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Poetry As
Right-Hemispheric Language

[We are sometimes told] to "look into our hearts and write." But that is not looking deep enough.... One must look into the cerebral cortex, the nervous system, and the digestive tracts.

— T. S. Eliot

Introduction

The human brain is divided into two hemispheres, right and left, that are joined by a thick 'cable' of neural fibres called the corpus callosum. It has long been observed that injury to the left hemisphere in the average adult damages speech, speech comprehension, and reading, and causes paralysis on the right side of the body. Injury to the right hemisphere, on the other hand, seems to leave linguistic capabilities intact, but causes paralysis on the left side of the body. These observations have given rise to the twin concepts of contralaterality of hemispheric control (i.e., that each hemisphere controls the opposite side of the body) and cognitive specialization of hemispheric function. As far back as the nineteenth century, it was recognized that the left hemisphere's specialty was language. Pioneering British neurologist John Hughlings Jackson asserted in 1868 that the left hemisphere was the 'leading side' in most people, responsible for the control of speech and will. In the decade of the 1940s, French neurologist Henry Hecaen and British psychologist Oliver Zangwill demonstrated that the right hemisphere, far from being passive, controlled visuospatial processing (Benton, 1991).

particularly in the decade of the 1970s, mass market publications popularized the notion of the left brain as the processor of language and rational thought and the right brain as the processor of visuospatial images and holistic or intuitive awareness. Hippies and artists were believed to be 'right brain' in orientation, while engineers and businessmen were believed to be 'left'. Indeed, the rather overly enthusiastic adoption of early laterality findings by western popular culture (exemplified by brain dominance quizzes on newspaper feature pages and

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the advertising of Saab automobiles as 'a car for both sides of your brain') made the whole subject seem rather oversimplified and absurd, and no doubt helped to blind the general public to an awareness of the implications of later research findings in the field of cerebral laterality.

Today it is known that, in about 97 per cent of all right-handed adults, the left hemisphere is dominant for language (Pinker, 1994). Even among the left-handed population, the great majority, 69 per cent, process language in their left hemispheres, like right-handers (Pinker, 1994). Moreover, the sharply increased rates of neurological deficits such as mental retardation, autism, stuttering, dyslexia, and epilepsy among left-handed individuals (Laccino, 1993) would make it seem even more apparent that left-hemispheric language is the 'norm' and right-hemispheric language a deviation from that norm. The isolated left hemisphere scores in the normal range on standardized tests of verbal intelligence (Gazzaniga and LeDoux, 1978). Only the left hemisphere possesses the complete lexicon and rules of syntax (Zaidel, 1983). Right- but not left-hemisphere-damaged patients, one group of researchers remarked, 'seldom have difficulties with phonology, syntax, or semantics, and will carry on a conversation which at first glance seems normal' (Benowitz et al., 1990). It would seem that the evidence for the left hemisphere as the 'seat of language' is indisputable. Or is it?

Not at all. Because, over time, evidence has been mounting to show that the right hemisphere controls, or is capable of controlling on its own, a number of very subtle but intriguing 'linguistic' functions (Van Lancker, 1997) which, this paper will attempt to argue, are virtually synonymous with 'poetry' or 'poetic' speech. Indeed, one could assert that the degree of right-hemispheric involvement in language is what differentiates 'poetic' or 'literary' from 'referential' or 'technical' speech and texts.

In the following pages, each of the major literary devices characteristic of 'poetry' will be shown to be either dependent upon the right hemisphere for comprehension/production, or capable of being processed by the right hemisphere as well as by the left. Definitions of the linguistic features characterizing 'poetry' and examples of their usage in actual poems will be drawn from John Frederick Nims' lucid introduction to the subject for college students, Western Wind: An Introduction to Poetry (2000),1 now in its fourth edition, supplemented where appropriate by Alex Preminger and T.V.F. Brogan's more technical New Princeton Encyclopedia of Poetry and Poetics (1993). Following the presentation of neurological evidence for poetry as 'right-hemispheric language', the question of why poets, in particular, produce language so rich in right-hemispheric content will be addressed and possible answers proposed.

1 The fourth edition of the book was co-edited by David Mason, who added new poetry selections, an instructor's manual, a section on poetics, and other features; however, as the definitions cited in this paper were written solely by Nims, 'Nims' and 'Nims and Mason' will be cited as their author.
Review of Poetic Devices

The image

Nims defined the term image as 'anything presented to consciousness as a bodily sensation' — an idea that is concrete as opposed to abstract. A concrete word like kite or bell or a phrase like 'the smell of fresh-mown grass' is an image, but an abstract word like 'justice' or 'supervision' or phrase like 'intention to detail' is not.

Although the left hemisphere is the seat of the complete 'lexicon' in normal adults, the right hemisphere has repeatedly demonstrated an ability to comprehend and act upon short, concrete, frequently used nouns, and seems also to be able to process some high-imagery adjectives and simple imperative verbs. Gazzagna (1970) found that 'split-brain' patients whose corpora callosa had been surgically severed in a procedure called commissurotomY to reduce their epileptic seizures, thereby isolating their right and left hemispheres, could process simple nouns that ended in '-er,' such as butter and water, with their right hemispheres, but not verb-derived nouns that ended in -er, such as seller and trooper. Gazzaia and Hillyerd's research built upon the discoveries of Roger Sperry (1966; 1970; 1974; 1977; Sperry et al., 1969; Levy et al., 1972), whose pioneering studies of post-commissurotomy mental function in cats, monkeys, and human beings earned him a Nobel Prize. In a subsequent experiment with two split-brain patients, Gazzaia and Hillyerd (1971) confirmed the ability of the isolated right hemisphere to recognize spoken and written 'simple nouns', though not more complex syntactical or grammatical constructions.

Similar effects were found in subjects with intact brains. Ornstein et al. (1979) found that subjects reading technical text produced stronger electroencephalogram (EEG) signals from their left than from their right hemispheres, indicative of greater brain activity in the former region, while the effect was reversed for subjects reading stories that were high in imagery. Jakobson and Santilli (1989) described Russian-language experiments in which subjects' left or right hemispheres were temporarily deactivated due to electroconvulsive therapy (ECT): the right hemisphere on its own had trouble understanding verbs other than simple imperatives, but was particularly adept at recognizing nominative forms of nouns.

Still other researchers have presented printed verbal inputs to a subject's left visual field, controlled by his or her right hemisphere, and to the right visual field, controlled by the left hemisphere. Such experiments have consistently shown a larger right visual field (left hemispheric) superiority for abstract than for concrete nouns (Ellis and Stepheid, 1974; Hines, 1970; 1977). Day (1979) decided to test the right and left visual fields for 'imagerability' of words rather than 'concreteness' per se and found no difference in visual hemispheric field response speed for 'high imagery nouns and adjectives', indicating that the right and left hemispheres could process them equally well, but a significant right visual field (left-hemispheric) advantage for 'low imagery nouns, adjectives and verbs as well as high imagery verbs'. The right as well as left hemisphere should thus be able to grasp a poetic phrase such as William Carlos Williams' 'red
wheel barrow glazed with rain water beside the white chickens', though not most randomly selected English-language phrases of comparable length.

_Simile and metaphor_

'The mind itself operates by finding likenesses. When a new piece of information is fed into the brain, it is whirled around the circuits until it finds its place with similar things,' wrote Nims in 1974, several years before the right hemisphere's ability to match novel stimuli to existing mental schemata on the basis of shared features or patterning had been made known. Nims was approaching the phenomenon from the point of view of a poet used to working with _simile_ (comparing one thing to another using like or as) and _metaphor_ (comparing one thing to another by saying it is the other thing); 'Lips like rubies' is a simile, while 'Life is just a bowl of cherries' is a metaphor.

Winner and Gardner (1977) tested patients with right- and left-hemispheric damage on their ability to match a spoken expression (such as 'He has a heavy heart') to one of four pictures, with the correct match being metaphoric (e.g., a picture of a person crying), another being absurdly literal (e.g., a person carrying an enormous heart), and two being foils. Patients with left-hemispheric damage performed significantly better than those with right-hemispheric damage in selecting the correct, metaphorically related picture; in fact, right-hemisphere-damaged patients selected the literal pictures very nearly as often as the metaphorlic ones. Brownell _et al._ (1984) went on to test right- and left-hemispheric patients on their ability to judge which two of three given adjectives were the most similar; two of each three words were metaphorically related (e.g., warm/loving), while the third was an antonym (e.g., warm/cold). Those with right-hemispheric damage selected significantly fewer of the metaphorlic pairs than those with left-hemispheric damage. Again in 1990, Brownell _et al._ performed similar tests, this time using a foil rather than an antonym for the nonmetaphoric alternative; again, patients with intact right hemispheres performed significantly better at selecting the correct, metaphorlic matches. Botinini _et al._ (1994) performed positron emission tomography (PET) scans of the brains of normal subjects processing literal sentences, metaphorlic sentences, and sentence-like strings containing nonwords. They found that regional cerebral blood flow (a sign of increased brain activity) increased in six regions of the right hemisphere when the metaphorlic sentences were being processed, but not when the literal sentences were being processed.

In their 1983 text, _Using the Right Brain in the Language Arts_, Simons and Stahl-Gemake hypothesized that the right hemisphere's ability to comprehend similes and metaphors might be related to its ability to process visual analogies on the basis of matching a common trait: 'The very key to the understanding of figurative language such as occurs in similes, metaphors, and oxymorons rests on seeing analogic, imagistic connectedness.'
Synaesthesia

Nims defined synaesthesia (from the Greek words for ‘blended feeling’) to mean ‘the perception or interpretation of the data of one sense in terms of another’, quoting representative lines from poet Charles Baudelaire ("There are perfumes cool as the flush of children, sweet as oobs, green as the meadows." ) as an example.

Approximately one in 25,000 people in the adult population experiences the actual phenomenon of synaesthesia (Cytowic, 1995), and brain scans conducted as they listen to words have shown that their visual cortices light up together with a larger than normal area of the auditory cortex; synaesthesia-free subjects do not experience activation of the visual cortex at such times (Carter, 1996).

More importantly from our perspective, synaesthesia is also associated with anomalous hemispheric dominance (Cytowic, 1995). According to Cytowic (1995), far more women than men are synaesthetes (three times as many in the United States, and eight times as many in the United Kingdom), and it is known that women as a group are less lateralized for language than men. Even more significantly, most synaesthetes are left-handed or ambidextrous (Cytowic, 1995), whereas more than 90 percent of the world’s population is right-handed (Carter 1998). Additionally, regional blood flow in the left hemisphere drops by an average of 18 per cent during synaesthetic experience, indicating a sharp decrease in left-hemispheric activity (Cytowic, 1995).

Allusion

Allusion, as defined by Nims, is ‘an incomplete reference to something that those who share our knowledge or background can understand’. According to Harris (2003), most allusions are drawn from history, Greek and Roman mythology, Shakespeare, and the Bible, although the movement away from a generalized liberal arts education has reduced the pool of ‘common knowledge’ from which allusions can be constructed. Allusion can be of the conceptual type, in which case it functions similarly to connotation, metonymy, or synecdoche (see below), evoking its referent by naming one or more things associated with or part of it. But a referent can also be evoked by echoing a little ‘chunk’ of the actual language of the original. Nims quoted two fine examples of the latter type of allusion from the poet Marilyn Hacker: the line, ‘Forty-two winters had besieged my brow’, meant to evoke Shakespeare’s, ‘When forty winters shall besiege thy brow,’ and Hacker’s, ‘Did you love well what very soon you left,’ meant to evoke Shakespeare’s, ‘To love that well which thou must leave ere long.’

Van Lancker and Kempler (1987) use the term ‘familiar expressions’ for ‘overlearned, holistic expressions’ that fall under the categories of ‘social interaction formulae (e.g., greetings), expletives, overlearned lists and serials (e.g.,

(2) For example, Shaywitz et al. (1995) demonstrated, using magnetic resonance imaging (MRI), that women used their right as well as left brains on tasks involving the rhyming of nonsense words, while men used only their left brains. Levy (1976) has hypothesized that women have evolved to represent language in both hemispheres because this condition may facilitate communication with infants and small children, who are not yet left-dominant for language.
days of the week), song lyrics, proverbs, and idioms. To their list, one should certainly add prayers and certain poems. What seems to characterize all of these types of familiar expressions from a neurological perspective is that they are perceived by, and stored in, the brain as wholes. Gordon and Bogen (1974) observed that:

a sentence, paragraph, phrase, or, in short, speech is composed from several morpheme units which are retrieved from memory according to grammatical rules and are ordered into a specified temporal arrangement. In contrast, songs, melodies, as well as many everyday prosaic passages, are remembered and produced as intact wholes. The parts of these units are not pieced together tone by tone, word by word, but rather are recalled all at once as a complete unit.

Such familiar expressions are often selectively preserved when left-hemispheric damage has destroyed all other aspects of a patient's speech. Gates and Bradshaw (1977), for example, cited nine different earlier reports of subjects who were unable to say the same words that they could sing after brain damage. Conversely, Jakobson and Santilli (1983) found that Russian patients whose right hemispheres were temporarily deactivated by ECT lost the ability to utter as well as comprehend interjections, exclamations, curses, and endearments — all forms of familiar phrases — with their fully functioning left hemispheres. Weinstein (1964) and Hier and Kaplan (1980) reported that right-brain-damaged patients had problems explaining idioms and proverbs, respectively. Myers and Linebaugh (1981) undertook a controlled study of idiomatic comprehension among right-brain-damaged, left-brain-damaged, and normal control subjects. They found that, while normal subjects scored 97 per cent correct and left-brain-damaged subjects 87 per cent correct in interpreting idiomatic expressions, right-brain-damaged patients chose the correct interpretation of an expression such as 'For weeks he hesitated to show the account books to the boss, but finally he decided he had to go in and just face the music' only 27 per cent of the time. Van Lancker and Kemple (1987) also studied right-brain-damaged (RBD), left-brain-damaged (LBD), and normal control subjects, but tested for comprehension of single words, familiar phrases, and novel sentences in their study. They found that the LBD group more likely to preserve familiar phrase comprehension despite impairment to syntactic processing, while the RBD group showed selective impairment of familiar phrase comprehension, and concluded that, 'These results support the hypothesis, derived from observations in production, that familiar phrases are stored and processed in the brain differently from newly generated language.'

Personification

In the childhood of the individual, in the childhood of the race, in the mind of the dreamer,' wrote Nims, 'we find extensive use of personification.' As a poetic device, personification refers to the endowment of something inanimate or non-human with living or with human characteristics. When carried to a ridiculous extreme, it becomes the pathetic fallacy (e.g., all of nature weeping over a death,
As neuroscientists have not yet tested right- and left-hemisphere-damaged patients for any differences in their comprehension of texts containing personification, nor have they scanned the brains of normal subjects reading such texts versus control materials, it remains to be seen whether there is a link between the literary device and right-hemispheric language. But its frequent occurrence (called animism) in the speech of young children aged two to seven (Piaget, 1967) and in the mythology and poetry of preliterate peoples (Flower, 1941) points to right-hemispheric involvement, as neither of these populations is left-dominant for language (a fact to be discussed in greater detail later in this paper).

Synechdoche and metonymy

Synechdoche. Nims wrote, 'single out some part of a thing as important enough to stand for the whole thing'. Among the examples in poetry that he cited are T.S. Eliot's lines, 'I should have been a pair of ragged claws/Scuttling across the floors of silent seas;' and Cwendolyn Brooks' line, 'They took my lover's tallow off to war...'. Metonymy, a closely related device, consists of 'referring to one thing by using the name of something associated with it.' Nims quoted the lines, 'Scepter and crown/ Must tumble down', from poet James Shirley, as one of his illustrations.

To define synechdoche and metonymy as literary devices is very nearly to describe how the brain's right hemisphere operates in relating new perceptions to existing memory traces: 'Particular skill at establishing part-whole relationships,' observed Winterrowd (1996), 'the right hemisphere is quite literally synecdochic in operation, synecdoche being the figure in which part stands for the whole...'. Joseph (1992) made a similar observation in noting that the right brain can 'infer what something may be or mean' when presented with just one or two features of that thing: the left brain, on the other hand, quite literally has difficulty 'seeing the forest for the trees'. Bogen (1977) tested split-brain patients for their ability to feel just one part of an object with either the right or left hand, then guess what the whole object must be by pointing to the correct picture. With their right hands (controlled by the left hemisphere), the split-brain patients were unable to identify the object; but, with their left hands (controlled by the right hemisphere), they were able to guess the object's identity with ease. The right brain could, 'from the part... infer or construct a gestalt;... must indicate obviousness'; in semantic terms of split-brain patients, Zaidel (1978a) further demonstrated that the right hemisphere was sensitive to part/whole relationships.

Paradox, oxymoron, irony, understatement, litotes, and hyperbole

Under the overall heading of 'binocular vision', Nims grouped the literary devices of paradox ('a statement that seems to imply a contradiction'); oxymoron (which 'links, is one syntactical unit, words that seem to cancel each other
out'); irony ('the statement that means its contrary' or an event or situation that is the opposite of what is intended); understatement ('to say less than one might rather than more'); litotes ('assert[ing] a truth by denying its opposite'); and hyperbole (from the Greek word for 'overshooting, excess'; an obvious exaggeration of the truth). Among the poetic examples Nuss gave of each are the following: for paradox, 'The cure for loneliness is solitude' (Marianne Moore); for oxymoron, 'the people's cold and fiery shade' (Howard Nemerov); for irony, 'And whence such fair garments, such propriety?' (Simone de Beauvoir); for litotes, 'for life's not a paragraph' and death I think is no parenthesis ('v. e. cummings'); and, for hyperbole, 'All the finches in the world are gathered in our yard tonight' (Liesel Mueller). What all of these devices have in common is their essential ambiguity: they require the mind to hold two contradictory versions of 'reality' in tension at the same time, in order to arrive at an understanding that goes beyond literal or semantic meaning. As one might suspect, the ability to comprehend such figures of speech seems to reside within the brain's right hemisphere.

Patients with right-hemispheric damage, Stumm et al. (1994) hypothesized, have just such an 'impairment at the level of planning or monitoring the integration of more than one mental model'. With their intact left hemispheres, they are fully able to comprehend literal and semantic meaning, but not indirect requests, inferences, irony, and other forms of nonliteral meaning in verbal and written language. Hirst et al. (1984) and Fedeli (1987) conducted experiments in which right-brain-damaged, left-brain-damaged, and normal control subjects were asked to select the appropriate response to an 'indirect request' such as, 'Can you open the window?' Such a request can have two possible meanings ('Are you physically able to open the window?' and 'Open the window, please!'), depending upon context; when intended as a request, the intended meaning is not equivalent to the literal meaning. Pictures were used to provide contextual cues showing the correct meaning of the indirect request (e.g., that it was hot in the room and the speaker wanted the window opened). Nevertheless, the right-brain-damaged subjects chose the incorrect, literal interpretations of the requests significantly more often than subjects in the other groups. However, the right-brain-damaged subjects were not impaired relative to the left-brain-damaged subjects on responses to direct questions or to 'what where, how' questions. Weisman et al. (1989) conducted a similar study but without pictorial support, to rule out the possibility that visuospatial deficits might be causing the right-brain-damaged subjects' poor performance in interpreting indirect requests; their results confirmed the earlier findings.

Gardner et al. (1987) tested right-brain-damaged subjects, normal controls, and aphasics (left-brain-damaged controls) on a wide range of abilities to process 'complex linguistic materials'. The right-brain-damaged patients varied widely relative to normal controls in the 'forminosity' ratings that they assigned to
'tricks' (such as 'Why do birds fly south for the winter?' 'It's too far to walk'), 'puzzles' (such as 'What speaks in every language in the world but never went to school?' 'An echo'), and puns, whereas normal subjects were consistent in their ratings. The right-brain-damaged subjects also found the 'unfunny' foils (such as 'Why do clouds move?' 'The wind pushes them') to be much funnier than the normal subjects found them.

A 1990 study by Kaplan et al. provided insight into the relationship between the right hemisphere and the perception of irony and sarcasm. Right-brain-damaged and normal subjects were told a short 'vignette' about a particular person performing either well or badly at golf, checkers, or some other activity, then receiving a comment on the performance from a second party. The comment could be either positive or negative, and the person making the comment could be either a friend or an enemy of the performer. The right-brain-damaged subjects had no problems in interpreting positive remarks about positive performances or negative remarks about negative performances, but they ran into difficulties in interpreting the motive of the commenter when the remark was at odds with the performance (i.e., a friend could be joking by calling a good performance bad, or an enemy could be using sarcasm by calling a bad performance good). Clearly, all of these results point to right-hemispheric involvement in the processing of ambiguous messages with nonliteral meanings.

Emotion

'Emotional experience: This, more than anything else, is what poetry gives us,' Nimis asserted. The 'emotion' of a poem resides not in the employment of a single literary device, but in a gestalt effect that arises from the interplay of its content and its form. In oral cultures, the lyric poem is expressive of a single overt emotional state, and it is sung or chanted to musical accompaniment. Although the written, as opposed to oral, lyric can present perceptions and/or ideas seemingly stripped of any emotional affect, we still tend to associate 'poetry' with the expression of 'emotion,' and even those who claim to dislike poetry seem to be drawn to it at emotional occasions such as graduation ceremonies, weddings, and funerals.

The right hemisphere is essential for the comprehension of emotion in spoken language, as expressed by vocal tone, pitch accent, and modulation ('emotional prosody'). Heilman et al. (1975) demonstrated that right-hemisphere-damaged patients performed poorly on tests of their ability to determine emotion from speech, while left-hemisphere-damaged patients (who had gross defects in semantic comprehension) performed surprisingly well. Zaidel (1990) reported that the disconnected left hemispheres of split-brain patients were similarly unable to interpret the emotional quality of spoken sentences. And several researchers have demonstrated a left-ear advantage for the processing of 'emotional prosody' in speech; that finding is significant in that the right hemisphere controls the left ear (Zuref, 1974; Blumstein and Cooper, 1974). When tested on their abilities to integrate the elements of spoken and written narrative materials,
right-hemisphere-damaged patients also displayed a 'dampened appreciation of the kind of emotion' experienced by the characters in the narratives (Wagner et al., 1987).

Similar defects have been discovered in the ability of the left hemisphere, on its own, to interpret the emotions revealed in facial expressions or pictures. Benowitz et al. (1990) had right- and left-hemisphere-damaged subjects view two-second film segments of an actress depicting emotional states, then select the more appropriate of two spoken descriptions of the situation. Left-hemisphere-damaged patients scored quite close to normal subjects, while right-hemisphere-damaged patients (including two who had post-stroke verbal IQs of 135 and 138, respectively) scored an average of two standard deviations below normal. Ciccone et al. (1980) had left- and right-hemisphere-damaged patients view a pictorial sketch of a highly emotional situation (such as a man being held up at gunpoint for 'fear'), then select the appropriate picture (out of four) depicting the same emotion. They also had the patients view a photograph of a face depicting an emotion, then select (from four test photographs) the same emotion as expressed on the face of a different person. Once again, right-hemisphere-damaged patients scored significantly lower than left-hemisphere-damaged patients.

Persons with right-hemispheric damage are also grossly deficient in their ability to express emotion. Several clinicians have made note of the peculiarly flat, monotonous, 'affectless' speech that characterizes many patients who have sustained damage to their right hemispheres (Wagner et al., 1981; Ross and Mesulam, 1979; Dordain et al., 1971; Monrad-Krohn, 1947, 1963). The ability to convey emotional affect by means of supplementary hand gestures while speaking is also lacking in right-hemisphere-damaged patients (Ross and Mesulam, 1979). When they do manage to convey emotional affect, that affect is often at odds with their semantically conveyed meaning or reported emotional state; for example, the patient might laugh while reporting that a parent is dying (Dimond, 1979, cited in Cook, 1986; Ross, 1981; Wagner et al., 1981). The insertion of off-colour remarks into inappropriate situations is also common in the right-hemisphere-damaged population (Gainotti, 1973; Gardner, 1975). Such patients are also unable to repeat a 'neutral' statement with varying emotional tones that would convey different emotions (Tucker et al., 1977). Conversely, patients with left-hemispheric damage can usually still gesture to convey emotional meaning (Jackson, 1915; Critchley, 1959), although their ability to gesture to convey semantic meaning (i.e., to pantomime) is compromised (Gainotti and Lemmo, 1976; Goodglass and Kaplan, 1963).

In the normal population, as well, the brain's right hemisphere appears to be dominant for emotion. Normal, right-handed individuals express emotion more intensely on the left side of their faces (controlled by the right brain) than on the opposite side, whether the emotion is positive or negative, genuine or staged (Sackeim and Gur, 1978; Heller and Levy, 1981; Monakovitch and Olds, 1981; Borod et al., 1981). It may be somewhat true, as Wolff proposed in the first half of the twentieth century (1933; 1943; cited in Sackeim and Gur, 1978) that the
right side of the face displays our 'public', masklike emotion, while the left side betrays our 'private', emotional state.

*Connotation*

'Connotation,' wrote Nims, is 'the suggestions that words accumulate in addition to their denotation, or dictionary meaning.' As an example, Nims cited the lines, 'Friend, what I want is to trade this horse of mine for your house; this saddle of mine for your mirror; this knife of mine for your blanket... from the poem 'Sheepwalker's Ballad,' by Federico García Lorca. Nims then went on to explain that when the speaker of the poem:

says he would like to trade his horse, saddle, and knife for a house, mirror, and blanket, he is not thinking of the denotation, or dictionary meaning, of the words... but of the connotation, or cluster of associations, each has. The horse connotes an outdoor life of wandering, adventure, and peril; the saddle connotes homelessness, discomfort, and hardship; the knife, passion and violence. The objects for which he would like to trade connotes safety, comfort, and settled domesticity.

The connotative meanings of the key words in a poem evoke a sort of 'shadow poem' in the reader's or listener's mind, wherein secondary meanings, suggestions, and allusions are all suspended in the realm of possibility. Some of them reinforce each other, but all enriching the 'surface meaning' of the poem. For example, Lorca's desired mirror connotes the act of self-reflection as well as the domesticity cited by Nims, and Lorca's desired blanket connotes sleep, and thus, by extension, death—the end of any traveller's journey.

The evidence obtained from research into denotation, connotation, and laterality is quite clear: the brain's left hemisphere processes the denotative meanings of words, but the brain's right hemisphere processes their connotations. One of the first clues that laterality might play such a big part in the denotation/connotation division occurred in 1973, when Gardner and Dinges were testing aphasics (persons with left-brain damage) on their ability to comprehend the denotative and connotative meanings of words. They included a small group of patients with right-brain damage in the study only to serve as controls, together with a group of non-brain-damaged subjects. However, the six right-brain-damaged patients behaved bizarrely when asked to take the connotation portion of the test; all six of them voiced objections to it, two of the six refused outright to take it, and a third could not complete it. The three who managed to complete the test performed worse than some of the aphasics, although the test population was too small for the results to have been statistically significant. But the serendipitous finding alerted researchers to a possible link between the right hemisphere and the processing of connotative meanings. And, the following year, Zari et al. (1974) presented aphasics with groups of three words at a time and asked them to select the two words that were *more* similar to each other. They found that aphasics did not seem able to group words by 'hierarchical' (i.e., denotative) relationships; instead, they grouped words according to
features associated with 'perceived or imagined environmental situations, especially the affective components of such situations' (i.e., by connotation).

In 1984, Brownell et al. conducted the first test of connotative and denotative abilities to employ both right- and left-hemisphere-damaged patients as test subjects, as well as normal controls. Once again, subjects were asked to select the two most similar words from groups of three. The researchers found that, whereas normal subjects were flexible in their ability to use either denotation or connotation as a grouping strategy, 'right-hemisphere-damaged patients showed a preserved sensitivity to denotation, and a selective insensitivity to connotative facets of meanings. In contrast, left-hemisphere-damaged patients exhibited a preserved sensitivity to connotation as well as a selective insensitivity to connotative aspects of meaning.' A subsequent study by Drews (1987) supported the findings of Brownell et al. (1984).

Carter (1998) suggested that the presence of the 'white matter', or myelinated 'bundled' of axons, in the right brain than in the left, connecting neurons that are more distant from each other that in the left hemisphere, might be the reason why the right hemisphere is inclined to come up with broad, many-faceted, but rather vague concepts. Cook (1984a, b; 1986; Cook & Beech, 1990) has proposed an even more intriguing explanation for the lateralization of denotation and connotation: the homotopic inhibition theory. Cook pointed out that the corpus callosum which connects the right and left hemispheres can send inhibitory signals as well as excitatory signals (i.e., information) from one hemisphere to another. He postulated that, while a word such as farm and all of its connotations (tractor, manure, harvest, etc.) could reside, redundantly, in both hemispheres, it is possible that an excitatory signal in one hemisphere deactivates the corresponding mirror-image region in the other hemisphere (e.g., for the word farm), but activates the area around that inhibited region (e.g., for the words associated with the word farm). Building upon earlier findings by Burgess and Simpson (1983a, b), Chiarello and Maxfield (1995) tested Cook's theory in a study which 'primed' the left or right visual field of a subject with a word related to a target word's dominant or subordinate meaning, then measured how long it took the subject to pronounce the target word after it was flashed on a screen. While their data did not support Cook's theory, because both hemispheres displayed priming for subordinate meanings, their data did support Burgess and Simpson's view 'that there is early activation of subordinate meanings in each hemisphere, but that over time subordinate meanings are maintained in the RH, and ultimately suppressed in the LH'. Whichever model proves to be the most accurate, there is no disputing the laterality of denotation and connotation.

The symbol

The symbol, wrote Nims, is 'an image that stands for more than it denotes literally'. Nims went on to observe that 'Symbolic images often are physical objects: a hill, a well, a river. They symbolize such abstractions as spiritual ascent, vitality, time. A lion is a symbol for fierceness or courage; a fox, for cunning; a rock,
for firmness; a torch, for learning. Light is a symbol for knowledge; darkness for ignorance.'

Building upon our knowledge of the laterality of connotation and denotation, we can hypothesize that the ability to comprehend the meaning of a symbol should be yet another element of 'right-hemispheric language'. Symbol processing seems to consist of the activation of a visual image plus the activation of connotative concepts associated with that visual image — both of which are right-hemispheric functions. It is suggested that researchers devise one or more studies of symbol comprehension among right-brain-damaged, left-brain-damaged, and normal control populations to put this hypothesis to a test.

Assonance

Vowel sounds differ from consonant sounds in that the flow of breath is not blocked or restricted — only shaped by the general configuration of tongue, lips, and open mouth. Although consonant sounds are pronounced by singers, it is the vowel sounds of the words in musical lyrics that we truly sing with appropriate pitch and duration. The repetition of the same vowel sound in words of close proximity within a poem is known as assonance, and it is a device that is virtually universal to poetry (Adams, 1993a). Nims cited two examples of assonance from the poetry of Sylvia Plath: the long 'i's of 'Christ! thy! they! panes of ice!' A vice of knives' and the short 'i's of 'fists nimble-winged in thickets'. A poet using assonance in place of end-rhyme might, for example, 'rhyme' the words shame and pain.

Cutting (1974) was the first researcher to discover that the brain's right hemisphere (which controls the left ear) is able to process vowel sounds as well as, or nearly as well as, the left hemisphere. This is particularly significant in that the brain's left hemisphere (right ear) is clearly dominant for the processing of consonant sounds (Krishen, 1977; Ivry and Leiby, 1998). Citing Tallal et al. (1993) as their source, Ivry and Leiby (1998) explained that the average duration of a syllable sound in normal speech is approximately 200 to 300 milliseconds, with the relatively 'steady-state' vowel sound taking up most of that time period, and the relatively 'dynamic' consonantal transition taking up only about five milliseconds. Tallal et al. hypothesized that the left hemisphere is dominant for the processing of rapid changes in perceptual input. Ivry and Leiby (1998), on the other hand, suggested that the left hemisphere may specialize in decoding high-frequency speech signals and the right hemisphere in decoding low-frequency speech signals, with the 'high' and 'low' attributes relative rather than absolute. In any case, it appears that the right hemisphere can appreciate the 'music' of a phrase like 'blue moon' just as well as the left.

Alliteration

The repetition of the same consonant sound at the beginning of two or more words or syllables in close proximity is called alliteration. According to the New Princeton Encyclopedia of Poetry and Poetics, 'Almost every major poetry in
the world except Israeli, Persian, and Arabic seems to have made considerable use of alliteration, which has been more popular and persistent than rhyme' (Adams, 1993b). Among his examples of the device, Nims cited this line by William Butler Yeats, with its subtly alliterative 'f and 's' sounds: 'I hear lake water 'lapping with low sounds by the shore.' The device is much more obvious in this line by Shakespeare which Nims also cited: 'Thou wretched, rash, intruding fool, farewell!' We have seen, in the preceding passage on sonorance, that the left hemisphere seems to be dominant for the 'decoding' of consonant sounds in speech, while the right hemisphere appears to be nearly as adept as the left in its ability to recognize vowel sounds. However, there appear to be some interesting exceptions to this general rule. Ivy and Lesby (1998) reported that the right hemisphere is able to recognize consonants when they are 'artificially lengthened'. In part because it is fragmented by line breaks, poetic speech is articulated much more slowly than conversational speech, which averages about 135 words per minute (Sinatra and Stahl-Gemake, 1983); even 'free verse', which is not forced into the artificially slowed rhythms of regular meter, is normally read out loud (or to the mind's ear) in a sort of singsong 'chant' that places emphasis upon each word and any syntactical or lineated pauses between words. Furthermore, alliteration in poetry often occurs in syllables that are stressed, which also lengthens syllable duration — and stress, pitch, and rhythm together define the prosody (see below) of speech, which is a function dependent upon the right brain for recognition and comprehension. Ivy and Lesby (1998) demonstrated that the right hemisphere is able to differentiate between consonant-vowel syllables that differ in place of voicing by using lower-frequency cues, although it cannot employ such cues in order to distinguish place of articulation. Citing Van Lancker and Fromkin (1973), they further suggested that laterality of speech-sound processing may depend upon the meaningfulness of the sound. If so, it would seem that the initial consonantal sound of a given word, and particularly of a concrete noun, should be more associated with its 'name' or identity than an internal consonantal sound or the initial consonantal sound of a given nounword (e.g., 'ba', 'pa', the types of cues that are normally used in tests of consonants and laterality), and thus could well be recognizable by the right hemisphere. In support of this hypothesis, one split-brain patient studied by Zaidel and Peters (1981) was able, using his right hemisphere only, to match some printed words to pictures of things that began with the same letter as the given word; he was also able to utter the beginning letter sound but not the rest of the word out loud.

Onomatopoeia

Onomatopoeia is the term used to describe a word that sounds like the noise its referent emits, or the noise it is associated with, in nature. Nims explained that, 'The Greek word means name making, as if something in nature made its own name by sounds associated with it.' Nims cited words such as bang, pop, sizzle, beep, and burp as examples, along with Tennyson's famously onomatopoeic
lines about 'The moan of doves in immemorial elms./ And murmuring of innumerable bees. . . .' While the left hemisphere (right ear) is dominant for the processing of speech sounds, it is the right hemisphere (left ear) that controls the processing of environmental sounds, such as a clap of thunder, a car horn, or a dog's snarl or whimper. This is perfectly consistent with the right brain's talent at pattern recognition, at immediately matching a 'new' stimulus to a previous experience stored in memory, without first having to 'decipher' the auditory input for coded meaning. An environmental sound is an event, an entity, a thing, and the right brain recognizes it as such, quite unlike a random syllable in a given stream of speech-sounds, which is a mere signifier relative to other signifiers. Theoretically, the right hemisphere should be able to recognize a word-sound that mimics an environmental sound, although this remains to be tested.

**Rhyme**

Rhyme in poetry most often refers to **end-rhyme**, which occurs when two words at the ends of poetic lines in close proximity share the same medial vowel and final consonantal sounds, but have differing initial consonantal sounds (Bregman, 1993a). Native English speakers may certainly be excused for assuming that rhyme — like assonance, alliteration, simile and metaphor, and other devices — is universal to poetry, but the fact is that it is not. Greenway (1964) found it to be rare in the poetry of preliterate cultures, and Whitehall (1968) found that very few of the thousands of languages spoken in the world (virtually all of which have produced poetry) employ rhyme as a poetic device. Finnegang (1977) identified a link between the development of rhyme in a given oral poetic tradition and the presence of a **written** literary tradition in close proximity to it. Repetition of word sounds and assonance (i.e.) are universal to poetry, but rhyme — however beautifully employed by Shakespeare, Yeats, Frost, and others — is not. It should therefore come as no surprise that the left hemisphere, and not the right, appears to be dominant for determining whether two printed words rhyme with each other (review in Kayman and Zaidel, 1991). Similarly, infants who have had their left hemispheres surgically removed before the onset of speech grow up to develop essentially normal linguistic functions in their right hemispheres (Searleman, 1977), although they typically have difficulties with **rhythming** and **syntax** (Dennis, 1980a,b).

Some evidence exists, however, that certain (but not all) right hemispheres may be capable of matching two pictures whose associated words rhyme (e.g., a picture of a rake and a picture of a rake), although those subjects cannot match a printed word and a picture whose associated word rhymes with the printed word (Zaidel and Peters, 1981; Gazaniga, 1983). The right hemisphere might also be able to discern rhymes on the basis of **acoustical** input (Zecker et al., 1986). To what extent do right hemisphere individuals differ from those whose primary language hemisphere is the left? And how does this knowledge help us understand the nature of language in general?

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(1) Could the possibility that some but not all right hemisphere understand rhyme explain why certain modern poets are so vehement in their criticism of poets who employ rhyme?
rhyme (Rayman and Zaidel, 1991). And gender may be significant: Shaywitz et al. (1995) found that male subjects used a region of the left brain but female subjects used regions in both hemispheres to interpret if pairs of nonsense words rhymed. Some right hemispheres can rhyme, just as some poetic traditions can rhyme, but rhyme in general should be considered tangential and not integral to a catalogue of poetic devices.

Prosody (stress, intonation, rhythm, and meter)

Prosody is essentially the study of the sound-patterning of poetry, and any given sound has three qualities that can be employed as the basis for patterning: its frequency, or pitch; its intensity, or stress (also called accent); and its duration, or length (Brogan, 1993c). English-language metered verse uses stress as the basis to group syllables into identically patterned units of sound, but other languages have employed duration or pitch as the principle of "binary opposition" by which certain syllables are marked (Brogan, 1993c). When the underlying sound-pattern of a poem consists of joined segments of the same repeating rhythmical unit, we say that the poem is "metered."

Nims has described how certain English-language metrical patterns can contribute an overall mood or emotional effect to a poem; for example, the pyrrhic foot (two weak beats) 'may dramatize some kind of leanness', while the spondaic foot (two strong beats) 'can reinforce notions of muchness, weightiness, or slowness'. The trochee (a strong beat followed by a weak beat) has a 'rising rhythm' that connotes excitement and vigour, while the iamb (a weak beat followed by a strong beat) has a 'falling rhythm' that connotes seriousness and stillness. However, meter is normally an ideal, abstract rhythm against which the actual rhythms of the poem's words play, like a musical lyric sung over the beat of a rhythm section. When a poem's words are too rigidly metrical, as in Robert Frost's 'Stopping by Woods on a Snowy Evening' ('Whose woods these are I think I know, his house is in the vilage though'); it becomes singsong. Likewise, the pitch and pitch-changes of the human voice in the process of reading aloud (or subvocalizing) a poem add a dimension to the overall sound-pattern that cannot be transcribed in ordinary print. For example, Jeanette et al. (1990) cited Cosmides (1983) and Williams and Stevens (1972) in explaining that, 'Happy sentences are usually emitted with a higher intonation... with larger ranges, and with more variability than sad sentences.' Even a free verse poem, or poem that is not metrical, employs stresses, rhythms, and intonations to convey emotional or comnotative meaning and to set its language apart from the language of everyday speech.

Studies of left-brain-damaged, right-brain-damaged, and normal control subjects' abilities to comprehend 'emotional prosody' in speech have repeatedly demonstrated that right-brain-damaged patients are deficient in their ability to 'decipher' the meaning of emotionally based stress and intonation; however, they show no such deficiency relative to left-brain-damaged patients in their comprehension of linguistic prosody (that which conveys lexical or semantic meaning; e.g., the stress difference between REDcoat and red COAT, or the
intonation difference between a declarative and an interrogative sentence) (review in Joanne et al., 1990). Almost unbelievably, but quite relevantly, Jakobson and Santilli (1980) reported that a subject whose right hemisphere had been inactivated by ECT was unable to recognize his wife’s and children’s voices, and also could not distinguish a male from a female voice. Such patients are also unable to identify environmental sounds (Jakobson and Santilli, 1980), which are also dependent upon the brain’s right hemisphere for recognition.

While nonlinguistic stress and intonation seem dependent upon the right hemisphere for processing, rhythm can be processed by either hemisphere, although the left seems slightly better at it (Milner, 1962; Robinson and Solomon, 1974). Gordon and Bogen (1974) injected an anaesthetic into the right or left hemispheres of subjects, then asked them to sing. When the right hemisphere was inactivated, melody was badly impaired, but rhythm was essentially normal aside from being somewhat slowed; with the left hemisphere inactivated, melody was normal and rhythm ‘not perfect’ but not measurably impaired (Gordon and Bogen, 1974; review in Gates and Bradshaw, 1977). Turner and Pöppel (1989) quoted Barbara Lex on the subject of cultural rituals that employ rhythmic dances, poetic chants, and other ‘affective’ participatory media to the effect that ‘the driving techniques employed in rituals are designed to sensitize and “tune” the nervous system and thereby lessen inhibition of the right hemisphere and permit temporary right-hemispheric dominance, as well as . . . to achieve synchronization of cortical rhythms in both hemispheres’ (daquile et al., 1979; cited in Turner and Pöppel, 1989). Given that both narrative and lyric poetry have their origins in collective, participatory, rhythm-driven cultural rituals, Lex’s hypothesis linking the employment of such rhythms to manipulations of normal hemispheric dominance is quite interesting, and warrants further investigation.

Line length, end-stopping, and caesura

Brogan (1993b) observed that poetry unfolds in lines, not in sentences and paragraphs as for prose: ‘The sense in prose flows continuously, while in verse it is segmented so as to increase information density and perceived structure.’ When the end of a poetic line coincides with the end of a syntactical unit, the strong pause at the end of the line is called an end-stop. But even when the syntactic phrase spills over onto the following line (ensnacement), the end of the line is normally signalled, when the poem is read out loud, by a slight pause (likened to ‘half a comma’ in a now-famous remark by poet Denise Levertov), or by a ‘paralinguistic cue such as elongation of the final syllable’ (Brogan, 1993b).

Nims observed that ‘a line may have any number of feet from one to about eight’ — at which point we run out of breath.’ Historically, a relatively long line such as the Greek hexameter or French alexandrine, both of which contain twelve syllables, tended to require a caesura, or pause within the line.

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4) Nims was obviously thinking of two-syllable metrical feet (iambic, trochaic, pyrrhic, spondaic), which are by far the most common in metered English verse, and not the unusual three-syllable feet (dactylic, anapaestic).
corresponding to a juncture in syntax (i.e., the end of a phrase, clause, or period), whose position was regulated by its particular poetic tradition. Four lines quoted by Nims from Yeats’s poem ‘The Second Coming’ display a ten-syllable (five-foot) line length, end-stopping, and a caesura in the third line: “Turning and turning in the widening gyre/ The falcon cannot hear the falconer/ Things fall apart; the centre cannot hold/ Mere anarchy is loosed upon the world…”

Turner and Poppel (1989) performed a cross-cultural study of metrical world poetry and discovered that the typical poetic line contained from seven to seventeen syllables (average: ten syllables) and required 2.5 to 3.5 seconds to recite (average: 3 seconds), followed by a distinct pause. Line lengths in the upper length range were usually divided by a caesura. The researchers hypothesized that such metrical divisions might be “a way of introducing right-brain processes into the left-brain activity of understanding language”. Turning to cognitive neuroscience, they pointed out that a pause of three-thousandths of a second or greater is necessary to distinguish two sounds as separate from each other; a pause of three-hundredths of a second or greater, to detect a sound stimulus. That there were ten such ‘reactive’ intervals, and an average of ten syllables, in the typical three-second-long metered line, seemed highly significant to the researchers. They went on to suggest that three seconds, the length of the average poetic line and the next power of ten step up in the progression, corresponds to the length of the human present moment (which they also termed the auditory present, neural present, or subjective temporal present). They also asserted that a pause or ‘buffer’ every three seconds or so is necessary for a speaker to gather what he or she will say next and for a listener to comprehend and integrate what has just been said.

While there are no experimental data yet to support Turner and Poppel’s hunch that the right hemisphere is somehow involved in the rhythms of meter, it may not be entirely coincidental that the famous Russian ‘memorist,’ or memory expert, described as ‘S.’ by Luria (1968) in his case study, The Mind of a Mnemonist, required a pause of three to four seconds between items being placed into his seemingly limitless visuospatial (i.e., right-hemispheric) memory. As in the ancient ‘Art of Memory,’ known by classical Greek rhetoricians (with which, however, ‘S.’ was not familiar, having discovered the system on his own), ‘S.’ would visualize the layout of his home town or the city of Moscow, take a mental ‘walk’ along the grid of streets, and mentally ‘position’ a concrete visual image corresponding to the number, word, or concept to be remembered at a precise geospatial location within the remembered town or city, such as a particular house, gate, or intersection. If, however, the pause between images being memorized was shorter than three to four seconds, ‘S.’ would complain that the images were ‘colliding’ with one another and were becoming confused. Interestingly,
for our purposes, 'S.' found poetry extremely difficult to read, because of its high density of visual imagery.2

Parataxis and Parallelism

'The omission of connectives that express logical relationships is common in primitive languages,' wrote Nims. 'Poetry, caring more for the sensory details than for the logical relationship between them, is especially inclined to use this kind of construction. It is called parataxis, or setting side by side.' Much of the Bible, the written record of an oral tradition, shows parataxic construction; for example, 'He built the House of the Forest of Lebanon; its length was a hundred cubits, and its breadth fifty cubits, and its height thirty cubits, and it was built upon these rows of cedar pillars, with cedar beams upon the pillars. And it was covered with cedar above the chambers that were upon the forty-five pillars, fifteen in each row' (1 Kings 7:2). Anaphora is the repetition of the same word or words at the beginning of successive poetic lines or phrases; it is often used in conjunction with parataxis. An example of both anaphora and parataxis from poetry would be these lines from Christopher Smart's 'Jubilate Agno': 'For I will consider my cat Jeoffry:/ For he is the servant of the Living God duly and daily serving him./ For at the first glance of the glory of God in the East he worships in his way...'. Parallelism, the repetition of the same syntactical construction in successive lines or phrases, is another device that goes hand-in-hand with parataxis; for example, 'The ari a sinking,/ All else continuing, the stars shining,/ The winds blowing, the notes of the bird continuous echoing...'. (Walt Whitman, 'Out of the Cradle Endlessly Rocking').

Parataxis stands in contrast to hypotaxis, which is writing characterized by the frequent use of subordinate clauses to denote logical or temporal relationships. Legal documents are a prime example of the latter. Parataxis and hypotaxis are equivalent in meaning to apposition and proposition, respectively, which are the terms preferred by cognitive scientists to denote the same two methods of joining chains of thought. In two review articles, Bogen (1969b; 1972) presented evidence to support his hypothesis that appositional thought is lateralized to the right hemisphere and propositional thought to the left. Bogen reminded readers that Jackson (1958) had characterized the left hemisphere as 'propositionizing' and had clarified that concept as follows: 'A proposition is not a mere sequence...it consists of words referring to one another in a particular manner [so that each] modifies the meaning of the other.' To Jackson's earlier observation, Bogen (1969b) added the complementary observation that, 'The right hemisphere recognizes stimuli (including words), apposes or collates this data, compares this with previous data...the right hemisphere has a highly developed "appositional" capacity. This term implies a capacity for apposing or comparing of perceptions, schemas, engrams, etc.'

[2] 'Before I can understand a new image, I have to get rid of an old one that's remained in my mind,' 'S.' explained to Larry (1968).
Story

Universal to the epic poems and ballads of oral cultures and to the literary prose genres of short story, novel, and play, but a device employed less frequently in the poems of literate societies, is narrative or story structure. This important literary device is also dependent upon the right hemisphere for its processing. For example, Sacks (1987) observed that, 'Very young children love and demand stories, and can understand complex matter presented as stories, when their powers of comprehending general concepts, paradigms, are almost non-existent. . . . A child follows the Bible before he follows Euclid.' However, right-brain-damaged adults, despite having supposedly 'normal' verbal abilities as measured by standardized intelligence tests, cannot understand stories. Wechsler (1977) first reported that persons with right-hemisphere lesions had problems with story recall, and Zaidel and Sperry (1974) reported the same deficit for the left hemispheres of split-brain patients, who were believed at that time to possess 'normal' linguistic abilities. Huber and Gleber (1982) and Delis et al. (1983) both found that, compared to normal subjects, right-brain-damaged persons had considerable difficulty arranging five or six sentences into a coherent story narrative. Wapner et al. (1981) administered a more complex battery of tests to right-brain-damaged, left-brain-damaged, normal, and elderly individuals. In addition to having problems with arrangement of story elements into a narrative, the right-brain-damaged patients performed at only a chance level at inferring the point or moral of a story and were unable to infer the characters' motives when they were not absolutely straightforward. They 'embellished' stories when recalling them three times as often as left-brain-damaged or normal subjects, and nine out of fifteen of them also 'confabulated', or falsified new story elements altogether. Six of the fifteen right-brain-damaged patients argued with aspects of the stories, which the researchers viewed as an inability to honour fictional conventions and the 'boundary' of a story. Oddest of all, the right-brain-damaged patients did not laugh or look puzzled like the other subjects when researchers injected 'noncanonical' elements into stories (such as a worker getting a big raise after being caught sleeping on the job), in fact, they often tried to rationalize such elements when recalling them. A subsequent study by Gardner et al. (1983) also found right-brain-damaged subjects to be impaired at story recall and at finding the moral of a story, but prone to inserting inappropriate comments and materials into the stories when recalling them. Finally, Schneidman et al. (1992) found that the presence of a thematic sentence as a cue did not help right-brain-damaged patients in arranging sentences into a story.

Discussion

Brain tissue is made up of 'grey matter', consisting of nerve cell bodies and unmyelinated nerve fibres, and 'white matter', or nerve fibres coated with a fatty, insulating sheath called myelin. When nerve fibres have been myelinated, they can conduct impulses efficiently and at high speed. Between the ages of two and seven years old (the time span during which acquisition of spoken and written
language is taking place), myelination of the nerve fibres in the corpus callosum, or bundle of nerve fibres connecting the brain's two hemispheres, is underway; thereafter, although myelination of other neural pathways continues into the early adult years, the process is essentially completed for the corpus callosum (Sinatra and Stahl-Gemata, 1983). The ratio of grey to white matter in the average brain is about even at the age of twenty months, but it climbs to 2.3 by age three, reaches its disproportionate peak of 1.8 by the age of eight, remains stable at 1.6 when measured at age sixteen and thereafter declines in adulthood (to 1.3, as measured by MRI, or 1.1 to 1.4, as measured by CT imaging) (Jernigan and Tallal, 1990).

Prior to the age of two, Annett (1985) observed, the infant is 'atavistic to a split-brain adult' — i.e., to an adult whose corpus callosum has been surgically severed, isolating its right and left hemispheres — because of the state of nonmyelination of the corpus callosum and lesser 'cerebral commissures'. The brain is also not lateralized for language in early childhood. Damage to either the right or the left hemisphere in a child below the age of two will result in a 50 per cent chance of aphasia (language impairment) when language is acquired, while only damage to the left hemisphere will impair speech and reading in the great majority of children aged five and older (Brown and Hecaen, 1976).

Myelination of the neural pathways connecting the brain's two hemispheres enables information to be transferred from one side of the brain to the other through a process of excitation. Galin et al. (1977) tested children aged four to ten on a task involving touching, with the thumb of the same hand, a spot on a finger that the researcher had just touched, or touching an identical spot on the opposite hand with the thumb of the opposite hand. They found that children younger than eight made far more 'crossed' errors than older children, a condition which they thought could be attributed to 'developmental improvements in interhemispheric transfer of information, perhaps related to progressive myelination or other aspects of maturation of the forebrain commissural neurons.' Brizzolara et al. (1992) showed that interhemispheric transfer time (IHTT) decreased between the ages of seven and eleven in normal children, while it did not decrease after the age of seven in persons born without a corpus callosum. Salamy (1978) established that IHTT reached adult levels of speed around the age of ten years old. But, somewhat counterintuitively, myelination of the corpus callosum also permits one hemisphere of the brain to suppress a region in the other hemisphere by sending an inhibitory signal (Selinck, 1974). Thus, both excitation and inhibition of the contralateral hemisphere should be considered in the phenomenon of lateralization of linguistic function.

There is some disagreement about the precise age at which lateralization of language to the left hemisphere emerges in children. Kinsbourne and Lempert (1979) asserted that it is established by age three, while Lemere (1967) argued that it is not complete until puberty. Most researchers seem to agree that is is evident by the age of five or six (Brown and Hecaen, 1976; Krashen, 1977; Carter, 1998) on 'dichotic listening' tests, which present competing verbal stimuli to both ears simultaneously and check to see which of the two the subject
registers as having teard. A 'right-ear advantage' for verbal stimuli is indicative of left-hemispheric dominance for linguistic input, because of contralaterality. The right-ear advantage does not hold true for all sounds, however; most persons have a left-ear advantage for environmental sounds (Curry, 1967), and most people other than trained musicians also have a left-ear advantage for musical input (Kimura, 1964; 1967). There is also no right-ear advantage for vowel sounds, which can be grasped by the right hemisphere as well as the left (Shankweiler and Studdert-Kennedy, 1967).

The right visual field advantage for written text seems to emerge somewhat later than the right-ear advantage for verbal speech in normal children. Although Reynolds and Jeeves (1978) could not find a visual field superiority for letters of the alphabet in seven- to eight-year-old children, they found a clear right visual field advantage in male adults for the same visual input. Silverberg et al. (1980) studied Israeli children learning to read their native language, Hebrew, and found that second-graders exhibited a left visual field superiority when reading, indicating that the right hemisphere was dominating, while third-graders displayed a right visual field superiority for the same words. In another experiment, PET scans of the brains of children reading showed right-hemispheric activation for younger children but left-hemispheric activation for older children (Light et al., 1988). Second languages, as well, seem to be read first on the right side of the brain, and then transferred to the left when mastery occurs. Silverberg et al. (1979) found, for example, that seventh-grade Israeli children learning English had a left visual field (right-hemispheric) advantage for it, whereas eleventh graders had a right visual field (left-hemispheric) superiority. Also, there are scattered cases in the neurological literature of bilingual or multilingual persons sustaining a stroke and having one language but not the other(s), or all languages but one, affected by it (Carter, 1998).

There is evidence to show, however, that left-hemispheric dominance for language is not an 'automatic' developmental process, but one that is dependent upon the type of linguistic input experienced during childhood. Preadolescent illiterate children do not exhibit the same right-ear advantage on dichotic listening tests that literate children of the same age do, although the illiterates have certainly been exposed to acoustical linguistic input (Khadem, 1976, cited in Dawson et al., 1982). 'Genie', a young woman who was deprived of any exposure to language until she was thirteen years and nine months old, and who then began to acquire it, showed an extreme left-ear advantage (right-hemispheric dominance) for verbal stimuli on dichotic listening tests, even though she was right-handed; her left hemisphere performed at only a chance level on verbal input recognition (Fromkin et al., 1974). Hopi Indian children, when speaking their native language, showed activation of the right hemisphere (Ehren-valld, 1984). Similarly, dichotic listening tests performed on bilingual Crow Indian children whose primary language was Crow and secondary language, English, showed that neither ear (i.e., hemisphere) was dominant for acoustical language processing, whereas monolingual English children, though not significantly different from the Crow children in first and second grade, displayed a strong
right-ear advantage (left-hemispheric dominance) in fifth and sixth grades (Vocate, 1984). Crow, like Hopi, is transmitted orally.

It has long been reported that illiterate adults do not seem to suffer the same severe linguistic impairments following left-hemispheric injury that literate adults do (Critchley, 1962). Cameron et al. (1971) performed a systematic study of sixty-five literate, semi-literate, and illiterate patients with a left-hemispheric lesion and corresponding right-sided weakness. Defining 'aphasia' quite strictly to mean complete loss of speech abilities for a period of at least two days, and not just linguistic impairment, they found that 78 per cent of the literate patients and 64 per cent of the semi-literate patients were aphasic, but only 36 per cent of the illiterate patients had suffered aphasia. 'The suggestion is made,' they wrote, 'that literacy emphasizes cerebral dominance for speech.' Conversely, Wechsler (1976) wrote up the case of an eighty-three-year-old, right-handed, illiterate woman who suffered aphasia after a lesion to the right hemisphere.

Young children and illiterates, then, do not exhibit the left-hemispheric dominance for language that we have presumed to be 'normal'. And young children and illiterates also differ from normal, literate adults in the extent to which their linguistic output is marked by the 'poetic' (i.e., right-hemispheric) devices catalogued in the previous section.

The linguistic similarities among poets, children, and preliterate persons were not lost upon Nims. 'Poets (like children, like aborigines, like all of us when we dream), naturally think in images,' he wrote of the first poet-stic device under consideration. Research data would seem to bear up Nims' grouping of children and preliterates with poets in their penchant for the concrete image. Brown (1957) found that 67 per cent of the nouns in children's speech were concrete, while only 16 per cent of the nouns in adult speech could be classified as such. And the great Russian neurologist A. R. Luria, in a field study conducted from 1931 to 1932 (but not published until 1976), observed that his illiterate subjects referred to geometrical shapes using concrete rather than abstract terms (plate or moom for circle, door or house for square, etc.), whereas subjects with only a few years of schooling were able to produce the abstract geometrical terms for the same shapes with ease (circle, square, etc.).

Young children, poets, and preliterates also share a tendency toward simile and metaphor. According to Garbique (1982), preschool-aged children produce many more spontaneous figures of speech, including metaphors, than children aged eight to ten. Around the age of eight, which is also the age at which most western children acquire fluency in reading, children seem to lose not only their...

[8] Certain developmental problems also seem to interfere with the development of left-hemispheric dominance for language. Children born deaf do not show any visual field superiority when reading words (Laccino, 1993), although sign language, when learned during childhood, is lateralized to the left like a normal spoken and written language (Hickok et al., 1996). Dawson et al. (1982) obtained EEG readings of autistic individuals aged nine to thirty-four performing linguistic tests and ten normal individuals of the same age range performing the same tests, and found that a stunning seven of the ten autistic subjects showed right-hemispheric specialization for linguistic functions. Similarly, dyslexic children over the age of five 'do not show the adult level of cerebral dominance when tested by dichotic listening,' according to Keshavan (1987) in his summary of three earlier studies.
pennant for generating figurative language, but also their drive to create large numbers of artworks (Gardner, 1982). Ruth Finnegan (1977), the foremost authority on the poetry of oral (i.e., preliterate) cultures, stressed that 'in many [oral poems], metaphorical expression is of the essence', with similes being less common than metaphors but still widespread.

Synaesthesia is yet another element linking all three groups. 'Early in human history, it seems.' wrote Nims, 'we did not distinguish between the senses as sharply as we do now. Sense data tended to overlap, as they still do in babies, whose world, according to a recent study, is a world of synesthesia, of confusion of the senses.' As Nims asserted, infants do seem to experience the world as a confusing mishmash of sensory input; Carter (1998) suggested that it is so because their auditory and visual cortices, as well as their retinas and a sound-processing portion of the thalamus, are neurally connected — connections that will be 'pruned' as time goes on. Additionally, Gardner (1982) has documented a secondary synaesthetic phase that occurs in children aged five to seven: 'an age of synesthesia begins a time when, more than any other, the child effects easy translations across sensory systems; when colors can readily evoke sounds and sounds can readily evoke colors.' In yet another link between young children and adult preliterate populations, synesthetic figures of speech occur in the Old Testament, the Iliad, the Odyssey, and many other examples of the transcribed literature of primary oral cultures (Brogan and Engstrom, 1993). Brogan and Engstrom found, for example, that the Bible contains references to tasting the word of God (Hebrews 6:5) and seeing a voice (Revelations 1:12).

As for the category of right-hemispheric language known as 'familiar expressions', who delights in such expressions more than the young child? Number counting sequences, the alphabet mnemonic, nursery rhymes, and other serials, songs, and jingles abound in the linguistic output of young children. Turning to preliterates, we know, from the pioneering research of Milman Parry as continued by Albert Bates Lord, that ancient bards did not 'write' epic poems and 're-cite' them from memory, but rather, improvised them afresh during each oral performance, calling upon a storehouse of 'formulas' (familiar phrases and epithets learned during their period of apprenticeship) that could be 'plugged' like modules into the governing meter of a poem. Not only ancient poets of primary oral cultures, but also illiterate epic poets of twentieth-century Yugoslavia, improvised their hours-long verses in performance with the aid of a stockpile of just such 'familiar expressions'.

We have already briefly touched upon personification as a linguistic feature characteristic of children and preliterates as well as poets. According to Piaget (1967), animism (which he defined as 'the tendency to conceive things as living and endowed with intentions') is a normal habit of mind among children aged two to seven, occurring in three predictable and progressive stages. First objects that are useful, then objects that are mobile, and lastly, objects that appear to move by themselves will be 'endowed' by children with life and intentionality. Young children also believe that changing the name of a thing will change its properties (Levorato, 1993). As to preliterates, Frazer (1941), in his cross-
cultural study of the progression from 'magic' to 'religion' to 'science' in world cultures, asserted that, 'To the savage the world in general is animate, and trees and plants are no exception to the rule.' Archaeological, mythological, and anthropological evidence for the belief in tree spirits, river gods, and other forms of nature worship among preliterate cultures certainly seems to bear up Frazer's overarching claim about animism, although some aspects of his methodology have since been discredited. And certainly we are all familiar with the ceremonial importance of naming in preliterate cultures, including the frequent practice of changing a person's name when his or her status within the community changes.

If left-hemispheric dominance for language is not the 'natural' condition of human beings aged eight and older, but rather, an effect of print literacy, then it stands to reason that the *qualitative changes in consciousness* between oral and print cultures — from communal identity, 'magical thinking', pervasive animist spirituality, and poetry to individualism, science and rationalism, faith-based religion or agnosticism/atheism, and prose — may be the outward signs of a fundamental shift from right- to left-hemispheric structuring of conscious thought processes and memories. Magical thinking, for example, can be understood as the interpretation in terms of parataxic, synodochic, metonymic, and metaphoric thought strategies of the relationships among events occurring in time and space. A mind that is primed to process modules of received speech such as idioms, proverbs, and oral poetic formulae but not complex, 'original' propositional thoughts would of necessity be communal in its orientation. To view inanimate objects, plants, and animals as endowed with conscious agency and will, and to grasp abstract ideas in the form of concrete images which embody them, is to inhabit the mythic world of the ancient Greeks, Egyptians, Native Americans, and countless other cultures prior to the introduction and proliferation of phonetic alphabetic print literacy.

Several twentieth-century thinkers have intuited a relationship between the shift from orality to print literacy within a given culture, and a fundamental shift in the quality of consciousness of the individuals within that culture. That of course is the central thesis of McLuhan (1962) in *The Gutenberg Galaxy: The Making of Typographic Man,* although he expounds upon it in prose that is maddeningly riddling and vatic: 'Print is the extreme phase of alphabet culture that detribalizes or decollectivizes man in the first instance. . . . Print is the technology of individualism. . . . As for the technique of doubt in Montaigne and Descartes, it is inseparable, technologically, as we shall see from the criterion of reponsibility in science.' Jaynes (1976) observed the absence of individual 'free will' and the puzzling presence of external, godly voices uttering mandatory commands to humans in ancient literary works such as the *Iliad* or the oldest books of the Old Testament. According to McLuhan (1962), technologically advanced societies have now embarked upon a new phase of 'secondary orality' due to the dominance of electronic media over print media. It stands to reason that further changes of consciousness should be occurring as a result — as anyone who teaches visual/image-oriented, parallel-processing strategies in high-school and college students raised on computer and video games can surely testify — blurring the formerly sharp delineations between oral and print consciousness.
Testament. He hypothesized that signals arising in the temporal lobe of the brain's right hemisphere could have travelled to the auditory area of the left via the small anterior commissures connecting the two lobes — i.e., bypassing the need for interhemispheric transfer via the corpus callosum. Significantly, from our perspective, Jaynes further argued that the hallucinated voices spoke in poetic verse, and that they disappeared with the rise of writing in the second millennium BC. De Kerckhove (1981, 1988a,b) put forth a theory of Greek drama as an outgrowth of phonetic alphabetic literacy which, in turn, trained audiences in the habits required for literacy: 'While they were attending stage productions illiterates might be deemed to develop their attention span, their concentration, their critical faculties and their capacity for abstraction, their manipulation of language, and even their visual skills from peripheral to centralized and directional vision. They might be encouraged for the first time to define and fragment experience in sequences and reorganize its patterns in a unified visual space.' Ong (1982) and Havelock (1986) have also written extensively about the restructuring of traditional oral consciousness by print literacy. It is hoped that this essay might suggest the underlying reasons for the observable differences between oral and print consciousness.

While young children and nonliterate adults seemingly produce speech that is rich in 'poetic' devices, most adult literates do not — but what about the case of poets? Could the phenomenon of adult, literate poets writing works rich in right-hemispheric language indicate that their lateralization for language might somehow be different from the norm? Gardner (1982) pointed out that children aged eight and older who have stopped producing the abundant, spontaneous figures of speech characteristic of younger children can still produce metaphors upon demand, and certainly the same is true of the adult poet: right-hemispheric language, like a stutter or a foreign accent, can certainly be faked or generated with conscious intent. But there is also sufficient evidence to support a hypothesis that poets, as a group, may be subject to temporary reversals of 'normal' laterality.

Moscovich (1973; 1976), following Bogen (1969a), hypothesized that right-hemispheric language might be a latent capability that is 'released' only upon damage to the left hemisphere or other brain trauma. He found that the nondominant hemispheres of persons who had sustained strokes to the dominant hemisphere or who had undergone sectioning of the corpus callosum outperformed the nondominant hemispheres of normal subjects on verbal dichotic listening tests. Interestingly, there are several case histories in the neurological literature of subjects who suddenly began to write poetry after sustaining left-hemispheric damage. Fisher and Mann (1953) documented the case of a seventy-six-year-old, right-handed Irish woman who, after suffering weakness in her right hand and stammering of speech, began to write with her left hand for the first time in her life; she also began writing poetry for the first time, and produced over fifty poems, several of which were good enough to be published. A brain scan revealed that she had a moderately severe generalized cortical atrophy... which was more marked in the frontal regions, especially so on the left side.'
Critchley (1967), in his article 'Creative Writing by Aphasics', documented two additional cases of the sudden onset of poetry writing in aphasic patients who had never written verse before.

From those scattered but fascinating cases in the neurological literature about nonpoets suddenly possessed to write poetry, one can move to biographical and anecdotal evidence about the lives of professional poets. It has long been taken as a 'given' by lovers of poetry that poets are more sensitive, more moody than average men and women. Given that poetry deals with strong emotions, it follows logically that a poet must feel things more deeply than others in order to be successful in his or her craft. But it is also apparent, from paging through the biographical headnotes to any major poetry anthology, that poets seem to suffer from debilitating mood disorders at a rate much higher than that of the general population. This is a situation acknowledged by poets themselves: Jamison (1993) quotes Lord Byron's remark about himself and his fellow poets that 'We of the craft are all crazy. Some are affected by gaiety, others by melancholy, but all are more or less touched,' and Byron's fellow Romantic poet, William Wordsworth, penned the following haunting lines in memory of poet Thomas Chatterton, who committed suicide: 'We poets in your youth begin in gladness; / Thereo come in the end despondency and madness.'

Jamison (1993), a psychiatry professor, co-author of a major textbook on manic-depressive illness, and victim of the disorder herself, was sufficiently intrigued by the anecdotal evidence linking poets and mood disorders to perform research into the lives and medical records, where existing, of all of the major British and Irish poets born during the hundred-year period 1705 to 1835. Eighteenth-century poets born in that time period, for example, included William Collins, Christopher Smart, William Cowper, Robert Fergusson, and John Codrington Hampdike, all of whom were committed to insane asylums, and Thomas Chatterton, who committed suicide. Looking at the nineteenth century, Jamison was able to diagnose John Clare (also committed to an asylum), William Blake, Lord Byron, Samuel Taylor Coleridge, Hartley Coleridge, Percy Bysshe Shorley, and Thomas Lovell Beddows (a suicide) with probable manic-depressive illness. Still other nineteenth-century poets, such as Thomas Gray, Leigh Hunt, and Gerard Manley Hopkins, were known to have suffered from severe depression. Altogether, Jamison calculated that the poets had five lives the rate of suicide of the general population, twenty times the rate of institutional commitment for madness, and thirty times the rate of manic-depressive illness. Among the twentieth-century modernist poets, T. S. Eliot had a nervous breakdown, Ezra Pound was committed to an insane asylum, and Virginia Woolf (a poet as well as poetic prose stylist) and Hart Crane committed suicide. Later in the twentieth century, Randall Jarrell, Delmore Schwartz, Theodore Roethke, John Berryman, Anne Sexton, and Robert Lowell all exhibited symptoms of manic-depressive illness, with Jarrell, Berryman, and Sexton committing suicide, as did Weldon Kees and Sylvia Plath. But, of course, such evidence is anecdotal at best, not scientific, and for every major poet on the 'stricken' list, there are many others who led happy, fulfilling lives.
But there have also been two systematic studies of the rates of mood disorder among later-twentieth-century writers that have turned up some significant findings about the psychology of poets. Over a period of fifteen years, Andreassen (1987) tracked the incidence of mental illness among faculty members from the University of Iowa Writers' Workshop, and among the members of a control group. The Iowa Writers' Workshop is generally acknowledged to be the leading creative writing program in the United States, and the faculty are all gifted creative writers themselves. While the writers were not identified as to their genre, it can be assumed that at least half were poets. Andreassen found that:

the rate of affective disorder (i.e., manic-depressive illnesses) was strikingly high. Eighty percent of the writers had had an episode of affective illness at some time in their lives, compared with 30% of the control subjects. A surprising percentage of the affective disorder was bipolar in nature; 35% of the writers had some type of bipolar illness, in comparison with only 10% of the control subjects. Both of these differences were statistically significant. In addition, the writers had significantly higher rates of alcoholism (30%, compared with 7% in the control subjects).

Terrifyingly, two of the thirty writers committed suicide during the course of the fifteen-year study.

Janson (1989) published her own controlled study of living writers two years after Andreassen. Her method was to select a group of British poets, playwrights, novelists, biographers, and artists who have won one of the most prestigious literary or art awards in the United Kingdom. Inquiring whether her subjects had been treated for a mental illness, she found that 55.2% of the poets, 62.5% per cent of the playwrights, 25 per cent of the novelists, 20 per cent of the biographers, and 12.5 per cent of the artists had been treated for an affective disorder at some point in their lives. Poets were the only subgroup to have been treated for bipolar illness (16.7 per cent); the other writers had mostly suffered from depression. Janson also asked her subjects to self-report any history of severe mood swings or prolonged states of elevated mood. She found that 28 per cent of the poets reported severe mood swings and 33 per cent of them reported prolonged states of elation. All of the poets reported experiencing high-energy periods of intense creativity characterized by elevated mood and fluent thinking, and poets more than any other group reported that 'intense feelings and moods' were very important to their work.

What, precisely, are the 'affective disorders' from which poets seem to suffer more than the rest of the population? Hypomania is a relatively mild form of mania. Subjects experience elevated or irritable mood, increased energy, a decline in their need for sleep, and a rise in self-esteem and boastfulness. Creativity is enhanced; subjects become more verbally fluent, reflecting an increased associativeness of thoughts and ideas, and their speech often becomes laced with jokes and puns. Productivity and creative output increase (American Psychiatric Association, 1987). As Thomas Caramagno (1992), the author of The Flight of the Mind: Virginia Woolf's Art and Manic-Depressive Illness, pointed out, our definition of verbal 'creativity' and the cognitive and verbal symptoms of hypomania are virtually interchangeable.
of a link among poets, right-hemispheric language, and hypomania. After all, one would presume that damage to or dysfunction of the right hemisphere would only increase the normal dominance of the intact left hemisphere over linguistic functions. But there is considerable evidence to suggest that the manic state itself is accompanied by reversal of normal laterality. In other words, during a manic or hypomanic state, the right hemisphere of a person who is normally left dominant for language may control linguistic processing.

To begin with, there are two case studies in the neurological literature of individuals switching handedness during the manic and depressed phases of manic-depressive illness. Lewis (1955) published an account of a Welsh patient who was left-handed when depressed but right-handed when manic. Flor-Henry (1979) encountered a very similar case of a woman who tested one hundred per cent left-handed on the standard Annett handedness questionnaire when manic but only one hundred per cent right-handed after her manic symptoms had abated. Flor-Henry was able to administer EEG tests of the subject's brain activity as she performed verbal and visuospatial tasks during her manic phase and after her recovery, and the EEG readings confirmed that the subject's language dominance shifted to the opposite (right) hemisphere when she was manic and returned to the left hemisphere upon her recovery from mania.

One will recall that the left ear (right hemisphere) normally shows an advantage for verbal sounds and the right ear (left hemisphere) an advantage for visual sounds on 'dichotic listening tests' in which competing stimuli are presented to both ears at once. However, several studies have shown that persons with affective disorders exhibit a reversal of normal laterality for nonverbal sounds, as well as abnormal performance of the right ear (left hemisphere) for verbal sounds (Yezzetti et al., 1978; Broder et al., 1987; Broder, 1988). Kaprinis et al. (1995) were able to refine those previous findings by administering verbal dichotic listening tests to twenty-six Greek manic-depressive patients at two different times: during the manic phase of their illness and following their recovery. Rather than the normal right-ear advantage for verbal input, the researchers found a left-ear advantage for verbal input during the manic phase, indicating that the right hemisphere was controlling linguistic function. The reversal of normal laterality returned to normal following abatement of manic symptoms. In support of their findings, Kaprinis et al. uncovered a case study of a single patient by Sackheim et al. (1983); that patient exhibited a left-ear advantage on verbal dichotic listening tests during mania, but a normal right-ear advantage following recovery.

On visual field tests as well as dichotic listening tests, hemispheric dominance appears to reverse during the acute stage of affective disorders. Silberman et al. (1983) administered visual field tests during verbal tasks to depressed patients, most of whom were bipolar (manic-depressive) rather than unipolar (subject to depression only). Once again, a shift from normal left-hemispheric to abnormal right-hemispheric control of language tasks was found among this population.

Flor-Henry (1979) obtained EEG data on a large population of subjects with affective disorders or schizophrenia while they were performing verbal and
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visuospatial tasks. For the manic patients only, patterns of brain activation were consistent with 'verbal-linguistic functions shifting to the right hemisphere as indicated by the negative right/left power ratios and by the reduction of right parietal power', coincident with 'a shift of spatial cognitive mechanisms to the left hemisphere'.

Finally, Kushnir et al. (1980, cited in Trevarthen, 1990) administered a 'cognitive laterality battery' to depressed patients. Such tests measure the difference between an individual subject's performance on tasks normally associated with the left hemisphere and tasks normally associated with the right hemisphere. Normal subjects usually score zero asymmetry on the 'CLQ', or 'cognitive laterality quotient', while an asymptotic score indicates that one hemisphere is dominating more than its usual share of functions. Several of the depressed patients tested by Kushnir et al. were also tested during subsequent manic episodes or while in remission and, interestingly, they showed a shift in CLQ from left- to right-hemispheric asymmetry.

Based upon all of the foregoing evidence, it seems possible that many, if not most, poets may experience temporary elevations of mood (hypomania) accompanied by a reversal of normal laterality for language. Hemispheric dominance for language shifts temporarily from left to right, as reflected by a density of right-hemispheric linguistic features marking their linguistic output: similes, metaphors, symbols, allusion, connotation, parataxis, and so forth. Indeed, the compulsive 'need to write' that is familiar to every poet, whether amateur or anthologized, may be a self-prescribed remedy for the discomfort of an overactive right hemisphere: restoring normal laterality by channeling linguistic function back from right to left hemisphere, and to the writing (or primary typing) hand controlled by it.

This view of the creative process in poets complements in many, but not all, respects the views of Bogen and Bogen (1969; 1999) on creativity as a lateralized process. Taking the four stages of creativity (preparation, incubation, illumination, and verification) into account, Bogen and Bogen (1999) suggested a physiological basis for each stage and for the creative process as a whole:

To produce something both novel and meaningful one must have a period of preparation. This involves acquiring a large fund of information. Following preparation is a period of incubation during which time the information is rearranged, typically while one is unaware of the process. Next is illumination. Almost everyone is

[3] Lest this concept of 'temporary' dominance seem far-fetched, consider that, despite our deeply entrenched left-hemispheric dominance for language, some howling of the stronghold must surely be in effect when we dream. We dream in concrete visual images and symbols, in scenes that appear to each other paradoxically, hearing (as the dream’s persona) environmental sounds and simple words or commands or familiar voices but not syntactic sentences or conversations—i.e., in the language of the right brain. And there is evidence to indicate that right-hemispheric function may be more active during REM (i.e., dream) sleep, while left-hemispheric activity increases during non-REM sleep (Kluver and Bucy, 1939). It is also known that cardiac activity (i.e., interhemispheric activation and/or inhibition) declines during the REM phase (Birnbaum, 1965) and that subjects awakening from REM sleep perform better on tests of right-hemispheric cognitive functions, whereas subjects awakening from non-REM sleep perform better on left-hemispheric cognitive tests (Goeden et al., 1981).
familiar with the cartoonist's use of a lightbulb to symbolize the instant illumination of an idea. Last is necessary a phase of deliberate reorganization and refinement, readily describable by the creator, to test and polish the initial product.

What can be the physiological basis for this succession of stages? During incubation, some very productive thinking goes on, which is inaccessible to verbal output (in that one cannot tell how it went on) and whose result can become available in a sudden insight. Where does this thinking take place? To say that it comes from the heart describes the quality rather than the origin. To say that it comes from intuition is merely to restate it rather than to give it a physiologic source. It surely requires an elaborate neuronal system, of a size, complexity, and activity level comparable to the organ—namely, the left hemisphere— that produces the richness of human language. It is likely that much of the thinking that goes on during incubation takes place in the human right hemisphere.

By contrast, the preparation and verification phases seem more left-hemispheric.

One sees the likelihood of a greater than usual interhemispheric communication during an individual's more intuitive moments, an interaction dependent upon the corpus callosum.

Certainly Bogen and Bogen seem correct in attributing the preparation and verification stages to left-hemispheric activity, the incubation stage to right-hemispheric activity, and the illumination stage to interhemispheric transfer of information from right to left. However, they also view 'a significant degree of intrahemispheric independence, such that the interhemispheric exchange is much of the time incomplete' as the normal state of human mental functioning, with creativity resulting from a sudden, temporary increase above normal in the flow of information from right to left ('One sees the likelihood of a greater than usual interhemispheric communication during an individual's more intuitive moments, an interaction dependent upon the corpus callosum' and 'A momentary suspension of this partial [hemispheric] independence could account for the illumination that precedes subsequent deliberate verification'). At least in the case of poets, however, whose generation of language rich in right-hemispheric linguistic devices bears such striking similarities to the language of young children and nonliterate adults— populations whose right-brain language function is greater and whose interhemispheric transfer efficiency less— than that of normal literate adults— and gives also the relationship between REM (dreaming) sleep and reduced callosal activity (Berlucchi, 1965; see note 8), it seems likely that a sudden and transient loss of or decrease in normal interhemispheric communication, removing inhibitions placed upon the right hemisphere and allowing into function a greater-than-normal linguistic activity level, would provide a more likely explanation of the phenomenon of creativity in poets. 'Illumination' would then signal either a restoration of normal callosal activity, or perhaps even (given Jaynes' theory of hallucinated poetic voices) an atavistic transfer of neural information across lesser commissures.

Conclusion

Assuming that genuine, professional poets or gifted MFA students in creative writing programs could be conditioned over time to produce poems despite the
presence of neural imaging equipment, the foregoing ideas could all be verified or disproven, as the case may be, under controlled experimental conditions. The poet, however, would have to dictate the timing of the neural imaging procedure, as 'inspiration' itself can be a transient and unpredictable phenomenon not subject to human will. 'Sing me, Muse,' begins the ancient Greek Odyssey— an epic poem which Jaynes (1976) dates, unlike the earlier Iliad, to the period following the loss of hallucinated godly voices. Cut off from the heard-out-loud or imagined voices of the gods speaking in poetry, the modern poet is reduced to lugging and praying for those silenced voices to be restored— calling it 'writer's block when they cannot be.

'Beauty is truth, truth beauty,'— 'that is all/ Ye know on earth, and all ye need to know,' wrote the poet John Keats, an almost certain victim of one of the milder forms of affective disorder (Jamison, 1993). And, although one can attempt to reduce the writing of poetry to a chain of neurochemical events, and attempt to assign both 'beauty' (a visuospatial perception) and 'truth' ('apodictic-certainty')— the experience of deep, unshakeable conviction and meaningfulness to the brain’s right hemisphere, one cannot, ever, take away one iota of the beauty and meaningfulness of those lines, nor of the world’s great body of poetry, which speaks to us from the lost realm of our ancestors and of our childhoods, allowing us, however briefly, to return.

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