

Shakespeare's Pacemaker: A study in poetic meter and cardiac rhythms

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April 2014

From the melodic quatrains of Shakespearean sonnets to the rhythmically erratic verse of Sylvia Plath, the dependence of poetic meter on emotional matters of the heart is as intrinsic to the body of the poem as the heart beat itself is to the corporeal body of the poet. To associate poetic meter with the emotional state of the speaker, however, without considering specifically how that meter corresponds with the heart as an organ, represents an oversight in the history of the study of poetry. Lacking, therefore, is a thoughtful consideration of how poetic meter is a model of the normal rhythm and arrhythmias of the heart as an anatomical, emotionally-affected organ. A study of cardiac pathophysiology, as exhibited through poetic rhythmical shifts, can bridge and enhance our understanding of the interrelation of art and medicine.

To assess variations in rhythm, it is first necessary to understand the basic units of both heart sounds and poetic meter. Physiologic heart sounds are defined by a systolic phase (S1) where blood is pumped from the heart to the body, followed by a diastolic phase (S2) where the heart ventricles are filling. The staccato sounds heard through a stethoscope are those of the heart valves closing to differentiate these filling and emptying phases. This consistent, rhythmic beating correlates pictorially to the pattern seen on electrocardiograms. Colloquially, the sounds associated with the biphasic heart contractions are referred to as “lub DUB,” or more technically as S1S2. The “lub” of the valves closing to allow ventricular emptying is followed by the louder “DUB” of the valves closing against the higher pressured systemic circulation that precedes ventricular filling. In an average, healthy adult at rest, the heart repeats this pattern 60-80 times per minute. This baseline, physiological rhythm is referred to medically as regular sinus rate and rhythm.

Whereas heart sounds are described as “rhythm,” poetic sound is referred to as “prosody.” Prosody can be defined by patterns of alternating verse, which can be further parsed into units of sound referred to as metrical “feet.” The most commonly used foot in Western poetry is termed the iamb, which takes its name from the Greek goddess Iambe. In Greek mythology, Iambe, the Goddess of Humor and Poetry, was said to have roused the grieving Demeter from her profound depression during her search for her daughter Persephone.¹ By Western definition, the iamb consists of one unstressed syllable followed by a stressed syllable, referred to colloquially as “da DUM.” An example of an iamb is the word “al-MOST.” When iambs are strung together, they form lines of verse. The most commonly used verse in traditional English poetry is iambic pentameter, which consists of lines consistently formed by five iambs.

The ensuing examination of heart rhythms and poetic prosody will be based up on the following proposition: Iambic pentameter is to poetry as Regular Sinus Rate and Rhythm is to cardiac function. The following is a stanza from Shakespeare’s Sonnet 18:

Shall I compare thee to a summer’s day?

Thou art more lovely and more temperate.

Shall-I/ com-PARE/ thee-TO/ a-SU/ mmer’s-DAY?

thou-ART/ more-LOVE/ ly-AND/ more-TEM/ pe-RATE.

da-DUM/da-DUM/da-DUM/da-DUM

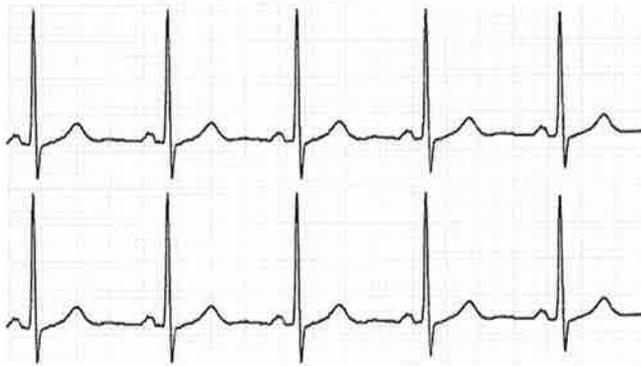
da-DUM/da-DUM/da-DUM/da-DUM

lub-DUB/lub-DUB/lub-DUB/lub-DUB

lub-DUB/lub-DUB/lub-DUB/lub-DUB

S1S2/S1S2/S1S2/S1S1/S1S2

S1S2/S1S2/S1S2/S1S2/S1S2



Notable in the words themselves, the glyphic translations of the words, and finally in the pictorial electrocardiogram tracing, is the biphasic nature of the basic unit, as well as the consistently paced spacing of these units. When either the basic unit [the rhythm], or the pacing of these units [the rate] is altered, it is noted as a deviation from baseline. For this analysis, the unit will always be defined as the smallest reproducible unit, or least common multiple--here, S1 followed by S2, and syllable 1 followed by syllable 2. In order to define rate, however, we will have to impose some standards of measurement. If we make the assumption that there are an average of 8 words per line of iambic pentameter, and that words are typically spoken aloud at 100-120 words per minute, then each line should require about 14-16 seconds to hear. If the average heart rate is 80 beats

per minute, then one line of iambic pentameter correlates to roughly 20 beats. Now that the units are interchangeable, we can consider any rate significantly greater or less than 20 beats per line to veer from baseline.

Now that we have established a baseline format with which we will associate euthymia, we can now examine deviations in both form and mood. We will begin by looking at Lord Tennyson's *In Memoriam A.H.H.* Lord Tennyson was an English poet, and was the Poet Laureate of Great Britain and Ireland during much of the 1800's. He entered Trinity College, Cambridge, in 1827 and published his first book of poems and won the Chancellor's Gold Medal for one of his pieces at the early age of twenty. He also became very good friends with one of his fellow classmates, Arthur Hallam. While at Cambridge, his father became ill and died, and Tennyson returned home before receiving a degree, to take care of his widowed mother and family. His good friend Arthur stayed with his family for some time, and eventually fell in love with and became engaged to Tennyson's sister, Emilia. He then published a second book of poems, but this time was met with heavy criticism. Around this same time, Arthur was on vacation in Vienna, and died very suddenly from a cerebral hemorrhage. Tennyson was deeply affected by this death of his friend, compounded by the death of his father and his dwindling poetic success. Armed with this complex array of emotion, Tennyson proceeded to write *In Memoriam A.H.H.*, alternatively titled "Way of the Soul." The year was 1850, and this was considered both the pinnacle of Tennyson's career, and his first masterpiece².

We will begin our discussion of *In Memoriam* by examining the structures of the stanzas. The following is the opening stanza from the poem's prologue:

Strong Son of God, immortal Love,

Whom we, that have not seen they face,

By faith, and faith alone, embrace,

Believing where we cannot prove;

The poem begins as a tribute to the Son of God, remarking that though we, as mortal beings, have never seen God's face nor have any palpable proof of his existence, we can connect with Him through faith. He goes on to attribute all of nature to God, deeming him the "creator of life and death," remarking, rather assertively, that "thy foot is on the skull which thou hast made." Though the speaker is commending God and acknowledging his vast power, he is also clearly struggling with his mixed emotions toward this being who has taken his friend.

The meter of this stanza, as well as through the vast majority of the stanzas throughout the poem, is iambic tetrameter with an ABBA rhyme scheme. Though this stanza was used prior to this poem, it is often called the "In Memoriam Stanza" as it was never used as consistently or in such length as in this poem. It was with purpose, then, that Tennyson elected to use this form. According to one critic, the fact that the stanza is 4 iambs rather than 5 iambs long brings the rhyme-syllables "perceptibly closer" which tends to "emphasize the uniformity of rhythm length." Additionally, as compared to pentameter, it "offers practically no variation of caesural pause." Further, each stanza is fully enclosed; that is, the sentence ends at the end of the stanza with the rhyme. He does not link his stanzas through continuation of the sentence, emphasizing both stability of structure and of mood. He asserts that this emphasis on uniformity is meant to "accentuate the monotony of the measure," with monotony intended to "accord with his profound but carefully restrained emotion."³

Tennyson's devout, almost painfully calculated adherence to stable meter and mood juxtaposes his outward dedication to artificial calm and his inward emotional struggle. In considering heart rhythms, if we compare iambic tetrameter to our "regular rate and rhythm" of iambic pentameter, we find that this meter is concordant with sinus bradycardia—sinus because it is consistent and formed by iambs (da DUM, lub DUB), and bradycardia because there are fewer syllables per time-unit.

A common cause of sinus bradycardia is increased vagal tone. A recent study from the journal *Neuropsychopharmacology* examined the role of vagal tone during grief elicitation⁴. Eight women who had experienced the death of a loved one in the past 18 months were scanned using fMRI during the presentation of personalized pictures and words that evoked grief, such as a photo portrait of the woman's late husband with the word "cancer" printed next to it. After measuring the women's baseline parasympathetic activity, fMRI was used to look at regional brain activity during these grief-elicitation tasks.

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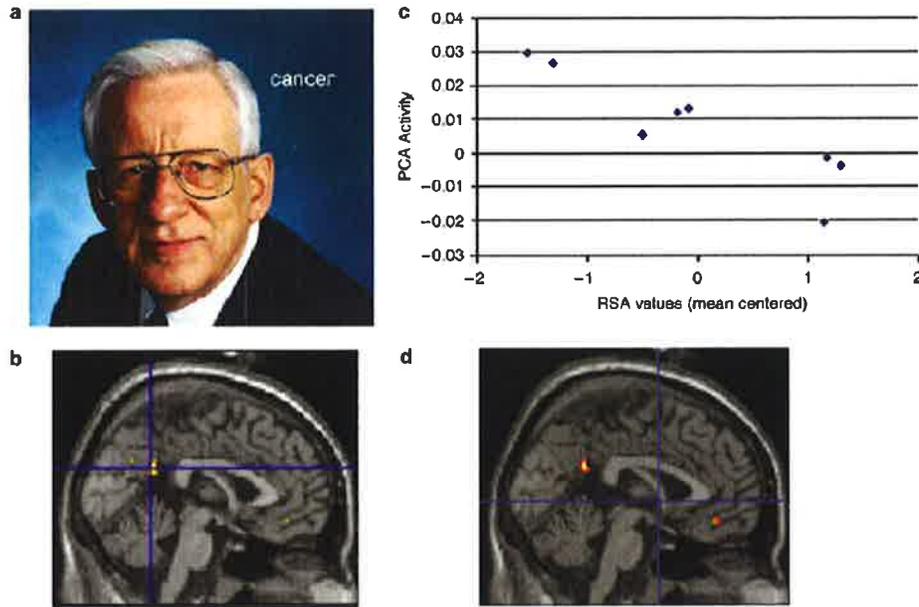
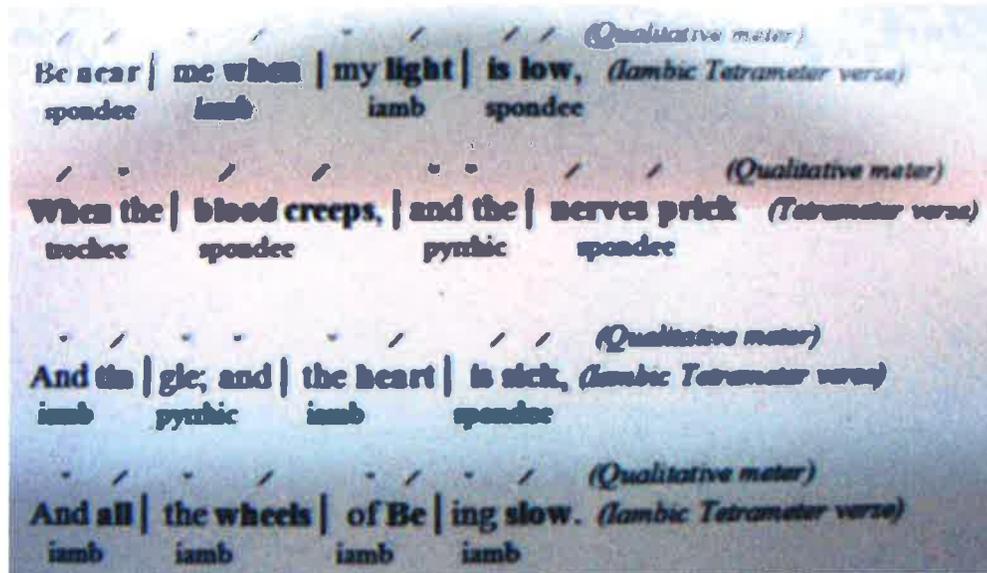


Figure 1 (a) Photo of the deceased with grief-related word. (b) Sagittal view of the vPCC (Talairach and Tournoux coordinates: 0, -54, 24). (c) Scatterplot of the negative relationship between vPCC activity and RSA (increased vPCC, decreased RSA) in the Deceased > Stranger condition. VPCC, ventral posterior cingulate cortex; RSA, respiratory sinus arrhythmia. (d) Brain regions resulting from functional connectivity analysis revealing positively correlated activity between the sACC/orbitofrontal cortex and posterior cingulate activity.

Peripheral parasympathetic activity has been associated with central neural activation of the posterior cingulate cortex, which is elicited by the memory and emotion and links to the autonomic nuclei in the brainstem. Increased PCC activity was found to occur during these grief-eliciting tasks, leading to increased parasympathetic tone, and possibly, by extension, decreased heart rate.

Though *In Memoriam*, along most of its extensive length consists solely of precise, measured “In Memoriam Stanzas,” sometimes it does veer from his strict iambic tetrameter. The following is the fiftieth stanza:

Be near me when my light is low,
 When the blood creeps, and the nerves prick
 And tingle; and the heart is sick,
 And all the wheels of Being slow.

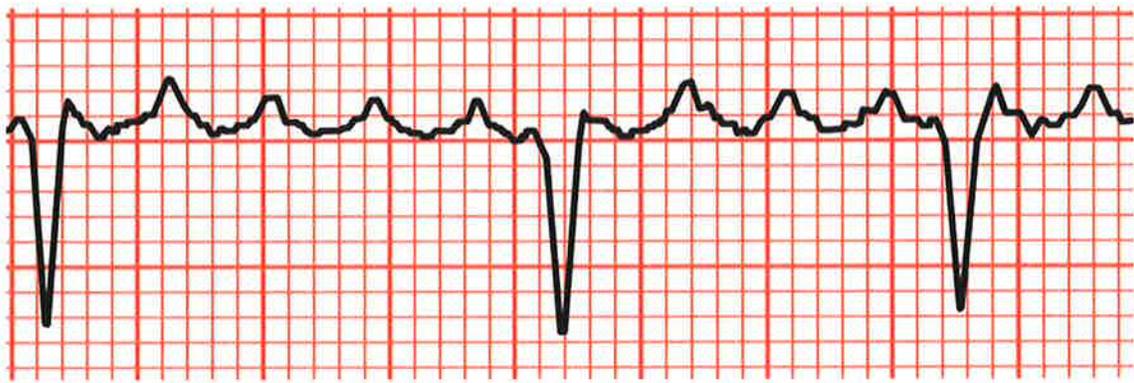


The above figure demonstrates the stanza after being dissected for changes in meter. From the very first line, the iambic tetrameter is broken. Though still written in tetrameter, the verses now consist of metrical feet distinct from the standard iamb. The spondee consists of two stressed syllables (“blood creeps”), while the pyrrhic consists of two unstressed syllables (“and the”). Additionally, the trochee (“When the”) is an inverted iamb, being a stressed followed by an unstressed syllable. By the final verse, he again returns to iambic tetrameter.

According to Dr. Rosenberg in his book *Victorian Poetry*, the absence of Tennyson’s friend is felt “with special keenness” in “the panic of Section Fifty.”⁵ He states that the hard “work of mourning collapses” at this particular point in his elegy, just as the difficult adherence to his metric pattern collapses too. Rosenberg calls this an “anxiety attack” and a “regression into terror.” He states that the “fear of darkness” implicit in his verse (“when the light is low”) is a “palpable, physiologic fear.” Rosenberg’s assertion that the poet himself is finally, at this point in the poem, truly

expressing his inner emotional state gives even more credence to examining how his sudden metrical shifts demonstrate his physical autonomic shifts.

The first line both begins and ends with a spondee, whose two back-to-back stressed syllables would be converted into S2S2 in our translation criteria. By heart rhythms, this would then be indicative of two diastolic phases without an intervening systolic phase. This type of erratic atrial contraction without demarcation by a ventricular contraction is termed atrial flutter.



Atrial flutter, while marked by repeated atrial contractions with insufficient amounts of blood being delivered to the ventricles (and thus to the body), is also a common cause of tachycardia. Though Tennyson's stanza still contains tetrameter, the repeated spondees and metric shifts quicken the pace of the verse, emphasized too by his final stanza which returns to the slower, plodding iambic tetrameter and concluded by his sentiment of the "wheels of Being" becoming "slow."

In a recent JAMA article, "Acute Emotional Stress and Cardiac Arrhythmias," researchers state that emotional stress is a common triggering factor identified by patients with atrial fibrillation.⁶ Episodes of atrial fibrillation are often initiated and maintained by ectopic impulses originating in myocardial cells in the pulmonary veins near their connection with the left atrium. Studies in dogs have shown that stimulation of autonomic

ganglia and combined parasympathetic and sympathetic nerve stimulation may lead to spontaneous activity of these cells, resulting in atrial fibrillation. Analogously, in humans, emotional stress may directly stimulate or alter the balance of autonomic input in these areas and lead to the initiation of atrial fibrillation. Finally, in addition to the repeated spondees, another metric variation is seen in the incorporation of repeated pyrrhics, consisting of two back-to-back nonstressed syllables, or S1S1. This would translate into two ventricular contractions without an atrial contraction, or ventricular arrhythmia. In the JAMA article, scientists postulate that lateralization of cerebral activity during emotional stress may stimulate the heart asymmetrically and produce areas of inhomogeneous repolarization. Recent evidence has shown that this asymmetric brain activity and subsequent electrical instability facilitate the development of ventricular arrhythmias. It has been estimated that at least 20% of episodes of serious ventricular arrhythmias are precipitated by intense or unusual emotional stress, in the setting of already reduced ventricular function. This percentage may be misleading, however, in that it is circumstantial and relies on patient recall and/or eyewitness reports.

One way of making the correlation between emotional stress and ventricular arrhythmia more objective is by monitoring patients with intracardiac devices (ICDs), which provide a record of arrhythmias which can be temporally related to discrete episodes of emotional stress. An ICD delivers a shock of electricity to the heart when it begins to beat out of rhythm, in order to “reset” the heart back to regular sinus rate and rhythm. In a study performed by Lampert et al, patients with ICDs recorded their activities and emotions during the two hour to 15 minute time period preceding an ICD shock.⁷ As a control, they were also asked to complete a second diary page 1 week later

on the same day of the week and time of the day they originally received the shock. The authors examined 107 shocked ventricular arrhythmias from 42 patients and found that anger was significantly more likely to be identified by patients in the time immediately preceding a shock than in the corresponding control period.

Although Tennyson's meter and tone are reflective of a man attempting to temper his grief, they are not indicative of a man with mental illness. His adherence to his strict metric form, with just a few bouts of panicky derailment, demonstrates his insight into, and management of, his struggle. The writing of the poem itself, which both begins and ends with calm stanzas of iambic tetrameter, is clearly a therapeutic process for Tennyson. By contrast, William Shakespeare, in his play "King Lear" portrays a man whose emotional burden precipitates his descent into depression and psychosis.

"King Lear," first printed and performed in 1608, is a five act play depicting an elderly king who, deciding that it is time to retire, vows to give his kingdom to the one of his three daughters who proves she loves him best. The two elderly daughters proclaim their love being more than anything else in the world, while the third daughter honestly claims that she has nothing to compare her love to nor words to properly express her love, and thus cannot make such remarks. Lear disowns his youngest daughter and splits his kingdom between his two eldest daughters. After living with daughters and their husbands, Lear learns that his daughters flattery was only aimed at obtaining his kingdom, and that they have betrayed him. Lear rushes out into a giant storm to rant against his ungrateful daughters, transitioning from anger and embarrassment at his earlier follies to florid psychosis as he faces the French army, stating that the whole world is corrupt. Lear and his youngest daughter are captured in the war between the British and

the French, and ultimately Lear carries Cordelia's corpse. Urged to resume the throne, Lear is overwhelmed by his trials and refuses, ultimately dying.⁸

King Lear's descent into madness, propagated by his daughters' betrayal, and exacerbated by the fall of his kingdom and death of his youngest daughter, can be traced not only by tonal shifts but also by alterations in poetic meter. The great majority of "King Lear" is written in blank verse, which is non-rhyming iambic pentameter. This segment, taken from the first act, portrays Lear's reaction to his youngest daughter Cordelia's lack of flattery:

Thou hast her, France: let her be thine, for we
Have no such daughter, nor shall ever see
That face of hers again. Therefore be gone
Without our grace, our love, our benison.

Though clearly upset, Lear's composure, as measured by his ability to adhere to meter, is intact. Each line contains five distinct iambs, and two complete thoughts/sentences are contained in the four lines.

Blank verse is maintained throughout the first three acts of the play, as Lear's mentation, though bruised by Goneril's betrayal, is upheld by his belief that he will find solace in the company of his middle child Regan. Once betrayed too by Regan, Lear's hold on his sanity breaks, and he rushes out into the coming storm. Prose, the ordinary utilization of speech devoid of poetic meter or rhythm, is introduced as Lear runs out into the storm, ripping off his clothes.

What, have his daughters brought him to this pass? (5 iambs)

Couldst thou save nothing? Didst though give them all? (5 iambs)

As he first enters the storm, his anger and incredulousness increases, though his meter remains constant iambic pentameter.

Death, traitor! Nothing could have subdued nature
To such a lowness but his unkind daughters.
Is it the fashion, that discarded fathers
Should have thus little mercy on their flesh?

As the storm worsens proportionally with Lear's mood, his iambic pentameter begins to loosen. And finally, as the scene ends and Lear begins tearing off his clothes, his adherence to meter completely dissolves:

Why, thou wert better in thy grave than to answer
with thy uncovered body this extremity of the skies.
Is man no more than this? Consider him well. Thou
owest the worm no silk, the beast no hide, the sheep
no wool, the cat no perfume. Ha! here's three on
's are sophisticated! Thou art the thing itself;
accommodated man is no more but such a poor bare,
forked animal as thou art. Off, off you lendings!
come unbutton here.

Lear's rampant, disorganized speech increases in intensity as his meter unfurls.

Metrically, pictorially, and verbally Lear in every sense embodies "the madman" of Shakespeare's time. Viewed through the lens of modern day geriatric psychiatry, Lear's differential diagnosis would include pseudodementia, dementia, and acute delirium.⁹

While depression typically presents with depressed mood and anhedonia, depression in

the elderly can present more like dementia, with the patient demonstrating declining cognitive ability, or the capacity to think and reason clearly. Additionally, patients can present with an agitated depression, exhibiting some of the transient irritability and psychosis that Lear demonstrates by running out into the tempest and removing his clothes. Here, his loosening meter mirrors his swiftly disorganizing mental status, as his worsening baseline dementia escalates into an acutely altered delirium. Delirium can be precipitated frequently in the elderly by common conditions such as urinary tract infections or pneumonias. The hallmark of delirium is that the patient returns to baseline following resolution of symptoms, just as Lear does with the clearing of the storm.

Sylvia Plath, American poet, short-story writer and novelist born in 1930's Boston, was a highly acclaimed artist whose own mental illness both inspired her work and ultimately culminated in her suicide. Plath's metrical style grew with her work and with her worsening descent into depression.¹⁰ Early in her career, her poems were carefully composed, consisting largely of rhyming tetrameter, and stanzas segmented by syllable number, as in "Full Fathom Five," in which each of the fifteen stanzas follow a scheme of three lines each, the first line having seven syllables, the second having nine syllables, and the third having five. By the end of her career, she is said to have crafted her poems more hastily, speaking the poems in "ear-count," rather than plotting them out by syllables and stanzas. Plath is said to have spoken the poems "out loud as they came in the urgent and accelerating rhythms of her own voice".¹¹ Her resulting meter was much more erratic and tonally emotional, as she herself rapidly spiraled into a debilitating depression and ultimately suicide.

The large-scale tonal and metric unloosening that can be traced over the course of Plath's life can be witnessed to a smaller extent over the course of some of her individual poems later in her career. Her 1962 poem, "Daddy," is written from the first-person perspective of a young girl handling the death of her father, a Nazi, and her resulting relationship with her Jewish mother. The poem was published posthumously, and was considered one of the greatest poems of the 20th century.¹² Per BBC interview with Plath (citation), the young girl has "an Electra complex," a term introduced by psychologist Carl Jung to describe a girl's psychosexual competition with her mother for possession of her father. The girl believes that her father is God, which complicates her grief and exacerbates the paralysis she already feels as a result of her parents' paradoxical socio-political affiliations.¹³ The poem begins:

You do not do, you do not do
Any more, black shoe
In which I have lived like a foot
For thirty years, poor and white
Barely daring to breathe or Achoo

The first line, written in iambic tetrameter, is hyperbolically regular and simple, with the sing-song predictability of a nursery rhyme. Plath employs this intentionally, to both introduce us to our young, naïve narrator, and then later to do just the opposite, in juxtaposing her supposed innocence with the brutality of her words in the coming stanzas. In the second line, Plath interposes an anapest (two unstressed syllables followed by a stressed [an-y-MORE]), followed by a spondee (two stressed syllables [BLACK-SHOE]), but keeping the end-rhyme scheme (do, shoe). This second line's significance

lies in its strong juxtaposition structurally to the sing-song regularity of the first line. Her meter has become forcefully, and suddenly, arrhythmic. One could argue that she further highlights this incompatible-with-life rhythm by going on to employ images of a pulseless extremity (foot that is “poor and white”) and that is “daring to breathe.” The rhythm, like the foot, and the spirit of the young girl, has been arrested.

Throughout the poem, Plath makes multiple references to the heart, both as emotional and physiologic organ. She refers to the “brute heart of a brute like you,” the “black man who bit my pretty red heart in two,” and the “stake in your fat black heart.” Her imagery of respectively sick, broken, and necrotic hearts underpins her increasingly irregular rhyme scheme and meter. For instance, her next stanza:

Daddy, I have had to kill you.
You died before I had time—
Marble-heavy, a bag full of God,
Ghastly statue with one gray toe
Big as a Frisco seal

This stanza, where she first declares that her father is dead, consists entirely of free verse—a poetic convention defined as having no fixed meter and no end rhyme. It is, appropriately in this instance, analogous to asystole or pulseless electrical activity. Chronic depression, as well as acute anger and psychiatric distress, have both been implicated as significant risk factors in both coronary artery disease and cardiac arrest. In a study of over 2,000 men and women, depression was found to increase the risk for cardiac mortality in subjects with and without cardiac disease at baseline.¹⁴ The excess cardiac mortality risk was more than twice as high for major depression as for minor

depression. In the poem, the narrator refers to two deaths—both hers and her fathers (“I was ten when they buried you, at twenty I tried to die”). The rhythm is intrinsically tied to the heartbeat of the narrator, but by correlating the atypical rhythm with the imagery of her father’s death, Plath emphasizes the ironclad link between the psychiatric wellbeing of the young narrator and the psychological health of her father. Interestingly, acute anger, such as that depicted by Plath in this poem, has been linked to both ventricular arrhythmia and to its refractoriness to medication. A study at Yale Medical School found that when ventricular tachycardia was induced during mental arithmetic and anger recall (either serially subtracting 7 rapidly from a 3-digit number with mistakes corrected harshly or discussing an annoying or frustrating event while being asked irritating questions), it was faster and more difficult to terminate than it was without exposure to this stressful experience.¹⁵

When making a case for the depiction of psychiatric illness as linked to cardiac mortality within both the meter and imagery in Plath’s poetry, it is significant to expand upon what some have termed the “Sylvia Plath effect,” or the statistically significant preponderance of mental illness in eminent female poets, as compared to other types of creative writers.¹⁶ In one study 1,629 writers were analyzed for signs of mental illness, and female poets were found to be significantly more likely to suffer from mental illness than female fiction writers or male writers of any type. A second study extended the analysis to 520 eminent women (poets, fiction writers, non-fiction writers, visual artists, politicians, and actresses), and again found poets to be significantly more likely to experience mental illness.

Since the beginning of poetry, critics have used meter and rhythm, verse and stanza, to gain a deeper, more intuitive understanding of the emotions and thoughts of the speaker. By expanding this critique to include meter as not only a marker of the intended temperament of the poet's invented speaker but also an analogy for the corporeal heartbeat of the poet himself, we can uncover greater subtlety and insight into the poet and his craft. By viewing poetic meter through the fundamentals of basic modern cardiology as well as through nuance gained through evidence based scientific research, we unearth and restore the acclaimed works of Shakespeare, Tennyson, and Plath, giving them new meaning and revitalized relevance.

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