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Mind Out of Time: Wordsworth and Neurophenomenology

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If literary art evokes extraordinary forms of cognition in principled ways, then theories and distinctive practices of poetics should prove illuminating for cognitive science. The question is, how to operationalize such theories and practices for controlled experimental study? This paper proposes an answer in terms of the neurophenomenological paradigm developed by Francisco Varela and his students, which seeks to correlate first-person (subjective, introspective) accounts of cognitive experience with third-person (objective, neurophysiological) measures. Given striking correspondences between the neurophenomenological theory of cognitive “transparency” and “breakdown” and the Romantic poetics of defamiliarization, I adopt the Wordsworthian “spot of time” as a test case and use standing literary-critical description to formulate specific neurophenomenological predictions about its defamiliarizing effects.

The arts can be defined as technologies of sensation, emotion, and imagination, that is, as objects or instruments that are adapted to the mind that makes and experiences them. Perspective in visual art is thus both a product and a manipulation of the depth-processing capacities of our visual system, just as the range of notes on an 88-key piano answers to and thereby addresses the limited range of human audition. Film-making is similarly constrained by the mind it entertains. For instance, the number of frames projected per second, traditionally 24 to 25, corresponds to the lower temporal threshold of consciousness, 40 milliseconds, which for humans constitutes a minimal “point in time” (Pöppel, “Windows” 1887). Any fractioning of this minimal temporal unit is (naturally) imperceptible to us: the new sequence will still appear as a simultaneity, as was neatly illustrated in an experiment in which a 20ms green flash was followed by a 20ms red flash, and subjects uniformly reported seeing a single yellow flash (Ephron 527).

Just as the technologies of visual, musical, and film media are necessarily (and wonderfully) adapted to the natural capacities of the human cognitive system, so too are the technologies of literature. Indeed, literary technologies (“techniques”) are arguably still better adapted because the verbal medium is in its very substance a *construct* and not just an *exponent* of human cognition. In contradistinction to the more materially constrained arts of painting, sculpture, song, and dance and the more socially restrictive arts of law and religion, literary art may be enabled by its essentially symbolic and readily manipulable medium to express more clearly and completely the creative imagination that underlies it. “This springs,” Percy Shelley argued in *A Defence of Poetry*,

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from the nature itself of language, which is a more direct representation of the actions and passions of our internal being, and is susceptible of more various and delicate combinations, than colour, form, or motion, and is more plastic and obedient to the control of that faculty of which it is the creation. For language is arbitrarily produced by the imagination, and has relation to thoughts alone; but all other materials, instruments, and conditions of art, have relations among each other, which limit and interpose between conception and expression. (7.113)

If Shelley is right that literary expression is an especially direct reflex of the imagination, it follows that the structures of such expression would have something important to tell us about underlying structures of human “conception.”

A similar hypothesis – only with the key terms reversed – lies at the foundation of cognitive literary studies: underlying structures of human conception, of “everyday” cognition and conceptualization, have much to tell us about structures of literary expression. This insight, first advanced by Mark Turner, Ellen Spolsky, Raymond Gibbs, Jr., and others some thirty years ago, predetermined the dominant practice of the new field, whereby cognitive-scientific theories and models are brought to the study of literature, in the best instances energizing criticism, contextualizing poetics, and constraining theory. But the everyday mind/literary mind isomorphism cuts both ways, and at this stage of the interdisciplinary game, literature and literary study may prove no less revisionary for cognitive-scientific inquiry and research. Just as cognitive approaches suggest new explanations for the old “data” of literature and literary criticism, these same well-documented data can (and therefore should¹) inform appraisal and, where appropriate, adjustment of the hardly-tested hypotheses upon which the new cognitive approaches are based.

To pursue this line of investigation is to grant that literature arises from the everyday mind or ordinary structures of cognition but to leave open the possibility that it exercises these underlying structures in extraordinary and therefore extraordinarily revealing ways. The power of verse to induce extraordinary experience was of course an article of poetic faith for the Romantics. For Coleridge, a “cardinal point” or purpose of poetry was to “awaken . . . the mind’s attention from the lethargy of custom,” as it were removing a “film of familiarity” from the reader’s “eyes,” “ears,” and “heart” and thereby “giv[ing] a charm of novelty to things of every day, and . . . excit[ing] a feeling analogous to the supernatural” (2.5–6). Or as Shelley put it in *A Defence*, echoing and extending Coleridge’s claim from a species to the genus: poetry “reproduces the common Universe of which we are portions and percipients, and it purges from our inward sight the film of familiarity which obscures from us the wonder of our being” (7.137). To translate these Romantic definitions into the parlance of cognitive literary studies: the “everyday mind” – which Shelley characterizes in terms of “the recurrence of impressions blunted by reiteration” – is not so much poetry’s template as its target. In the production and reception of poetry, familiar, customary ways of sensing, feeling, and thinking are to be strategically – i.e., formally – disrupted, so that the mind can catch a glimpse of the marvelous complexity (“the wonder of our being”) it arises from and yet, through the lethargy of habit, routinely conceals.

Given such explicitly theorized psychological purpose, cognitive literary scholars have made Romantic-era literature and literary theory a frequent (if not yet quite habitual) object of study. Instructively, in discerning the specifically *literary* means by which Romantic poetry measures up to the defamiliarizing poetics of its era,² cognitive literary critics are often compelled to supplement and even challenge the cognitive theories and models they have brought to bear. Insofar as these theories and models

confine their explanatory attention to everyday or familiar cognition, they will fail to capture or clarify the extraordinary features and qualities of poetically-induced cognition. Conversely, insofar as it *does* capture or clarify the extraordinary features and qualities of literary experience, cognitive literary studies will prove itself indispensable to the wider project of the cognitive sciences.

In his latest book on “cognitive theories and Romantic texts,” Alan Richardson anatomizes this defamiliarizing and cognitively revealing imperative in English Romantic poetry, dubbing it “the neural sublime.” Echoing Shelley’s echo of Coleridge to the effect that poetry “strips the veil of familiarity from the world” (7.137), Richardson suggests that the new poetics of neural sublimity corresponds to the period’s “emergent sense of the brain’s awesome complexity and capacity,”³ but “owes still more to the [poets’] desire for at least a negative encounter . . . with what might be called a ‘brain’s eye view’ of the world, a view stripped . . . of the usual overlay of conceptual and linguistic categories, an unfiltered and unedited encounter with the real” (37). Richardson characterizes this “negative encounter” chiefly in terms of powerfully embodied experiences undergone by the *poet*, experiences that “short . . . out the conceptual grid through which [he] ordinarily perceives . . . the material world” and thereby “offer . . . an intuition of what is ordinarily subsensible” (34–35). The *reader* or *auditor* of Romantic verse, however, cannot undergo quite the same embodied experience (e.g., Wordsworth ice-skating or Alastor swooning) but may instead undergo an analogous one effected by the formal structure of the verse.

Nancy Easterlin pursues this structural angle in a cognitive study of Coleridge’s “Dejection: An Ode,” arguing that the poem’s “overabundance of metaphors” – a plenitude which reveals the poem’s “artificial” status “in comparison with everyday cognition” – “likely inhibits” rather than excites the processes of image-schematic priming, projection, and integration that are supposed in the cognitive theory of “conceptual blending” to govern everyday perception and thought (193, 202). Coleridge’s poem thus creates an effect that “is rather the reverse of the account of emergent structure in conceptual blending”: “whereas conceptual blend theory suggests that new structure is created when double-scope capacities merge aspects from different domains, Coleridge’s metaphoric substitutions undermine the sense of a coherent semantic whole and as a consequence emphasize the fragmented nature of experience and feeling” (203). Independently of Easterlin, I undertook a cognitive study of the overloaded metaphorical structure of Shelley’s “To a Skylark” and arrived at virtually the same conclusion: “Shelley’s complexly metaphoric verse . . . orients attention not to emergent meanings or achieved mental representations but rather to the underlying *processes* of meaning-making and representation that precede, produce, and ceaselessly replace any such *products* of (literary) cognition” (“Harmonious Madness” 619). The convergence of our independently produced results suggests that poetic structure can indeed be manipulated to create exceptional, and exceptionally revealing, cognitive effects. If so, that structure and its correlated effects may be reproducible in controlled circumstances, with an eye toward refining cognitive theories (of metaphor, blending, mindreading, etc.) that must finally account for such outlying literary phenomena.

The balance of this paper will pursue this idea of fruitful transfer from (Romantic) cognitive literary studies to cognitive science by considering how a Wordsworthian spot of time might be “operationalized” for study within the experimental paradigm of neurophenomenology. Richardson has sensibly cautioned against the possible anachronism involved in reading the Romantic poetics of the embodied mind in terms of any cognitive science except that with which it was contemporary, yet he has also

spelled out clearly and sensitively the compelling reasons one might nevertheless take that risk, which in Wordsworth's case are indeed considerable (*British Romanticism* 91). Moreover, if, as Richardson suggests, "the most significant area of divergence between Wordsworth's thinking on language and the primary concerns of recent cognitive theorists" is Wordsworth's emphasis on "passion or emotion," this is probably his most significant area of *convergence* with neurophenomenological theorists, who make common cause with him "in granting a primary role to feeling and emotion within an embodied and ecological understanding of mind and culture" (90–91).

Indeed, neurophenomenology converges theoretically with Wordsworth's poetics in more than just this one regard. In a lengthy article from 2003 that "reviews in detail [the late] Francisco Varela's work on subjectivity and consciousness in the biological sciences," Varela's students explain that his theory of neurophenomenology rests on three related hypotheses: "autopoiesis, operational closure and circular causality" (Rudrauf et al. 46). The first, autopoiesis, proposes that living systems may be defined by "the evidence of a unitary nature, a coherent wholeness, an *autonomy* that is 'brought forth' by the system itself"; "the living being is a *process*, that of 'being autonomous'" (31). This self-generating and self-delimiting process is "operationally closed": not impervious to the environmental surround but self-identically divided from it, however permeable the border. The operations of a cell are thus distinct from yet essential to the operations of an organ, as those of organs are distinct from yet remain essential to the operations of a human being. Moreover, these "closed" or autonomy-producing operations involve a "circular" or reciprocal causality in which local causes produce global effects that cause (or "bias") those local operations to produce just such effects. In the words of Rudrauf et al.,

In such a process . . . there is mutual specification or definition of the internal chemical transformations and of the physical boundaries . . . Identity *emerges* and *persists* within the bounded system through a continuous circular or recurrent process. Specific organizational *relations* (like the ensemble of biochemical pathways of the cell and its membranes), bounding the metabolism and the physiology of the system, are continuously regenerating through the internal production of their substratum components (cell organelles and structures, molecules controlling the metabolism) in the correct functional, dynamical and spatial distribution. In other words, the system continuously produces *itself* through the production of its own components in the topological distribution that the ongoing global process constrains, and that the components require to maintain the relations that define them. (32–33)

The systemic features of autopoiesis, operational closure, and reciprocal causality have at least metaphorical relevance to the self-constructive dynamics of *The Prelude* and Wordsworth's related autobiographical poetry, but I am interested here in two further developments of Varela's thought that lead us beyond the mind of the poet (which is after all irrecoverable) to those of his readers (which are, in principle at least, available for study). Shortly before his death, Varela turned his attention to the emergence of cognition from what he termed, in keeping with Heidegger's phenomenology, the "transparency" of lived experience. In daily experience, we tend to be unaware of our sensations, intentions, and actions, but rather live them unthinkingly, automatically. The mind rises to awareness only when habitual expectations and routine behaviors are interrupted by what Varela called "breakdowns." As Rudrauf et al. explain, Varela referred "to the Heideggerian paradigm of the field of relations and tools in which we are living transparently: turning lights on and off, walking down the street, etc. For Heidegger, cognition and awakening appear when some

situation of dysfunction occurs: my key doesn't work in this lock, I don't find my wallet in my pocket" (57). In other words, Varela accepted as a general cognitive fact that only defamiliarizing stimuli bring the everyday mind into self-disclosing activity. These breakdowns in experiential transparency are in the first place *felt* rather than *thought*, which suggested to Varela that "all cognitive phenomena are emotional-affective" . . . Going even further, he considered affect as '*generative for consciousness itself* . . . , as a cause of transition from one moment of consciousness to another as well as a cause for the emergence of subjectivity itself' (58–59).

Intriguingly, Varela correlated this affective ground of (self-)consciousness with imagination, which he envisioned not as a faculty of mind informed by the sense and informing the understanding (à la Kant) but rather as a preconscious, oceanic background out of which sensation and understanding arise and over and against which they are discriminated. From this point of view, perception appears as "constrained imagining" (Varela and Depraz 200), that is, as a sensory-motor delimitation of an ongoing, self-producing, and otherwise free-form process of mind. Varela's theory, much like Coleridge's in *Biographia Literaria*, posits the primary activity of imagination as the dynamic source of consciousness, sometimes constrained by sensory-motor perturbations (as in perception) and sometimes not (as in dreaming or sensory deprivation). But even within perception, constraint turns out to be a product not only of impinging stimuli but also of memory and prospection. Varela and his colleague Natalie Depraz develop this idea with reference to the phenomenology of Husserl:

Husserl realized that imagining as the presence of the nonpresent is, in essence, a property of how the living, specious present is constituted. In every moment of now there is surely the just present, which is full of perceptual content. But one of the subtleties that a careful phenomenology of the present reveals is that together with the perceptual or (as we shall say) *impressional* consciousness of inner time there is also another time consciousness that is proper to imagination, remembrance, and fantasy, which we will refer to as *reproductive* consciousness . . . In other words, the very core of our temporality is an inseparable mixture of these two modes of apprehension.

The mixture of these two concurrent forms of consciousness means that they are constantly (at every present moment) emerging from a background that is prereflexive or prenoetic, that is, unconscious. From this floating background a constant self-constitution shapes a living present where the impressional and the reproductive coexist. This background's capacity for such recurrent manifestations is reflected in its affective or emotional quality, rather than being a neural or mechanical process. This can be cast also as the performative nature of memories acquired over a life of habits or intense learning . . . (211)

If this seems heavy going, consider that it essentially recapitulates the temporal dynamics of the Wordsworthian spot of time, which concerns precisely the imaginative blending of sensational or "impressional" and memorial-imaginative or "reproductive" forms of consciousness. The poet's "self-constitution" in a spot of time involves a doubling of temporally disjunct perspectives that comes to awareness in the first instance as an "affective or emotional quality" – a feeling of feeling coming in aid of feeling, creating (the experience of) a self-reflecting continuity, or identity, over time.⁴

What's more, because of its poetic form, the spot of time appears to reproduce the phenomenal experience of blended past and present (in Varela and Depraz's neat phrase, "the performative nature of memories") that it sets out to describe. As I've argued elsewhere ("Time as Space"), among its many other functions Wordsworthian scholarship provides a rich record of empirical testimony to this distinctive cognitive effect. Especially revealing are the metaphors deployed to capture the reader's

experience of what Varela would describe as the phenomenological “co-presenting” of “reproductive” (memorial) and “impressionist” (sensational) forms of consciousness, not just in the poet’s mind but, thanks to the poetry, in his reader’s as well. Colin Clarke, for instance, reports effects of “double-exposure,” Geoffrey Hartman of something akin to an “after-image,” Isobel Armstrong of a “palimpsestic layering” of past and present experiences. One could argue that Wordsworth’s self-reflective *theme* biases these critics’ self-reports, but they and many others before and after them (beginning with Coleridge and carrying through to yours truly) conscientiously link their cognitive-affective experiences to the specific verbal structures at play in the verse in question. Here, for instance, Hartman analyzes the characteristic cognitive effect that Wordsworth achieves through his recurrent and sophisticated use of chiasmus. The example at hand is a verse fragment from the Alfoxden notebook – “solemn dreams, / Dreams beautiful as the fair hues that lie / About the moon in clouds of various depth, / In many clouds about the full-orb’d moon” – about which Hartman observes,

Much of the fragment can be plotted as a series of rhythmic phrases whose ABBA (chiasmic) form draws motion out of convergence. Solemn (A) dreams (B), dreams (B) beautiful (A) is such a pattern expanding from three syllables to four; while the next two lines are a fine self-rounding instance with the repeated nouns made fuller; moon, full orb’d moon; in clouds, in many clouds. Almost any passage of “Tintern Abbey” will show this style perfected. There is a drawing out of words into doublets, gradual expansions that blend thought with thought, link feeling with feeling, yet the whole, though constantly expanding, falls inward like circles emphasizing their concentricity:

that blessed mood,
In which the burthen of the mystery,
In which the heavy and weary weight
Of all this unintelligible world
Is lighten’d: – that serene and blessed mood . . . (178)

Hartman here sees deeply into the mysterious life of Wordsworth’s verse, locating in well-plotted rhetorical patterns of repetition, inversion, and variation those effects of temporal doubling – the “blending” of “thought with thought,” of “feeling with feeling” – that ground his metaphor of the “after-image,” which he takes to be, following Wordsworth and anticipating Varela, “a formal part of the structure of experience” (207).

Both Hartman’s characterization of his experience as a reader of Wordsworth’s verse and his analysis of the verse structures that prime that experience may be convertible to the basic experimental paradigm of neurophenomenology, which seeks to correlate first-person (subjective and mental) and third-person (objective and physical) accounts of one and the same cognitive phenomenon. This design makes explicit and takes seriously cognitive psychology’s inescapable dependence on introspection (see Bruhn, “Romantic Reflections”), thus avoiding the reduction of mental experience to neuronal expression. Instead, “the aim is to integrate the phenomenal structure of subjective experience into the real-time characterization of large-scale neural operations. The response to [this] challenge is accordingly to create experimental situations in which the subject is actively involved in identifying and describing experiential categories that can be used to identify and describe dynamical neural signatures of experience” (Lutz and Thompson 42). In Hartman’s first-person report of his subjective experience, we may find preliminary indications of “experiential categories” that do in fact unfold in “the real-time” experience of Wordsworth’s verse. The “after-

image” effect, for example, may be hypothetically formulated as a cognitive experience of temporal succession being converted to spatial juxtaposition (the technical phrase is Coleridge’s; see Bruhn, “Time as Space” for discussion). Hartman’s metaphor of a “constant expansion” in the sequence that nevertheless seems to “fall inward concentrically” rather than pushing onward linearly would seem to confirm that he is describing an experience of time-to-space conversion, in which “motion” appears as an amplifying product of processes of convergence. Just as Hartman’s introspective report of particular cognitive effects may be translated into hypotheses of experiential categories or “phenomenal invariants” – that is, “categorical features of experience that are phenomenologically describable both across and within various forms of lived experience” (Lutz and Thompson 32) – so his expert analyses of Wordsworth’s verbal artistry might be recruited to the task of formulating experimental conditions with which to prime and measure “the dynamical neural signatures” of these hypothesized categories or invariants.

When it comes to predicting the distribution and amplitude of the dynamical neural signature that might correspond to any particular literary effect, the literary critic must in practice give way to the trained neuroscientist, and that I am not. But for the sake of argument and illustration, I will proceed on the following assumptions about neural dynamics and the experimental paradigms available to measure them. To begin with, we cannot expect to “locate” the affectively-regulated imagination or its phenomenological features (such as unity or integration, multi-modal imagery, spatio-temporal dimensionality, etc.) in this or that region of the brain. Though neural dynamics reveal constant local fluctuations in activity, these fluctuations are caught up in, and therefore strongly conditioned by, global patterns or oscillations that radiate across the entire brain. As Varela and Depraz put it, “one cannot hope to find a naturalized account of imagination as some sort of cognitive module or brain region. It must necessarily correspond, instead, to a dynamic, emerging global pattern that is able to integrate the body/brain activity at a large scale and subside rapidly, for the benefit of the next moment of mental life” (202).

The rapid emergence and subsidence of the “global pattern,” whereby one moment gives way to “the next moment of mental life,” must somehow correspond to the two- to three-second interval that structures our cognitive experience of “now” or “the present,” which is after all not a *point* in time – 40ms – but rather a brief *duration* of time – 2000–3000ms (Pöppel “Windows”). Bi-stable imagery such as the Necker cube, the duck–rabbit figure, and the lady–hag figure (see Richardson, *Neural Sublime* 17ff.) provides striking evidence of this window of presence: for most people, such figures reverse pattern spontaneously every two to three seconds, a phenomena which neuroscientists explain as a process of “refreshment” in which the brain-mind attends preferentially to new information and accordingly sees the “other” pattern in the bi-stable figure (Pöppel “Windows” 1892; Evans 27). Additional evidence for a two to three second window of now-awareness comes from across the cognitive sciences: visual attention studies, sensorimotor synchronization studies, gestural studies, and, notably for our purposes, studies of memory and speech (Pöppel “Windows” 1892; Evans 22–23).

The constantly refreshing global pattern that underlies and correlates (not directly but isomorphically) with the cognitive now emerges from and biases local neuronal activity, creating experiences of continuity over time. For example, in reading an essay, one’s intentional direction of attention to linguistic processing produces a moment-by-moment enhancement of neural activity in some areas (Broca’s and

Wernicke's areas, but also areas involved in attention modulation in the prefrontal and parietal cortexes) and inhibition of activity in other areas (e.g., areas of the sensorimotor cortex involved in interoception and proprioception that would be enhanced during exercise or therapeutic visualization). Generally speaking,

the large-scale integrative state that underlies a moment of newness is capable of *accessing any local neural process*. Stated bluntly, this means that a mental state has agency and causal power over the very substrate that it needs to arise from. In other words, a unitary emergence is, by constitution, a double, or two-way, passage between two levels . . . This global-to-local action is constitutive because it shows up as order parameters in the dynamics and is mediated by means of the reciprocal and extensive inter-connectivities in the brain and the organism itself. (Varela and Depraz 212–13)

“Order parameters in the dynamics” is another way of saying “dynamical neural signature”: the claim here is that intentional and attentional mental states (for example, seeing a bi-stable image, reading an essay, meditating, etc.) may be correlated with order parameters that emerge in the global pattern over the span of time in which that intention/attention is in force. This is where first-person mental experience and third-person neural quantification meet.

With these premises concerning cognitive and neural dynamics, we can address the question of experimental approach. In Wordsworth's spot of time, the “palimpsestic” effect of “double-exposure” has been described as “the renewal of the past in the present” “despite time” (Hartman 269–70) or “a strange blend of present and past” (Clarke 65). The critics are evidently characterizing an effect of working memory, in which ideas and effects cued by the aspects of the sequence already read (the past) are refreshed by being reinvoked further along the sequence (the present; compare Hartman's analysis of Wordsworth's chiasmi). Because the critics' working memories and present perceptions are of linguistic forms (perceived partly through the senses, but fully instantiated in terms of semantics and imagery only in the mind), the after-image effect should involve persistent and perhaps distinctive activation of the verbal working memory. Verbal working memory is not so much a subdivision of a putative “working memory module” but rather one of the many different forms working memory can take. Like imagination (and arguably co-extensive with it), working memory is not a place in the brain but a function of the global pattern, which can preferentially and selectively maintain, by persistently refreshing, activation in any part of the brain. The cognitive-neuroscientist Mark D'Esposito thus suggests that “verbal working memory may be conceptualized as involving sustained activation of all relevant pre-existing cortical language (phonological, lexical or semantic) representations” (14). This “active rehearsal is hypothesized to consist of the repetitive selection of relevant representations or recurrent direction of attention to those items . . . Similar mechanisms may be involved in active maintenance of visual information such as objects, which may be represented by their visual features (e.g. size, colour, texture, shape) as well as verbal information associated by an individual with a visual stimulus” (14). The active co-rehearsal of verbal and visual information in working memory is exactly what we mean to investigate in Wordsworth's spot of time – again, consider the visual metaphors of “double exposure,” “after-image,” and “palimpsest” to characterize a verbally cued cognitive effect.

The question now becomes, how does Wordsworth's verse manipulate the reader's verbal and visual working memories, and can we predict and detect emerging order parameters in neural data when subjects are presented with conditions replicating essential

structural features of Wordsworth's verse? In short, can Wordsworth's defamiliarizing verse (compare Clarke's "*strange* blend of past and present") be shown to have a distinct neural signature? Where and how would we begin to look for it?

In this case, we'd be seeking to measure "enhancements and suppressions of activity magnitude and processing speed" in correlated areas of fronto-temporal and visual cortex (D'Esposito 19). The possibility of taking such measurements is suggested by neuroscientists Patrik Vuilleumier and Jon Driver, who write,

Across a wide range of paradigms it has been shown that, while holding stimulus displays constant, directing attention towards or away from a particular stimulus (by making it task-relevant or irrelevant) will affect sensory neural processing for that stimulus . . . Moreover, these attentional modulations of sensory processing can have strong corresponding effects on perceptual judgments and awareness . . . Typically, sensory responses or activations are enhanced for a given stimulus when attended, relative to the same stimulus when ignored. (127)

In their own research, Vuilleumier and Driver have found that "increases in visual activation triggered by emotional [and attentional] information are usually quite specific, affecting those visual regions selectively activated by the current stimulus category, rather than a non-specific arousal effect that influences all brain areas" (137). The strongly visual and emotionally salient effects of Wordsworth's verse are cued precisely by verbal structures that "direct attention towards . . . a particular stimulus" through strategies of repetition that overdetermine the stimulus's "task-relevance." By testing these verbal structures against a set of control conditions that direct attention *away* from the particular stimulus or make it otherwise task-irrelevant, it should be possible to identify a dynamic neural signature, measurable in "activity magnitude and processing speed," for the task-relevant conditions.

Specific predictions might be cast in terms of Geraint Rees's research on visual consciousness. As Rees argues, "the most parsimonious account of currently available data is that the current contents of visual consciousness consist of a representation in primary visual cortex and ventral visual pathway corresponding to the attributes represented in consciousness, together with related activity in specific parietal (and perhaps) [*sic*] prefrontal structures" (198). In the case of verbal working memory as stimulated by Wordsworth's structures, the related activity in the parietal and prefrontal structures would include or involve the "active rehearsal mechanisms" predicted by D'Esposito, and representation in primary visual cortex would likely be, in the words of Vuilleumier and Driver, "quite specific, affecting those visual regions selectively activated by the current stimulus category" (in this case, the semantic category associated with the repeated sound-image). As Rees has shown in ingenious experiments involving binocular rivalry (a phenomenon related in its neural dynamics to bi-stable imagery), "the information encoded in early visual cortex during binocular rivalry . . . can be sufficient to reconstruct the dynamic stream of consciousness. Information that is contained in the multivariate pattern of responses to stimulus features in [visual areas] V1–V3 as recorded using fMRI can be used to accurately predict, and therefore track, changes in conscious contents during rivalry . . ." (194). To demonstrate the possibility of decoding conscious contents from neural signals in the visual and prefrontal areas, Rees and his colleagues programmed a computer to analyze the multivariate response patterns in the fMRI data. Once trained, the computer could identify, on the basis of the neural signatures it detected, not only that a subject was experiencing a reversal in a binocular rivalry condition, but also which one of the two competing figures the

subject was now focalizing. Such data suggest that the resolution of neurophysiological instrumentation and analysis is arriving at the point where it might profitably be trained upon the literary object.

The literary object is notoriously complex,⁵ however, and here it is the neuroscientist who must defer to the expertise of the literary scholar. Obviously, you can't simply strap subjects into fMRI and PET machines and/or EEG/ERP headgear and/or eye-tracking stations and record them reading through a spot of time. There are simply too many variables at play in any stretch of Wordsworth's verse to go at it this bluntly; any results would be subject to widely varying interpretation (e.g., is the measured effect a consequence of alliteration, metrical pattern or deviation, lexical or imagistic repetition, grammatical parallelism, metaphoric transfer, etc.?). What's required is a level-by-level analysis of the rhetorical, sentential, grammatical, metrical, phonological, metaphorical and other structures that are coincident in the given stretch of verse and to which any particular effect, cognitive or neural, might plausibly be attributed. Such a comprehensive analysis is beyond the scope of this paper, but for the purposes of illustration I can focus on the single, certainly critical level of discourse structure,⁶ analyzed according to the "intonation unit" model of spoken discourse developed by the pioneering cognitive linguist Wallace Chafe.

Chafe's model recommends itself particularly because it hews to the neurological insight about a two to three second temporal window framing present consciousness and feeding into (working) memory. Analyzing ongoing stretches of actual conversation in terms of pauses, pitch, accent, and duration (among other variables), Chafe has identified the fundamental unit of spoken discourse as the "intonation unit," the duration of which appears to be calibrated to the two to three second interval constituting the phenomenological "now." That duration, Chafe hypothesizes, corresponds to what he calls "echoic" memory, which we encountered above as "verbal working memory"; by either name, it is a brief period (one cycle) of active rehearsal in which the contents of a given intonation unit can be grasped as a whole (rather than a sequence) in consciousness:

echoic memory [is] the ability to shift one's consciousness of sound from the semiaactive to the active state during the first few seconds after it has ceased to be present in the air . . . Sound remains briefly available in active consciousness even if it failed to enter that state while it was physically present. This ability is clearly observable through introspection, as when we are able to retrieve something that was said to us, even though we may have been reading a newspaper when it was actually said and failed to focus active consciousness on it then. It is an ability that has a clear relevance to language, for it allows us to process sound sequences as wholes, not just "from left to right" as the sound enters our ears . . . This ability compensates, in a small but important way, for the evanescence of sound, making it briefly scannable as a whole in the way a visual scene can be scanned. (55)

Two other features affecting the intonation unit, at least as it is realized in everyday speech, are likewise characterized by Chafe in terms of cognitive constraint. The first, the "light subject constraint," dictates that the grammatical subject of a clause or starting point of an intonation unit tends not to be entirely *new* (or "heavy"), as judged in light of the unfolding discourse, the shared context of utterance, presumed world knowledge, etc. (92). The second, the "one new idea constraint," dictates that if the clause or intonation unit does introduce a new idea (it needn't), it will introduce only one and, following the light subject constraint, not in the subject position (119). These two constraints lie at the back of the familiar handbook advice to help freshman writers create "flow" in their paragraphs: each new clause should begin with an idea

already established in the discourse, with new material introduced only in the predicate. The difference in Chafe's model is that the intonation unit may be a clause but is often much less: a noun phrase, a verb phrase, a prepositional phrase, etc., with an average length (in English) of four to five words (65).

Though his model is based on spoken samples, Chafe has found evidence that written language is structured by the same or similar cognitive constraints on temporal duration, topical sequencing, and novelty. For example, Chafe had readers read an unpunctuated passage of academic prose aloud and found "that even though the writer used no punctuation at all . . . , readers are able to process language of this kind in a manner not unlike the manner in which they process speech. That, at least, is the evidence from reading aloud. Whether silent readers follow a similar pattern as they assimilate such language into their consciousness without overt sound is a major question. One might hope that a study of eye movements would be a profitable way of investigating the hypothesis that reading takes place in terms of one new idea per major period of visual attention, each such unit embracing a segment of language which, like an intonation unit, reflects a single focus of consciousness" (293). Chafe likewise suggests that, "when we turn to writing, we find that writers' punctuation units and sentences tend very roughly to imitate spoken intonation units and sentences respectively, although they often expand and elaborate them" (300). The tendency to imitate speech-like patterns and constraints may be still greater in poetry, in which the line itself is a reflex of the origins of verse in sung and spoken word and is accordingly timed, in linguistically and culturally diverse traditions, as a two- to three-second interval (Chafe 57; Pöppel "Mechanisms"; Evans 27). For the sake of argument, I will adopt the hypothesis that written language, especially in common, everyday usage, does tend to honor the same cognitive constraints as spoken language, and that in poetry, the boundaries of intonation units are typically indicated by caesural pauses and line-endings. So characterized, everyday written language constitutes an external norm against which to measure a poem's discursal, and thus cognitive, conformity and deviance.

My proof text will be the "visionary dreariness" spot of time, as rendered in the 1805 *Prelude*; my aim is to use Chafe's model to try to pinpoint where exactly in the opening stretch of this sequence Wordsworth deviates from the norms of everyday discourse and thereby produces defamiliarizing effects that might be powerful enough to generate identifiable neural signatures. To make the analysis perfectly clear, I will reproduce Wordsworth's verse as intonation units rather than lines, and I will use different styles of type to indicate the status in working memory of the information within the intonation unit: plain text for active information (i.e., evoked within the preceding intonation unit), italicized text for *semi-active* information (i.e., recently evoked within the discourse), underlined text for accessible information (i.e., not previously evoked but contextually salient – for example, the "I" and "you" of speaker and auditor – or understood as part of shared specific and schematic knowledge – for example, the topic of "restaurant" normally includes the topic of "wait-staff"), and bold text for **new** information (i.e., unprecedented in the discourse and not accessible as part of contextual or shared world knowledge). Here, then is the first period of the visionary dreariness spot of time, broken into intonation units (on the basis of caesural pauses and line-endings) and coded as described:

At a time⁷
 When **scarcely**
 I⁸ was then **not six years old**

My hand could hold a bridle
 with proud hopes
 I mounted
 and we⁹ rode towards the hills
 We were a pair of horsemen
 honest James
 Was with me
 my encourager and guide¹⁰
 We had not travelled long ere some mischance
 Disjoined me from my comrade
 and through fear
 Dismounting
 down the rough and stony moor
 I led my horse,
 and stumbling on,
 at length
 Came to a bottom where in former times
 A murderer had been hung in iron chains (11.278–89)

A Chafean analysis immediately reveals a number of interesting features in the structure of Wordsworth's discourse. We observe to begin with that – significant exceptions notwithstanding – Wordsworth for the most part does appear to honor both the light subject and one new idea constraints. The grammatical subjects of the clauses, for example, are *I, my hand, I, we, we, honest James, we, some mischance, I, a murderer*. Only “some mischance” and “a murderer,” as new and unexpected information, violate the light subject constraint, and this is surely strategic: the violations communicate shocks of surprise analogous to those experienced by the child when, first, he realized he was “disjoined . . . from my comrade” and then, “through fear / Dismounting” and “stumbling on,” discovered himself in the precinct of grisly crime and grislier punishment. Wordsworth by and large obeys the one new idea constraint as well, but he again violates it strategically at the end of the period, to overwhelming effect. Even where he abides by the constraint he nevertheless manipulates it for his thematic and affective ends. Thus, simply to list the genuinely new ideas in the period is to trace the emotional trajectory of the episode from happy expectation to hapless anxiety: *scarcely, not six years old, hold a bridle, proud hopes, the hills, encourager and guide, disjoined, fear, the rough and stony moor*. By semantically suggesting *lack* and homophonically embedding *scare*, the opening two ideas foreshadow the crisis of helplessness and fear with which the series concludes.

Having through most of the first period largely conformed to cognitively-conditioned discourse constraints, Wordsworth dramatically concludes it with two breathless intonation units, each corresponding to an entire line. Both violate the one new idea constraint by introducing two unprecedented ideas apiece; the second and final one additionally violates the light subject constraint by giving a new idea as the subject of a clause. Significantly, not only are the new ideas unprecedented, they momentarily reorient the narrative along three criterial axes: space, time, and agency. Thus, the deictic verb in the first of the topical shifts, “*Came to a bottom*,” relocates our point of view on the developing action, which had been unfolding from the speaker's mobile perspective but now seems anchored in the place in which he arrives, to which he *comes*. The immediately ensuing idea of “former times” further displaces our orientation, which now focuses not on the narrative present but on some unspecified prior time period. These radical and surprising turns of event can hardly be digested before the enjambment hurries us to the next intonation unit and the powerful shock

of “A murderer,” who unexpectedly steals the role of protagonist in the displaced time and space of the foregone past. The murderer’s presumed agency in this unanticipated scene proves to be illusory, however: the murderer is in fact a patient in the scene, the unsuspected victim of an unexpected justice (“had been hung in iron chains”). Foregrounded, which is to say cognitively amplified, by combined violations of the light subject and the one new idea constraints, the text-world-upsetting information of these last two lines must come as disorientingly out of the blue for the reader as the scene it describes did for the child who stumbled upon it in mounting terror and dismay.

The analysis thus far indicates both the sophisticated structure and consequent power of Wordsworth’s discourse practice as well as the relevance, force, and value of Chafe’s analytic in helping to uncover that structure and account for its power. We may therefore narrow our attention to the critical question: how do we operationalize Wordsworth’s structures, especially where they deviate from cognitive constraints and everyday discourse expectations, for cognitive (first-person) and neuroscientific (third-person) study? The next three periods in the sequence provide a clue:

The gibbet mast was **mouldered down**
 The bones
 And iron case were **gone**
 But on the turf¹¹
 Hard by
soon after *that fell deed was wrought*
Some unknown hand had carved the murderer’s name
 The monumental writing was engraven
In times long past
 and **still from year to year**
By superstition of the neighbourhood¹²
The grass is cleared away
 And to this hour¹³
The letters are all fresh and visible
Faltering
 And ignorant where I was
 At length
 I chanced to *espy those characters inscribed*
On the green sod
 forthwith I **left** the spot . . . (11.290–302)¹⁴

In basic structure, the first of these three periods, ending with “Some unknown hand had carved the murderer’s name,” imitates in slightly smaller space the structure of the narrative’s opening sentence, likewise culminating in a line that simultaneously violates the light subject and one new idea constraints. Because the preceding intonation units in the sentence uniformly obey these constraints, the cognitive impact of “some unknown hand” should be considerable, especially since the following new ideas, hurried on top of this one, must sustain its surprising imprint: the “unknown hand” is conceptually or schematically entailed in the act of carving and the object carved (“the murderer’s name”¹⁵). This predictable impact should also be measurable, for example in EEG/ERP and fMRI paradigms (ideally in combination as in much of the neurophysiological research summarized and cited above). Because the lexeme “hand” refers not just to an anatomical concept but to a richly embodied aspect of selfhood that is mapped across an extensive portion of the motor and somatosensory cortex, it may have a particularly distinct neural signature, especially when evoked by the strategic flouting of the light

subject constraint. One way to test this would be to evoke the concept under normal or constraint-bound conditions at an earlier point in the discourse, as Wordsworth does: the narrative begins “At a time / When scarcely . . . / My *hand* could hold a bridle . . .” By replicating Wordsworth’s basic design and comparing a measure of an early and unproblematic usage of the target term with a measure of a subsequent deviant or constraint-violating usage of the same term, it may be possible to establish the concept’s “baseline” neural signature through correlated analyses of multivariate patterns of response in specific areas of the verbal, visual, motor, and somatosensory cortex.

Were such a dynamical trace to prove detectable in controlled conditions, it might be predicted to be reactivated in subsequent intonation units that, using passive and participle constructions as Wordsworth does (“was engraven,” “is cleared away,” “inscribed”), evoke the targeted trace without explicitly invoking the target term. If successful, such targeted evocations should reproduce the double-exposure or after-image effect, involving the active rehearsal mechanisms of working memory as regulated by attentional and emotional centers. Such regulatory attention and emotion could be controlled for by careful manipulation of the new information contained in the discourse, again along the lines of Wordsworth’s model. Notice that the bulk of the genuinely new information in the three-period stretch analyzed above concerns the unknown hand and its superstition-charged writing. By such novel means does Wordsworth’s own memorial inscription achieve its peculiarly haunting effect of defamiliarization, which, as Coleridge describes it, “gives the charm of novelty [or surprise] to things of every day, and . . . excites a feeling analogous to the supernatural.”

As though to reproduce in the reader’s mind the “spot” of cognitive-affective trauma that he is describing, Wordsworth sets it echoing in distributed working memory through the carefully timed refreshment of key images and ideas: “the turf,” “the grass,” “the green sod”; “carved the murderer’s name,” “the monumental writing,” “the letters . . . fresh and visible,” “those characters inscribed”; etc. With each successive iteration, the past, reproductive consciousness resounds within the present, impressional consciousness, creating a task-relevant global bias that may selectively and persistently amplify local neural dynamics. Because they are both highly structured and strategically deviant, the first four periods of Wordsworth’s most famous spot of time may well inculcate a state of “visionary” or defamiliarized receptivity even before we reach the ensuing triple-climax for which the episode is usually celebrated: “a naked pool,” “the beacon on the summit,” “a girl” in “the blowing wind”; “the naked pool,” “the beacon on the lonely eminence,” “the woman” in “the strong wind”; “the naked pool,” “the melancholy beacon,” “those two dear ones” in a “radiance more divine.” Through such insistently self-amplifying constructions, Wordsworth effectively “blend[s] thought with thought” and “link[s] feeling with feeling” in the reader’s experience to create an effect of multi-temporal perception akin to the one he describes.

Wordsworth clearly intended to produce this uncommon but, in the case of his poetry, thoroughly characteristic effect of multi-temporal neural sublimity. In the verse paragraph that after 1805 appears between the visionary dreaminess and waiting-for-the-horses spots of time, Wordsworth writes,

. . . I would give
While yet we may, as far as words can give,
A substance and a life to what I feel:
I would enshrine the spirit of the past
For future restoration. (11.338–42)

Wordsworth's success in this poetic purpose can be demonstrated by the record of scholarly opinion, which argues not only *that* his verse achieves its distinctive cognitive-affective ends, but *where, how, and why* exactly. It remains for science to engage *both* these forms of expertise, the literary and the literary-critical, in an enterprise that, thanks to neurophenomenology and related trends in the cognitive sciences, now seems as do-able as it is desirable.

Notes

1. Patrick Colm Hogan puts the point unequivocally: "the arts are not marginal for understanding the human mind. They are not even one somewhat significant area. They are absolutely central. Put differently, if you have a theory of the human mind that does not explain the arts, you have a very poor theory of the human mind. . . . cognitive science cannot afford to ignore literature and the arts" (2).
2. For more on this poetics, see Richardson (*Neural Sublime* 49ff.) and Easterlin (63ff.).
3. On which, see Richardson, *British Romanticism*.
4. For a related discussion of "Tintern Abbey," see Richardson ("Defaulting to Fiction" 676–77). For a thorough-going cognitive critique of Wordsworth's autobiographical self-construction, see Steen.
5. See Bruhn ("Exchange Values" 417–20) on the alleged "incommensurability" of literary experience and scientific measurement.
6. For discussion of the other levels that are involved, see Bruhn, "Time as Space" and "*The Prelude* as a Philosophical Poem."
7. This narrative opening has been prepared for in the preceding lines – "Life with me, / As far as memory can look back, is full / Of this beneficent influence" – and the formula, the setting of the forthcoming story at "a time" – is highly conventional, both in spoken discourse (Chafe 202) and written and fictional discourse ("Once upon a time . . .").
8. See previous note.
9. Though the switch to the plural pronoun introduces something new to us as readers or auditors of this discourse, the information is not new to the speaker of it; see Chafe (226ff.) on "displaced immediacy."
10. I take the two words as constituting a single new idea with respect to "honest James," that of "role" or "function." Even though honest James clearly performed better in one capacity than in the other, "encourage and guide" are not two new ideas but two aspects of one new idea; thus, the one new idea constraint is in force here.
11. Compare "moor" and "bottom," above.
12. Again, not two new ideas because "superstition" or, more broadly, "belief" schematically entails some believer who holds it.
13. The present tense was implied in the preceding intonation unit.
14. For analysis and discussion of the remainder of this spot of time, see Bruhn, "Time as Space."
15. I take "the murderer's name" to be brand new information and not implicit. Even though it is necessarily the case that all murderers have names, it is probably not the case that invoking the topic of a murderer schematically entails the unconscious priming of the semantic slot "murderer's name."

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