УДК 201.8 (88)
DOI: 10.32788/ jlrtp.01.49-59

IT'S ALL IN THE BRAIN?! TRANSMISSION OF NEUROSCIENCE INTO LITERARY ACTION AND LINGUISTICS

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Abstract. The pursuit of the paper rests on the investigation that relate literature and language to the organization, structure, and workings of the human brain. An increasing number of psychologists, neuroscientists, literary critics and linguists are now studying the neural basis of literary creation, and language. An increasing number of research that focus on cognitive and systems neuroscience. The emerging area of studies in literature, language and its relations to the human brain spurred by remarkable recent growth in the neurosciences. Cognitive and computational neuroscience continues to influence issues traditionally addressed within the humanities, including the nature of consciousness, action, knowledge, and normativity. Empirical discoveries about brain structure and function suggest ways that "naturalistic" programs might develop in detail, beyond the abstract philosophical considerations in their favor.

Keywords: neuroscience, education, literature, linguistics, and second language acquisition

Introduction

Interest in function of brain was known already in ancient Greece. Alcmaeon of Croton was an early Greek medical writer and philosopher-scientist (Beare, 1906,).His exact date, his relationship to other early Greek philosopher-scientists, and whether he was primarily a medical writer/physician or a typical Pre-Socratic cosmologist, are all matters of controversy. He is possibly to have expressed his ideas sometime between 500 and 450 BCE. The surviving fragments and testimonial focus primarily on issues of physiology, psychology and epistemology and reveal Alcmaeon to be a thinker of considerable originality. He was the first to identify the brain as the seat of understanding and to distinguish *understanding from perception*. Alcmaeon thought that the sensory organs were connected to the brain by channels (*poroi*) and may have discovered the *poroi* connecting the eyes to the brain (i.e. the optic nerve) by excising the eyeball of an animal, although it is doubtful that he used dissection as a standard method. He was

the first to develop an argument for the immortality of the soul.

The intellectual history of the twenty first century tries to solve the riddles of human agency, subject formation, language acquisition, and consciousness, with little or no awareness of the spectacular developments in psychology, literature, linguistics, philosophy of mind, and neuroscience that form the central story of Western intellectual life from the 1950s to the present. These fields, which have been uniting (along with artificial intelligence) under the rubric of "cognitive science" or "the cognitive neurosciences," have largely abandoned the Saussurean and Freudian approaches to language and mind that still set the terms for most literary theory - however dated within the disciplines from which they were originally borrowed. An entire new set of frameworks and paradigms, inspired by advances in neurobiology and computer science that were nearly unimaginable a half century ago, has multiplied in their fields, and the cognitive neurosciences have emerged as most exciting and rapidly developing interdisciplinary endeavor of our era.

The works characterize “literature and neuroscience” and “neurolinguistics” The former discusses foundational issues concerning literary creations and the neurosciences. The latter concerns application of neuroscientific concepts to traditional linguistic questions. Exploring various concepts of representation employed in neuroscientific theories is an example of the former. Examining implications of neurological syndromes for the concept of a unified self is an example of the latter.

The neuroscience was delving directly into cognition, especially learning and memory.

For example, Eric Kandel (1976) proposed presynaptic mechanisms governing transmitter release rate as a cell-biological explanation of simple forms of associative learning. With Robert Hawkins (1984) he demonstrated how cognitivist aspects of associative learning (e.g., blocking, second-order conditioning, overshadowing) could be explained cell-biologically by sequences and combinations of these basic forms implemented in higher neural anatomies.

A major turning point in philosophers' interest in neuroscience came with the publication of Patricia Churchland's *Neurophilosophy* (1986). In her (1986) book, Churchland distilled eliminativist arguments of the past decade, unified the pieces of the philosophy of science underlying them, and sandwiched the philosophy between a five-chapter introduction to neuroscience and a 70-page chapter on three then-current theories of brain function. She was unapologetic about her intent. She was introducing philosophy of science to neuroscientists, literary critics, and neurolinguists. Nothing could be more obvious, she insisted, than the relevance of

empirical facts about how the brain works. Her term for this interdisciplinary method was “co-evolution” (borrowed from biology). This method seeks resources and ideas from anywhere on the theory hierarchy above or below the question at issue. Standing on the shoulders of philosophers like Quine and Sellars, Churchland insisted that specifying some point where neuroscience ends and other sciences begin is hopeless because the boundaries are poorly defined. Neurolinguists, literary critics would pick and choose resources from both disciplines as they saw fit.

The Literary Mind is a different sort of book: compact, more stylish, written with a wider audience in mind. Turner makes some very important, and very persuasive, arguments regarding central issues of cognition, language, and literature, writing with an authority earned from his previous work and with more cogency and flair than ever. The pervasive concern with metaphor characteristic of Turner's (1987) and Lakoff's (1989) work to date has now transmuted into a broader interest in story, forecast, and parable, facilitating the larger claims that Turner makes here for cognitive rhetoric. These claims are supported not only by Turner's convincing description of basic forms in literature and ordinary language (drawing on his own ongoing research as well as a growing body of studies by a group of linguists, anthropologists, psychologists, and philosophers loosely associated with Lakoff's "cognitivism") (Lakoff, 1987), but also by their compatibility with the neuroscientific theories of Gerald Edelman and Antonio Damasio. (The latter was sufficiently impressed to endorse Turner's book, perhaps the first work of literary theory reference by a prominent brain scientist.)

Turner emphases the importance of story--"narrative imagining"--as the "fundamental instrument of thought," crucial for planning, evaluating, explaining, for recalling the past and imagining a future (Turner, 1991,p. 4-5). In this Turner could find allies among artificial intelligence researchers, such as Roger Schank (1995) and Jerry R. Hobbs (1990), who similarly place narrative forms (stories, scripts, schemas) at the center of human cognition. What differentiates Turner's approach is his insistence on the embodied and ecological character of cognitive procedures ("acts of a human brain in a human body in a human environment," as he puts it in *Reading Minds*) (Turner, 1991), his interest in the neural substrates of cognitive activity, and his conviction that the seemingly messier, more "literary" aspects of language, particularly metaphor and other rhetorical tropes, are central rather than marginal to cognition and communication. Turner's narrative imagining, for example, relies extensively on what he calls "parable," our capacity, usually effortless and frequently unconscious, to project one story onto another, to organize the story of a life, say, in

terms of the story of a journey (p. v). *The Literary Mind* develops this basic idea in various ways, detailing the many and complex forms of parable and projection, and showing their pervasiveness in various kinds of conceptual, linguistic, and literary activities.

Consciousness has re-emerged as a topic in the cognitive and brain sciences over the past three decades. Instead of ignoring it, many physicalists now seek to explain it (Dennett, 1991).

The focus is exclusively on ways that neuroscientific discoveries have impacted philological debates about the nature of consciousness and its relation to physical mechanisms. Scholars are still tend to pose questions about neuroscience. Such questions include: What is the nature of neuroscientific explanation? And, what is the nature of discovery in neuroscience? Answers to these questions can be pursued either descriptively (how does neuroscience proceed?) or normatively (how should neuroscience proceed)? Normative projects in philology of neuroscience can be deconstructive, by criticizing claims made by neuroscientists. For example, scholars of neuroscience might criticize the conception of personhood assumed by researchers in cognitive neuroscience (Roskies, 2009). Normative projects can also be constructive, by proposing theories of neuronal phenomena or methods for interpreting neuroscientific data. These latter projects are often integrated with theoretical neuroscience. For example, Chris Eliasmith and Charles Anderson developed an approach to constructing neurocomputational models in their book *Neural Engineering* (2003). In separate publications, Eliasmith has argued that the framework introduced in *Neural Engineering* provides both a normative account of neural representation and a framework for unifying explanation in neuroscience (Eliasmith, 2009).

Neurophilology applies findings from the neurosciences to traditional, mainstream of literary criticism questions. Examples now include: What is an emotion described by the writer in literary work? (Prinz, 2007). What is the nature of desire? (Schroeder, 2004). How is social cognition made possible? (Goldman, 2006). What is the neural basis of moral cognition? (Prinz, 2007). What is the neural basis of happiness? (Flanagan, 2009). Neurophilosophical answers to these questions are constrained by what neuroscience reveals about nervous systems. For example, in his book *Three Faces of Desire*, Timothy Schroeder argues that our commonsense conception of desire attributes to it three capacities: (1) the capacity to reinforce behavior when satisfied, (2) the capacity to motivate behavior, and (3) the capacity to determine sources of pleasure. Based on evidence from the literature on dopamine function and reinforcement learning theory, Schroeder argues that reward processing is the basis for all three capacities.

Thus, reward is the essence of desire.

Neuro Literary Criticism, or else "applying the neurosciences to literary hermeneutics," in Patricia Cohen's definition, will lead to unexpected insights into individual texts while attempting to answer questions, such as "Why do we read fiction? Why do we care so passionately about nonexistent characters? What mental processes are activated when we read?" (Ortega and Vidal, 2013). The answer to these questions does not merely lie in humanities, in hermeneutics, and text interpretation; it also lies in the brain, "in the activation of neuronal processes that are specific to the particular text and to the unique particular cortical wiring of the recipient but that also have transhistorical, cross-cultural, and evolutionarily longstanding properties that are related to fundamental features of neural anatomy and basic neurobiological processes" (Armstrong, 2013).

Again, interdisciplinary study is necessary; again, learning from methods and techniques of other disciplines is profitable; and again, the exchange between humanities and sciences provides inspiration for all.

Neuro - Literary Criticism is the study of how great writing affects the hard wiring inside our heads. It is a field, where academics from the arts and from the sciences are getting together to understand the biological processes behind reading, creating, and processing fiction. As Richard Wise, a neuroscientist at Imperial College claims, "reading is a hard-wired thing in our brains. There are brain cells that respond to reading and we can study them" (Harris and Flood, 2010). And yet, one could not help wondering: Why does this theory matter? What makes it important? Let's say that we find the connections and we do understand them… So what? Doesn't it imply a "death" of literature the fact that we dissect the brain? And isn't it like denying the transcendent value of literature when we try to reduce it to technical terms? Well, it matters. It matters because we need to understand what makes the experience of art so rich and powerful, not because we aim at putting the experience under a microscope but because we need "to reflect on the root of all our teaching and research; what defines what we really do beyond our balkanized academic departments. We do literature, and at the heart of our endeavors is language as it has been shaped – and shapes – literacy. Reading and writing is to humanists what nature is to physicists," as Michael Holquist, professor of comparative and Slavic literature at Yale, so clearly puts it. And it also matters because we always want to learn more; we want to receive the light of new discoveries; to connect our past to the future; to pass from romantic ideals of philology to the philology of the digital era: one that provides us with all the tools for understanding thought, language, image, pleasure, art…

Since the 1990s, the universe of critical theory has been filled with disciplines, which combine *neuro* with a social or human science; neuroanthropology, neurotheology, neurolinguistics, neuroaesthetics, have brought new meanings into the literary text. What follows, according to Dr. Michailidis (2016), Vice Chancellor for Academic Affairs in Webster University, is "an attempt to extrapolate from the realm of general literary aesthetics a more specific concept of beauty of literature, which can be included in the realm of neuroscience aesthetics as well as philosophy." And since neuroscience is related to literally all the aspects of our life, its value to literature reading, writing, and interpretation is undeniable. For this reason, to approach the issue in the scientific depth it calls for, we must examine the parallels between certain features of literary experience and functions of the brain and explore the ways in which neuroscience and literature illuminate each other. In particular, we must examine the interplay between the brain in literature and literature in the brain: the brain's plasticity, its connections with diverse areas, its flexibility of function as well as the ideas of harmony and dissonance, synthesis and tension, symmetry and asymmetry, certainty and ambiguity; we must examine what Iser described as reading: an "anticipatory, reciprocal, multidirectional, unstable, ambiguous act" (Armstrong, 2013, p.56), all of which comply with brain activity.

The first aspect that demonstrates the correlation between aesthetic activity and brain structure is the fundamental, crucial to understanding reading and interpretation, paradox of time. While the lived experience of time is intuitively obvious, when we examine it, it becomes paradoxical. Past, present, and future penetrate each other both in life and reading, a phenomenon, which has greatly concerned both neuroscience and critical theory. Non-simultaneity of the brain's cognitive processing is one aspect of life's inherent temporal imbalance. The temporality of cortical processing explains how the brain deals with the conflict between the tendency toward stability and constancy and the opposite tendency toward openness to novelty and multiplicity (Armstrong, 2013, p. 92). The fact that cells assemblies in different regions of the brain reciprocally interact is consistent with the phenomenological perception of time since, as Iser observes, "the reader experiences the text as a living event" and since consistency building and to-and-fro movement of the hermeneutic cycle gives a spiral character to temporal processes of lived time. Time, therefore, is in both cases elusive; lost in different directions; diffused; as Maurice Blanchot (2016) maintains: "to write is to surrender oneself to the fascination of the absence of time… where there is no present or presence" (Adams and Searle).

Indeterminacy of time is closely related to the second correlation of neuroscience and

literary experience: the ancient truth of hermeneutics; the circular character of interpretation; the idea of reading as a retrospective, not linear process; the process of breaking down a whole in its parts while simultaneously relating each part to the whole it belongs to. Contemporary neuroscience, in agreement with phenomenology, perceives the brain as "a decentered, multidirectional ensemble of parallel-processing operations" (Armstrong, 2013, p. 54). The strange combination of fixity and plasticity of which the brain consists seems to be connected with the neuronal underpinnings of aesthetic experiences. As every mental act is characterized by "a concurrent participation of functionally distinct and topographically distributed regions," as neuroscientist Varela suggests, and as the brain is viewed as a model of network, speed, fluidity, complexity, and parallelism, in which messages constantly crisscross each other (Armstrong, 2013, p. 42), the act of literary interpretation constitutes a similar model. Furthermore, visual representation of ambiguous figures is of great relevance since the brain has the capacity to stabilize such ambiguous images in multiple, incommensurable patterns. As the neuroscientist of vision, Margaret Livingstone notes, the function of our vision is to extract biologically important information from the environment rather than merely reproducing a pattern of light (90) while neuroscientist Semir Zeki observes that "even the initial translation of light into optical signals is not a 'mirror' but an interpretation… a map that emphasizes a particular part of the view" (Armstrong, 2013, p. 59). Since vision is inherently hermeneutic and since hermeneutic processes resemble those of vision, it becomes obvious that neuroscience has a lot to offer to today's critical theory.

Of course, there has been opposition against the idea of using scientific methodology as a tool of literary analysis. A body of researchers suggests that neuroscience may reduce artistic value and that through neuroscience the individual's private world is sacrificed (Literary Critics). Other researchers claim that such neuroscientific approaches take an "agnostic stance" toward the aesthetic object and that humanists cannot turn into scientists (Can Neuro). But neither is true; discovery and knowledge of scientific truth behind artistic passion does not take any of the immensity of pleasure or the literary object itself. Neuro Lit Crit, within the scope of "neuroculture" and "neurodiversity," just sheds new light into aesthetics. It just encompasses the truth of beauty, the beauty of truth, the beauty of nature, the beauty of brain itself. After all, without a brain, nothing works. Although no individual is mere brain, the brain is an integral part of human nature, of being, of "dasein," in Heidegger's term. The only caution we should have is not to surrender to

the threat of hermeneutic reduction: to regard authors of works as intuitive neuroscientists and works of art as venues of implicit neuroscientific knowledge. And also, we must ensure that the ontological questions of philosophical, social, and cultural character do not become secondary… Because whatever theory we use, whatever science, the existential questions of literature will always return in new disguises to signify the continuation of a story…

Overall, the functions of the brain are innumerable. The literary theories and movements are innumerable. When neuroscientists, authors, and critics come together in a united inspiration and challenge, the outcome is magnificent. Because, no matter how extreme it may sound, there is an immense body of combinations to be made between brain structures and textual interpretation; it is up to all of us to establish them.

Cognitive Linguistics and the field of Neuroscience have provided us with insightful findings about the activity of the brain in the process of learning a second or other language(s), thus making us more conscious of our cognitive abilities as language learners, and on the countless brain benefits of second language learning, promoting a healthier life, especially in later years.

On first note, comparative studies in Neuroscience have made it possible for us to examine the capacity and activity of the brain when picking up a second or other language. In a Swedish study, MRI brain scans showed that the brain of language learners grew in size, and especially in the regions related to language learning (hippocampus and cerebral cortex), proving that learners were better in language than in motor skills ("What…Learn a Language?"). Conversely, the brain structures of science or medical students did not undergo any change.

Moreover, MRI brain scans can detect which parts of the brain are activated while learning a second or other language(s). A perfect example to consider is the Japanese speakers trying to hear the difference between the English sounds of "r" and l". In the Japanese language, these do not exist as separate sounds, but as one single sound entity (phoneme) ("What…Learn a Language?"). As a result, brain imaging studies reveal that for the English speakers, there are two areas of activity, one for each distinct sound, whereas for the Japanese speakers, only one region of the brain is activated ("What…Learn a Language?").

An additional study headed by Kara Morgan-Short, a professor at the University of Illinois at Chicago also uses brain imaging research to study the "hidden" complexities of the brain. The results were stunning as she and her coworkers found that the brain processes of learners immersed in the target-language environment resembled those of the native speakers, while the learners who received formal classroom instruction

performed better in grammar because they had learned via the explanation of rules ("What…Learn a Language?" and Ullman).

One might ask: how are multiple languages represented in the human brain? Joy Hirsch and her colleagues at Cornell University showed that in the area responsible for the motor skills (mouth, tongue, and palate movements), or (Broca's area), the native and second languages are spatially separated (Talukder, 2016); however, in the area responsible for language comprehension (Wernicke's area), there was little separation between the two languages (Talukder, 2016). Therefore, what's obvious is that adult learners of a second language may have more difficulty with speaking than with understanding word meanings.

What's more surprising is that Cornell researchers who studied the brains of "true'' Bilinguals, those learning both languages within childhood, found that there was no spatial separation in either areas for both languages, and the same regions of the brain enabled them to process both languages (Tulukder, 2016).

Last, a culminating study carried out by brain scientists from Spain and Germany reveal to us that people who develop their vocabulary skills "stimulate" the "pleasure" center of the brain (ventral striatum) which becomes activated in the same way when we engage in other moments of intense satisfaction such as sex, gambling, or eating chocolate (Joshi, 2014).

Apart from being extensively informed about and overwhelmed by the "functional" role of the brain, thorough research in bilingualism and second language learning discloses apocalyptic facts about these people being at an advantage, or one could even say that they are "privileged". Firstly, second language learners are more careful, slow thinkers as opposed to being emotional or impulsive (Keim, 2014). Learning English is hard, and this means that they are thinking harder or "overthinking"; also, they're communicating in a language which is more challenging and with which they don't feel comfortable. Thus, they tend to be more cautious, rational and fair when it comes to making decisions or taking risks (Keim, 2014). Studies show that these learners switch to the second language mode when talking about embarrassing or sensitive topics, swearing (seems less offensive), or expressing anger (Keim and Sedivy, 2014). On the other hand, they prefer to use their native language only with family members, especially when they are emotionally charged (Sedivy, 2014).

Furthermore, researchers concluded that those who spoke another language had higher levels of intelligence (Iaccino, 2014) and had significantly better overall cognitive abilities (Alban, 2016). And this applies to bilinguals in early childhood or much later in adulthood. As the study from the University of Edinburgh confirmed, "Bilingualism may benefit the ageing brain" (Joshi, 2014). Brain

scans found that the brains of bilingual seniors "worked much more efficiently, more like those of young adults" (Alban); this means that they are also less likely to suffer from age-related memory loss as "scientists believe these seniors' brains have more reserve power that helps compensate for this" (Alban, 2016).

Additionally, Canadian studies suggest that bilinguals may be diagnosed with Alzheimer's disease or the coming of dementia much later in their lives than monolinguals ("What …Learn a Language?"). In fact, statistics show that these may be delayed by 4.5 years (Alban, 2016).

Last but not least, Alban emphasizes that adults who speak multiple languages are prone to:

–having better focus, concentration and attention

–having better memory and memorization skills

–exhibiting mental flexibility

–scoring higher on standardized math, reading and vocabulary tests

–being better at planning and prioritizing

–having good listening skills

–being creative.

It's evident that the more we delve into the complex fields of Cognitive Linguistics and Neuroscience, the more we encounter that these sciences are uncovering marveling truths and facts about the human brain and the numerous benefits of second language acquisition. As our research firmly states, it's never too late to begin learning another language. It is high time you discovered it for yourself!

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