; that the writing and reading of poetry—even when conducted in Wordsworthian solitude—is never an exercise in isolation but an encounter with entities, forces, and networks both like and unlike and beyond the self. Language is among these. So, too, may be computers—especially if, as with language, we can engage them as participants in reading who are neither always dominant nor always subordinate in the process.

In fact, I am convinced that what’s needed in poetry visualization is not a program that will automatically detect and display every interesting poetic feature, pattern, and relationship. Such a quest is both impossible and undesirable. Computers have limits too—some of them temporal. (It still takes them time to perform calculations, for example.) More importantly, computers and software are subject both to incompleteness and error. These limitations can become strengths of the overall collaborative process because they invite and direct humans’ further engagement in reading poems. The strengths and weaknesses of machine and human can complement each other. As already acknowledged, neither Poem Viewer nor Poemage captures the full degree of pattern morphing we might find in a poem. Yet by visualizing patterns incompletely, they suggest further questions and interpretive angles for humans to explore. The visualized isolation of “you” in Williams’ “This Is Just To Say” provides another example of this aspect of collaboration. For, while it is true that “you” stands apart from the rest of the poem in terms of the rhymes and other sonic patterns we have mathematically described so far, it shares a similar vowel modulation to that we observed in “Night”—but in reverse: the “oo” in “you” opens but slightly retreats to the long “o’s” at the end of the poem (“so sweet / and so cold”). Still, this tenuous relationship is also intriguing. Unlike the plums, whose sweetness and coldness seem simply “delicious,” a beloved who is perhaps also linked to these terms, albeit less directly, suggests a mournful ambivalence in the speaker, who may lament felt separation from the “you” who is “so sweet” while at the same time justifying guilt over loss of a “you” who is “so cold.”

As with incompleteness, so, too, error may be a productive computational limitation human readers can engage. An early Poemage prototype, for example, assumed the pronunciation of “wind” in Bogan’s line, “The restless wind of the inlets,” was the verb “to wind.” It therefore linked that long “i” with words like “tide,” “lights,” and “behind” elsewhere in the poem. Results like this might be taken for meaningless, undesirable noise—except that “Night” enacts and meditates on various kinds of movement and so the notion of winding (of certain movements storing potential energies for other, differently expressed movements) is actually highly relevant, even though a reader might not have noticed it without a prompt. Here again, we have poetic “raveling” through sound. And, as Katharine explains, a computer’s capacity to provide statistical probabilities about the accuracy of its findings

offers still further means of seeing that raveling at work (see Coles, this issue). Potential computational errors expose new areas of interpretive uncertainty for us to address: new ambiguities we can choose or decline to weave into our own readings.

In human-poem-computer collaboration, the silences of incompleteness and the noise of error become familiar literary qualities. After all, poets and readers are attracted to the interplay between silence and noise: part of our work is to render those dynamics meaningful and aesthetically pleasing. Context and framing are essential to that work because they 1) change or extend the scope of possibilities by adjusting what is considered "incomplete," and 2) provide structures for assessing the possibilities so recognized: "noise" in a larger context or more connected frame might just be unfamiliar music.

As we know, poems change with every encounter. Readers bring their own particular interests, emotions, curiosities, and experience (in short, their own unique contexts and frames of reference) to each encounter with a poem. These varying contexts may help emphasize or suddenly reveal certain aspects of a poem previously unnoticed (by that reader or others) as potentially interesting and meaningful. Out of these unique perceptions can arise powerful new readings of poems that subsequently affect future readings, redirecting literary history in the manner that, Ramsay reminds us, Chinua Achebe's reading of *Heart of Darkness* changed subsequent possibilities for how that novel would be read by others (42).

Because humans' changing frames of reference are always imbricated in literary engagements, mystery will remain part of textual interpretation, even when practiced as surface reading with or without computer input. Though unhidden, many of the rhyme-set relationships visualized by Poemage—internal and overlapping sets together comprising poems as complex wholes—would likely be invisible to most readers. An anagram set in Bogan's poem joins "nights" with "things": Poemage renders such magic visible, to conjure those things in "Night" (and in other poems too) that would otherwise escape readers' notice, and so enlarges and enriches their poetic awareness, wonder, and insight.

Still, where does all this attention to sonic patterns lead us? The preceding discussion of alphabetic character clusters, and the potential significance of anagram especially, may well bring to mind Ferdinand de Saussure's fascination with, and elaborations of, the sonic patterning he perceived in early Latin poetry. From these patterns he deduced and constructed a poem's unique "theme word" which—while absent in the poem itself—nevertheless purportedly provides an encrypted key to its meaning. Though presumably disbursed and encoded in the sound and structure of particular poems, the "paragram" or "hypogram" (as Julia Kristeva and Michael Riffaterre later

treat the concept) exemplifies a mode of "repressed meaning" based on language rather than culture: in this case it is not (or not only) socio-political forces pushing meaning away or into disguise, but semiotic ones. Riffaterre in fact declares that "[t]he text functions something like a neurosis" (17), requiring the reader to participate in and perform vaguely mystical transformations in pursuit of meaning.

Though we share an emphasis on poetic sound and its semiotic potential, this approach is different from the practice our team is advocating. In fact, its goal is at odds with ours: instead of seeking a single magic key to unlock the secrets of a poem, we assume the poem to be already open and always inviting new ways for us to enter. The magic happens through entrance: when we emerge somewhere new, having changed ourselves and the poem-frame in the process. What we make of all that's now before us remains to be seen.

Telling Truth Slant

In closing, I'd like to offer another example of the ways DH research has transformed my reading of a familiar poem—first, through the new contexts our research has encouraged me to adopt while "just reading," and, later, in response to patterns visualization technology showed me in the poem. Among the works I sought out while trying to find my way through the early stages of this project was another Dickinson poem, usually read as *ars poetica*:

Tell all the Truth but tell it slant —
Success in Circuit lies
Too bright for our infirm Delight
The Truth's superb surprise

As Lightning to the Children eased
With explanation kind
The Truth must dazzle gradually
Or every man be blind —

Curiosity about the new possibilities our research offers prompted me to approach the poem with a tentative "what if" orientation: What if the second-person address signals direction for *reading* a poem as much as writing one? Dear Reader, "Tell all the Truth but tell it slant." An opening invitation to the experience of the poem, this first line could describe a goal of criticism more generally: a paradoxical vanishing point deliberately skewed that advocates fullness, abundance, even exhaustion ("all") but—tellingly—not completion.

If the “telling” is “slant,” it has perspective, direction, a particular angle of approach—which of course demarcates and divides it from other potential approaches.

“Tell,” a term prominent due to its metrical stress at the beginning of the poem’s first line and then emphasized through repetition, nicely joins individual narrative, performative, qualitative and quantitative modes of reckoning: of revelation, recognition and explanation. Present-tense, its work is manifold and continual. How does that relate to notions of “just reading”? In one sense we could “Tell all the Truth” of a poem *just* by reciting it; but *recounting* it, or our experience of it, necessarily requires a particular “slant.” Not even a powerful computer could collect and analyze all the data (let alone truth) of a poem, since it changes, however slightly, with every reader’s encounter. This is not new. Still, we need—as the multiple meanings operating within “tell” imply—both fidelity to the text and flexibility in changing encounters with it. What a computer can do is expand the scope and strength of such encounters by helping us see things we otherwise might miss, which includes drawing attention to ambiguities and uncertainties. This sense of partiality, of incompleteness and flux even in the computational digital domain, is something we have steadily sought not only to retain in our software, but to enhance and accentuate. In this, our approach has differed significantly from that of others in DH, where meticulous exactitude has commonly emphasized scientific proof over literary play. Ramsay summarizes the disciplinary tensions this way:

Literary critical interpretation is not just a qualitative *matter*; it is also an insistently subjective *manner* of engagement. . . . [C]onclusions are evaluated not in terms of what propositions the data allows, but in terms of the nature and depth of the discussions that result. . . . We are not trying to solve Woolf. We are trying to ensure that discussion of *The Waves* continues. (8-9, emphasis added; 15)

Literary DH should provoke new questions, provide and support new contexts for literary work and so contribute to new literary experiences. Our goals and values are different from those of the biologists, physicists, surgeons, and other scientists who typically turn to visualization in hopes of discovering answers and saving time. If anything, we are looking for ways to enhance and navigate complexity, rather than to reduce, eliminate, or resolve it. Happily, the computer scientists on our team have been unusually receptive to our humanities-based priorities. Even so, as Katharine’s discussion of precision illustrates (see Coles, this issue), we continue to wrestle together to figure out how to combine differing engineering and literary notions of precision and uncertainty, among other qualities, with respect to both a poem and the reading experience. Poets want to keep options open. We are often reticent to choose one direction in the programming because it might close

other possibilities. But we saw with Poem Viewer that it’s not actually all that helpful to try to keep hold of everything. Perhaps we were confusing precision with completion, or a mistaken drive for certainty. Yet, we know from writing and reading poems that reticence to make decisions can contribute to vagueness. In contrast, precision is necessary to create productive, engaging multiplicities and ambiguities. We are learning that—even when writing in computer code—decisions need not be binary.

Here I return to Dickinson’s poem. For while the second line can very well mean something like “roundaboutness is the best way forward,” other possibilities are also in play: “Success” connotes not only victory and good fortune but (value-neutral) continuation of a series in time; “Circuit,” even in Dickinson’s day, carried electromagnetic valences thanks to Faraday. We could argue, then, that the “way forward” for the mode of telling/reading envisioned in this poem involves not only discursiveness but also temporally based patterns of quantification (“Success”) within, and in part constitutive of, charged connection and exchange (“Circuit”): connection and exchange primarily between reader and text, but also perhaps with fellow readers and other texts, now even extending to/through the circuitry inside a laptop. The pun on “lies” at the end of the second line, though, stops us short: we cannot be certain the “Circuit” is reliable or even potentially beneficial.

The location of the pun—early in the poem and at the hinged end of the line initiating the notably punctuation-free internal circuitry of the poem—strengthens its dual meanings. Here, between the em-dashed first and last lines of the poem, Dickinson’s lineation moves us forward and back through various syntaxes/synapses of our connection with the text. Giving credence to cadence and rhyme, perhaps the most forceful and straightforward reading suggests that the Truth (or its “superb surprise”) overwhelms not only “our infirm Delight” but also our critical capacity: that—like children experiencing the beautiful but terrifying power of lightning, who need to be comforted by gentle and reassuring scientific or mythological explanations about its qualities and causes, or like prisoners emerging from Plato’s cave—we need to learn about and look on the brightness of the Truth through gradual training and discovery if we are to be able to see it at all.

But syntax also implies that “Success” and even the plural noun “lies” might similarly be “Too bright” for our limited perception. “Lightning,” moreover, may not be (simply) analogous to “The Truth’s superb surprise” but also a simile for it. To represent the shock of the (poetic) sublime “As Lightning” is a different “kind” of explanation; another “Circuit.” Here, “Children [are] eased” not by detraction or protection from the sublime, but by its conversion (i.e., its channeling and transformation) into specific sensory experience and poetic language. In this scenario, the power and complexity of lightning and our encounters with it are not to be minimized or simpli-

fied through theory, proof, or argument; instead, they are to be pursued, studied, and experienced for what they might reveal about themselves and broader Truth. This is the stance we continually advocate in our DH research: to use computers and visualization to intensify, rather than stifle, poetic complexity, but in a way that is illuminating and navigable.

A single stroke of lightning might be experienced suddenly; it surprises. But a succession (or sequence) of bolts often develops and discharges throughout the course of a storm (or poem): a succession whose temporal unfolding, whether slow or swift, “dazzle[s] gradually.” Were it not for such lightning-like revelations, we would “be blind.” Moreover, if blindness can occur, according to these possible readings, in both the saturation *and* absence of Truth and its “superb surprise,” then the art and challenge for every critical endeavor to “tell” is to find and follow these various kinds of illuminating “Circuits” that traverse the transverse “slant.” The last bit of Dickinson’s text extends this invitation graphically and grammatically, the em-dash reaching out to us from the end of the poem. Having extended the original imperative of the first line through the succeeding lines, it now (and always, via circuitous continuation) asks us to close the circuit of the poem by connecting with it.

Electric, revelatory, intimate contact between reader and poem (and other readers and other poems and so on): this is what we pursue through our ongoing poetry visualization research. While that work continues, Poem Viewer and especially our developing Poemage experiments are beginning to help us realize those aims. Poem Viewer, for example, reveals the diphthong long “i” (“ai”) sound not only in the rhymed pairs “lies”/“surprise” and “kind”/“blind” — but also in “bright,” “Delight,” and “Lightning.” To visually discover the sonic “I’s” (i.e., “eyes”) dispersed throughout a poem about perception is interestingly “telling” but not entirely unexpected. Poemage, on the other hand, draws attention to a set of words we might not have suspected to be sonically linked: “Circuit,” “our,” “infirm,” “superb,” “surprise,” and “every” all exhibit the sound “er,” or (though it differs from my own pronunciation of the word) “err” (see fig. 4). This particular sonic connection, among these particular words, linked to a word ambiguously present through rhyme but lexically absent from the poem, supports the appropriateness of our goal: partial, specific, shared, unpredictable, moving literary encounters. That these words occur in close proximity to the earlier set, even overlapping in “surprise,” intensifies dynamics between revelation and uncertainty, those multiple aspects of *epiphaneia*. Poemage also reveals “a/l/n” and “a/n/t” clusters twice joining “slant” and “explanation,” emphasizing once again the positional and provisional telling we seek to engage in along with computers via our visualization software. Needless to say, this is a challenge that remains incomplete.

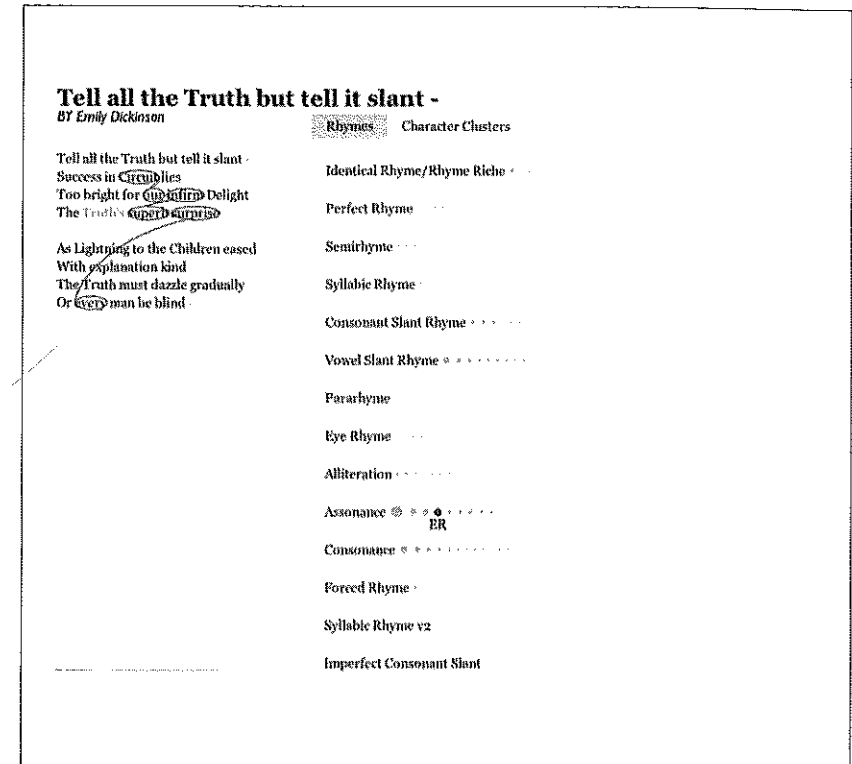


Fig. 4. A sketch version of Poemage tracks the “er” sound through Dickinson’s “Tell all the Truth but tell it slant—.”

In fact, the challenge of joining poems and computer programs is a difficulty stretching at least to the beginnings of DH, to its earlier days when it was still known as “humanities computing.” Jerome McGann noted in 1999 that poetry presents a special textual ethos, whose analytical requirements certain programming structures can’t help but fail to meet:

Unlike expository text, poetry is not organized in a determinate hierarchy. TEI [Text Encoding Initiative] and SGML [Standard General Markup Language] markup, therefore, while reasonably adequate vehicles for expository and informational texts, fails to render those features of poetic text that are most salient for its makers and users. Poetical texts are recursive structures built out of complex networks of repetition and variation. No poem can exist without systems of “overlapping structures,” and the more developed the poetical text, the more complex are those systems of recursion. So it is that in a poetic field no unit can be assumed to be self-identical. . . . This

essential character of poetical text helps to explain why content in poeisis [sic] tends to involve more broadly “semiotic” rather than narrowly “linguistic” materials. The sonic and visible features of text are, so far as the poets who make these texts are concerned (or the readers who engage them), nearly as apt for expressive poetical purposes as the semantic, syntactic, and rhetorical features.

Here, McGann anticipates some of the frustrations and insights independently realized in our own research, including an emphasis on recursion, network, and overlap. That poetry continues to challenge not only TEI specifically but also, fifteen years later, the most advanced programming languages and visualization techniques, testifies to poetry’s complex “raveling” and “telling” evoked by Dickinson, and recalls tensions between “quiver” and “cover” elegantly set forth in H.D.’s “The Pool.”

Computation can never fully capture poetry. Neither can we. What we can aim for are more diverse and meaningful connections, more revelatory encounters with poems and fellow readers—even if those revelations, like H.D.’s poem, begin and end with questions. It may be that such perpetual and perpetuating inquisitive openness is essential to collaborative revelation however it occurs: whether among humans or with poems and computers. H.D., reflected in the many surfaces of DH, calls again, anew to us: “What are you—banded one?”

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