BORGES AND THE BRAIN: VISIBLE CONNECTIONS WITH NEUROCOGNITIVE LINGUISTICS

José María Gil

If the brain were simple enough for us to understand,
we would be too simple-minded to understand it.
Anonymous (Lamb, *Pathways* 293)

1. A VERY SHORT INTRODUCTION: ON THE STUDIES ON BORGES AND THE BRAIN

There have been relevant contributions on the relation between Borges's literature and the brain. In *Variaciones 32*, Ezquerra has accounted for the concrete and astonishing similarities between "Funes el memorioso" and *The Mind of a Mnemonist*, "a little book about a vast memory" written by the eminent Russian neuropsychologist Alexander Luria. Some other similarities between Ireneo Funes and Solomon Shereshevsky (a real mnemonist and a real patient of hypermnesia) had been considered previously by Verbene. Within this context, according to Novillo-Corvalán, neuroscientific research can shed light on the affliction suffered by Funes (and other literary characters).

Quian Quiroga, a neuroscientist who published in 2011 the book *Borges y la memoria*, considers that "Funes el memorioso" is an exploration of the intrincate pathways of memory and the consequences of a permament recollection. In an article published in *Nature*, he observes that this tale reveals Borges's "longstanding interests in psychology, memory and

neuroscience" (611). Quian Quiroga discovered neurons in the cortex that respond to abstract concepts but ignore particular details, precisely in the way Borges imagined the consequences of remembering every detail but being incapable of abstraction. He also suggests that Borges accounted for the problems of distorted memory capacities well before neuroscience developed. In a study using electrodes with different kinds of patients such as epileptic individuals, he and some colleagues identified a type of neuron that fires in response to particular concepts (Quian Quiroga et al., "Invariant" 1107). For instance, one neuron in a patient fired only in recognition of different pictures of the actress Jennifer Aniston. These neurons seem to connect perception and memory by abstracting concepts and forgetting irrelevant details. If these neurons were lacking, the ability to abstract concepts could be limited, producing conditions such as autism or personalities like that of Funes. Borges's intuitive description is sharp and completely consistent with such a discovery:

> ...era incapaz de ideas generales, platónicas. No sólo le costaba comprender que el símbolo genérico *perro* abarcara tantos individuos dispares de diversos tamaños y diversa forma; le molestaba que el perro de las tres y catorce (visto de perfil) tuviera el mismo nombre que el perro de las tres y cuarto (visto de frente). Su propia cara en el espejo, sus propias manos, lo sorprendían cada vez. (490)

This article may count as another contribution aiming at showing the powerful correspondences between some of Borges's writings and the scientific knowledge of the brain provided by neurosciences. Concretely, I will try to demonstrate that several insights offered by Borges are absolutely compatible with core hypotheses about the linguististc system of the brain that haven been proposed by Neurocognitive Linguistics.

2. Neurocognitive Linguistics and Relational Network Theory

Neurocognitive Linguistics is a theory created by the American linguist Sydney M. Lamb on the basis of Stratificational Linguistics (*Outline*; "Language as a Network"). It posits a set of hypotheses about the structure and operation of the linguistic system of the brain, and shows how linguistic information can be actually represented in the connectivity of a huge network where thousands of locations are active in parallel. Its main hypotheses seem to be confirmed by the findings of neuroscience (Lamb, *Pathways*; *Language and Reality*; "Dimensions"; "What"; "Semiotics"; "Language and Brain"; "Being").

It should be acknowledged here that Neurocognitive Linguistics is not the main stream in language sciences. In fact, it could be considered as a rather marginal neurolinguistic theory, because its main hypotheses are incompatible with the ones corresponding to the most powerful linguistic theory: Generative Linguistics, which is mainly represented by his creator, Noam Chomsky. However, neurocognitive hypotheses *are* neurologically plausible. On the other hand, generative hypotheses are disconfirmed by such evidence. For example, Generative Linguistics proposes symbols in its accounts of the linguistic system of an individual, but there are no symbols in the brain, and the brain does not have an internal device to manipulate symbols. Regarding this particular case, the main stream has not provided any meaningful hypotheses of brain function that can be easily related to the work of Borges, whereas Neurocognitive Linguistics has. This situation provides one further reason to pause and take a more serious look at this linguistic theory and what it has to say. In addition, some avant-garde investigators, like Majumdar and Sowa, have recently seen its values and have used it in their work. As another example, we could also mention that some of the last discoveries in neuroimaging, based on Friedeman Pulvermüller "neuroscience of language", are consistent with the neurocognitive hypothesis according to which the linguistic system is a particular brain system richly and strongly connected with other cognitive systems, namely the visual, the auditory, and the somato-sensory systems. This concrete hypothesis seems to be confirmed, for example, in the empirical research conducted by J. González, A. Barrós-Loscertales, and their colleagues.

In fact, according to Lamb, the term "language" is conceived as a simple label that can be put into use in order to talk about a particular configuration of interconnected subsystems: phonological recognition, phonological production, lexical systems, morphology, syntax, semantics of concrete nouns, etc. We simply like to think about those different systems as if they were unitary. Within this context, the linguistic system of the individual is conceived as a real biological system which has the form of highly complex set of networks (Lamb, "What"; Gil).

Since the linguistic system is conceived as a network of relationships, there must be some type of notation accounting for this fact. In this sense, *relational network theory* will provide concrete diagrams to depict *any part* of the actual linguistic system of an individual. For example, Figure 1 aims at representing some of the relationships involving the Spanish lexeme *historia* [*story*, *tale*]. The relationships represented in Figure 1 include the synonyms *cuento* and *relato*: The three lexemes (*historia-cuento-relato*) are connected with the node corresponding to the semantic representation of TALE. Figure 1 also accounts for the fact that *historia* is polysemic, because the node for this lexeme is connected both with the meanings TALE and HISTORY.

The diagram helps us to understand one of the main hypotheses of Neurocognitive Linguistics: the linguistic system *is* a network of relationships. Nections and connections are the fundamental (and unique) constituents of relational networks. Nections are the basic modules, and they have a central line connecting two nodes, one with upward branching, and the other one with downward branching. Connections are represented by means of the lines that link nections.

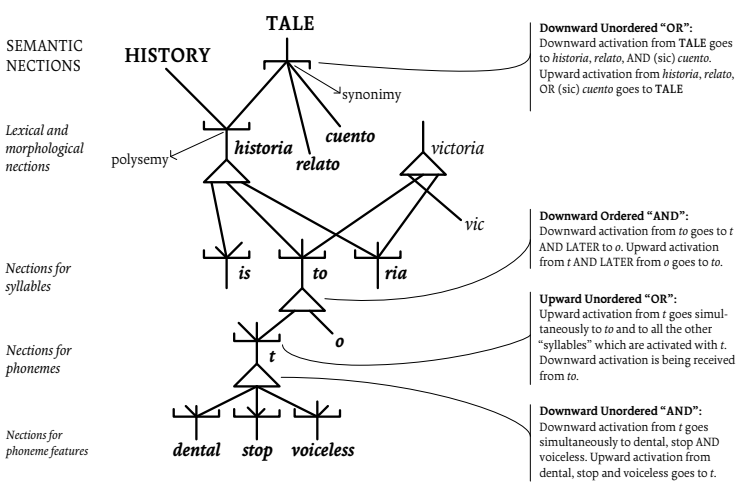

FIGURE 1. The Spanish lexeme *historia* and some of its connections

Figure 1 provides examples of different types of nodes used in the abstract notation of relational networks, also known as "compact notation" (Lamb, *Pathways* 67). The nodes differ from one another according to three parameters of comparison:

(1) UPWARD VS. DOWNWARD ORIENTATION. Roughly speaking, upward orientation goes to semantics, whereas downward orientation has in phonology its final destination. Labels for semantic nections are represented in CAPITAL LETTERS. Lexico-grammar is the intermediate level, between semantics and phonology, and labels for lexico-grammatical and phonological nections are represented in *italic letters*.

(2) AND VS. OR NODES. This opposition between "ands" and "ors" does not only account for syntagmatic and paradigmatic relationships, but it also allows us to represent them. Sometimes, all the connections of a node have to be activated, i. e., all of its connections are *in praesentia*. Sometimes, only one of the connections of the node is activated, and the rest of the connections are there *in absentia*.

(3) ORDERED VS. UNORDERED. Some activations are simultaneous (i.e., unordered), but other involve sequence management. For example, the activation of the features of a phoneme (like dental, stop, voiceless) is unordered, but the activation of the syllables of a lexeme has to be sequentially ordered.

It must be emphasized that activations are bidirectional here. (There is another type of notation where activating lines are unidirectional.) Relational networks are very useful to illustrate that, as Halliday explains, the linguistic system is "a three-level system in which meanings are first coded into wordings and these wordings then recoded into expressions" (xvii-xviii). These three levels are clearly represented in Figure 1, where we can identify semantics (SEMANTIC NECTIONS), lexico-grammar (*nections for lexemes and morphemes*), and expressions (nections for syllables, phonemes and phoneme features).

Relational networks can also be used to account for the not unusually great differences in text interpretation, for example those suggested in "Pierre Menard, autor del *Quijote*." In fact, Cervantes ("the lay genius") and Menard ("a contemporary of William James") made manifest in their writings the same sequence of words:

> *... la verdad, cuya madre es la historia, émula del tiempo, depósito de las acciones, testigo de lo pasado, ejemplo y aviso de lo presente, advertencia de lo por venir.* (449)

But Borges taught us that everyone who reads *Don Quixote writes Don Quixote*. Written by Cervantes, this enumeration is a just a rhetorical praise of history, typical in the seventeenth century. This interpretation is depicted in Figure 2, where the semicircle is a threshold node representing the concept HISTORY. This node can be activated by several entering lines (connections to other semantic nections), for example the concept DEPOSITORY-OF-DEEDS.

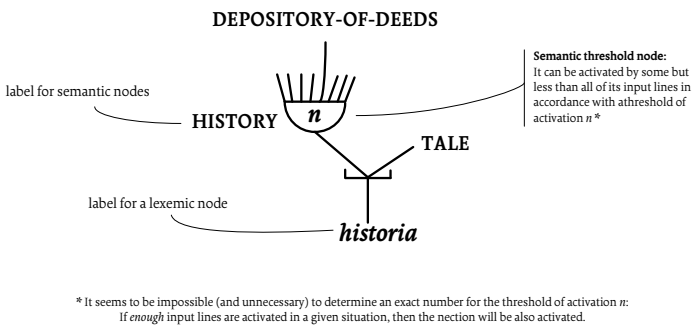

FIGURE 2. Conventional interpretation of HISTORY in *Don Quixote*, written by Cervantes

On the other hand, in the version of *Don Quixote* written (or read) by Pierre Menard, the concept HISTORY is defined as the very origin of reality: "No define la historia como una indagación de la realidad, sino como su origen" (449).

Menard's alternative interpretation is represented in Figure 3.

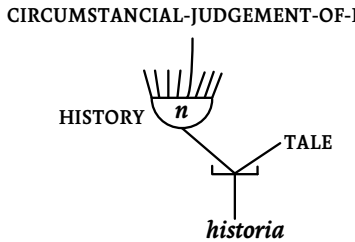

FIGURE 3. Menard's interpretation of HISTORY in *Don Quixote*

The comparison of Figure 2 and Figure 3 helps us to show that text comprehension is possible thanks to the internal linguistic structure of a particular individual. Namely, the nections and connections in Menard's linguistic system differ from those in Cervantes's system. It should be added that neurocognitive relational networks are *purely* relational: in Hjelmslev's terms, they free linguistic science from the metaphysical hypothesis that objects and symbols are something different from relationships. Since symbols are not part of the linguistic system, the inscriptions in relational networks are just labels.

We could also consider that neurocognitive relational networks are realistic because (among other things) they are neurologically plausible (Lamb, *Pathways* 293-4): its hypotheses seem to be compatible with what is known about the brain from neuroscience. For example, our brains do not store and do not manipulate symbols. The internal linguistic system does not have symbolic representations of phonemes, morphemes, lexemes, concepts, etc. but the means for producing such forms in oral or written texts. In other words, the *products* of the linguistic system, which (for instance) can be represented in written forms, are very different from the internal structure that makes them possible.

Relational networks are attractive from a neurological point of view because, as already stated, they are compatible with neurological evidence. Neuroscience research has shown that the cerebral cortex *is* a network, and that learning develops as strengthening of connections. Basic processes involved in text comprehension operate directly in the network "as pat-

terns of activation traveling the pathways formed by its lines and nodes" (Lamb, "Language and Brain" 157). Linguistic information is not stored as symbolic representations, but *it is in* the connections.

There is a good amount of indirect relevant indirect evidence for the neurological plausibility of relational network theory. For example, Hubel and Wiesel demonstrated that visual perception in cats and monkeys works in the ways that would be predicted by the relational network model, and that the nections of visual network are implemented as *cortical columns*. "The nodes are organized in a hierarchical network in which each successive layer integrates features from the next lower layer and sends activation to higher layers" (Lamb, "Language and Brain" 168).

The famous neurologist Vernon Mountcastle discovered and characterized the columnar organization of the cerebral cortex. In his book *Perceptual Neuroscience: The Cerebral Cortex*, he explains that the basic unit of the mature neocortex is the cortical *minicolumn*, a narrow chain of neurons that extends vertically across cellular layers II-VI. Each minicolumn contains about 80-110 neurons and all the major phenotypes of cortical neural cells. Mountcastle's general hypothesis is that the minicolumn is the smallest processing unit of the neocortex, and he also claims that "every cellular study of the auditory cortex in cats and monkeys has provided direct evidence for its columnar organization" (181).

Since speech perception is a higher-level perception process, it is permissible to suggest the following extrapolation: each node (or nection) in the neurocognitive system of an individual can be implemented as a cortical column. Within the linguistic system, every nection/cortical column has a highly specific function. For example, there may be one nection/cortical column corresponding to the lexeme *historia* as it is represented in Figure 1. In fact, Lamb's extrapolations allow us to consider seriously the argument for the neurological plausibility of relational networks:

i. Nodes represented in relational networks are implemented (with an important level of abstraction and generality) as minicolumns.

ii. Connections represented in relational networks are implemented (with an important level of abstraction and generality) as fibers.

iii. Minicolumns and fibers integrate real cortical connections.

iv. Therefore, relational networks represent (with an important level of abstraction and generality) real cortical connections.

In conclusion, neurocognitive relational networks can be interpreted as realistic maps of certain pathways in the linguistic system of the brain. This internal and individual structure is the highly complex system which allows human beings both to produce and undertand oral and written texts of any kind.

3. Borges's literature and Lamb's neurolinguistics

Quian Quiroga has been in direct contact with manuscripts written by Borges. In his article in *Nature* he tells us that there is a personal intriguing note in a copy of *The Mind of Man*, a psychology textbook by G. Spiller (1902). Borges wrote: "Memories of a lifetime, p. 187."

On this page, Spiller estimates how many memories a person has from different stages in a lifetime: around 100 for the first 10 years, 3,600 until 20 years, 2,000 more memories between the ages of 20 and 25, reaching about 10,000 in the first 35 years of life. He also states how much time it would take to recall these memories. For example, one does not remember every detail of a long trip, but instead certain landmark points–perhaps the moment of departure and arrival, or some stop in between. Borges says of Funes: "Two or three times he had reconstructed an entire day; he had never once erred or faltered, but each reconstruction had itself taken an entire day" (611).

In Neurocognitive Linguistics, there are also relevant considerations about the number of nections/minicolumns that an individual would need in order to represent linguistic information. For example, Wernicke's area (in the upper part of the left temporal lobe, close to the primary auditory area) is the zone of phonological recognition. There we have our phonological representations. On the basis of rough measures, Lamb (*Pathways* 318-9) suggests that, in a typical person, we get a surface area of 15 to 20 cm^2. Of course, we do not know how many neurons there are there. Nevertheless, it is possible to make another rough estimate by measuring the cortical surface of Wernicke's area and multiplying by a reasonable estimate of the number of neurons per cm^2 of cortical surface. Lamb estimates the density of neurons to be around 80 to 100 per mm^2 of cortical surface, or 8 to 10 million per cm^2. Using the figures at the ends of both ranges, we get between 120 and 200 million neurons in Wernicke's area.

By the end of section 2 we said that one single nection can be implemented as one single cortical column, and cortical columns consist of about 110 neurons (including both excitatory and inhibitory neurons). Thus, we can divide 120-200 million neurons by 110, to get from 1.1 million to 1.8 million nections in Wernicke's area. Lamb's estimations are very rough, but we are in the range of 1 to 1.5 million nections.

According to the nerucognitive approach, Wernicke's area needs enough nections to represent all phoneme features, phonemes, syllables, phonological words etc. that could become known by a person in as many languages as a person is likely to be able to learn. A very generous estimate would be 50.000 nections per language. Consequently, even for polyglots, there are more than enough latent nections to represent all the phonological information in Wernicke's area: there are more than one million nections available, and we would need "only" 50.000 nections per language.

This first comparison may help us to show that Borges and Lamb have been deeply engaged in the explorations of the capacity of our cognitive and linguistic systems. Although Borges was not a neurolinguist or a neuroscientist, he has written astonishing passages that can be straighforwardly interpreted in neurocognitive terms. I will provide further examples about this interpretation in the following paragraphs.

3.1 THERE IS NO SUCH A THING AS THE MEANING OF A TEXT

It has been said that it is a revelation to compare Menard's *Don Quixote* with Cervantes's. Figure 2 illustrates that the enumeration about history is, at the beginning of the seventeenth century, "un mero elogio retórico de la historia" (Borges 449). On the other hand, it is interpreted that the expression "madre de la verdad", when written by Menard, implies an astounding idea: history is not an inquiry into reality, but the origin of reality. This interpretation has been represented in Figure 3. In neurocognitive linguistics, there is no such a thing as *the* meaning of a text apart from an interpreter. Meanings are not conveyed by a text. Rather, elements of the text evoke meanings in the minds of interpreters (Lamb, "Interpreting" 296).

3.2 REFERENTIAL POWER OF WORDS

Many times, Borges has made manifest his reluctance to the referential capacity of language. For example, in his essay "El lenguaje analítico de John Wilkins", he does not only suggest that every linguistic classification of the Universe is arbitrary and full of conjectures, but he also quotes Chesterton's words about language clumsiness:

> Esperanzas y utopías aparte, acaso lo más lúcido que sobre el lenguaje se ha escrito son estas palabras de Chesterton: "El hombre sabe que hay en el alma tintes más desconcertantes, más innumerables y más anónimos que los colores de la selva otoñal [...] cree, sin embargo, que esos tintes, en todas sus fusiones y conversiones, son representables con precisión por un mecanismo arbitrario de gruñidos y chillidos. Cree que del interior de un bolsista salen realmente ruidos que significan todos los misterios de la memoria y todas las agonías del anhelo (G. F. Watts, pág. 88, 1904)." (709)

The neurocognitive approach assumes that categories are in the mind, not in the real world, and that they influence thinking. We may consider, for example, the Spanish word/lexeme *gato*. It could be said that *gato* stands for cats, peculiar objects in the outside world. In *Pathways of the Brain* Lamb suggests that if we do believe that lexemes stand for objects in the world, we will ignore the mind and indulge in the "transparency illusion". A salient characteristic of the functioning of our minds is "to make themselves as transparent as possible", keeping us from realizing that we are dealing directly only with them, our cognitive systems, and only indirectly, and through them, with reality. This is the "transparency illusion" (12).

The lexeme *cat* is not directly connected to anything in the external world: It is connected to the concept CAT, which is connected to the visual, the auditory, and the somato-sensory systems, since visual images representing the appearance of a cat, the representation of the cat's meow, or the feeling of the cat's fur, *are* part of the meaning of the concept CAT. Of course, this concept has connections to other concepts, like ANIMAL, FELINE, PET, DOMESTIC, etc.

The perceptual systems (visual, auditory, and somato-sensory systems) are in turn connected to sense organs, and *these* sense organs are the ones which have direct relationships to things of the world. It is only through other mental modalities (conceptual, perceptual, and motor) that lexemes have relationships to those referents in the external world. Fig-

ure 4 aims at depicting some aspects of the complex connections between nections for lexemes, nections for meanings, parts of the body as interfaces, and objects of linguistic reference (like flesh-and-blood cats).

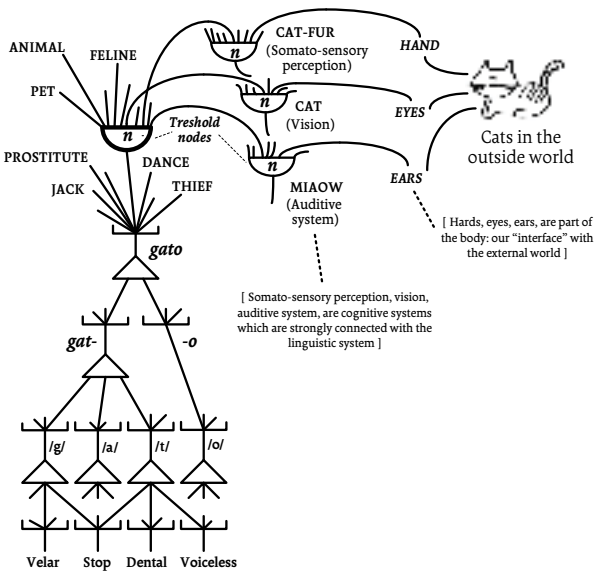

FIGURE 4. The nection for the lexeme *cat* and some of its main connections. (Lexemes/ words are several steps removed from extra-mental reality)

In summary, words/lexemes are several steps removed from extra-mental reality. We have the normal tendency to believe that they denote perfectly or directly things in the outside world. This is a very reasonable tendency in our ordinary life, because on its basis we manage for example to organize experience and to solve everyday problems. (Generally, we do not especulate about the referential meaning of *toilet* if we need to use it.) However, like Borges, Neurocognitive Linguistics helps us to understand why the belief in a *direct* reference to the external world is just an illusion.

3.3 ON THE NATURE OF ENDURING OBJECTS

Amongst the doctrines of Tlön, the most scandalous has been traditional realism or "materialism." Most *Tlönians* can only perceive that realism is an "inconceivable thesis." In order to explain it, many versions of the sophism of the nine copper coins were devised. The following is the most common:

> *El martes, X atraviesa un camino desierto y pierde nueve monedas de cobre. El jueves, Y encuentra en el camino 4 monedas, algo herrumbradas por la lluvia del miércoles. El viernes, Z descubre tres monedas en el camino. El viernes de mañana, X encuentra dos monedas en el corredor de su casa. El heresiarca quería deducir de esta historia la realidad –id est, la continuidad– de las nueves monedas recuperadas. Es absurdo (afirmaba) imaginar que cuatro de las monedas no han existido entre el martes y el jueves, tres entre el martes y la tarde del viernes, dos entre el martes y la madrugada del viernes. Es lógico pensar que han existido –siquiera de un modo secreto, de comprensión vedada a los hombres– en todos los momentos de esos tres plazos.* (437)

The various languages of Tlön, as Borges notes, resisted the formulation of this paradox. Most people did not even understand it. The "defenders of common sense" argued that the paradox was just a verbal fallacy inspired in the reckless combination of two unacceptable neologisms: the verbs *encontrar* and *perder* [*find* and *lose*], which presuppose the identity of the first and of the last nine coins. They recalled, for example, that very nouns like *hombre*, *moneda*, *martes* or *lluvia* [*man*, *coin*, *Thursday*, *rain]* only have metaphorical value.

According to Lamb, one of the consequences of the "transparency illusion" (see paragraph 3.2.) is our impression that the world comes in the form of objects, readily available to all and that a language needs only to assign names to them. But, as Whorf says, phenomena come in the form of "kaleidoscopic flux" (213), and this flux is segmented and organized by our mental systems. Thus the perceptions of objects we tend to take for granted are in part the products of our mental systems themselves. If we look close enough, there are no things at all, because "the assumption of enduring objects is one of the byproducts of the functioning of our cognitive networks" (Lamb, *Pathways* 240).

"Tlönians" cannot even conceive enduring objects. Their cognitive systems (which could be interpreted as a counterexample of actual human

cognitive systems) do not allow them do so. "Tlön, Uqbar, Orbis Tertius" enables us to ask the question to what extent our cognitive systems are really good enough to know "real world." Maybe, we are those who are incapable of thinking about an "essential" discontinuity of external objects. For example, words do not occur in isolation in everyday speech. Our ears receive sequences that do not have physical gaps making a segmentation of words. The auditory system and the phonological system of the brain are in charge of this segmentation. Thus we experience the useful illusion that we are hearing speech in the form of a succession of individual words. Even the "objecthood" of objects is a product of our brains, which not only have the tendency to separate parts of reality, but also to assume self-identity through time of the resulting parts. Human beings tend to assume that their continued self-identity from one time period to the next is an essential property of objects. The neurocognitive approach to language and cognition maintains, similarly to Borges, that this property is actually bestowed on them by our brains.

3.4 Complete descriptions are impossible

In the short parable entitled "Del rigor en la ciencia", Borges aims at making fun of the naïve conception of science, i.e., the conception according to which scientific descriptions must be absolutely exhaustive.

> En aquel Imperio, el Arte de la Cartografía logró tal Perfección que el Mapa de una sola Provincia ocupaba toda una Ciudad, y el Mapa del Imperio, toda una Provincia. Con el tiempo, estos *Mapas Desmesurados* no satisficieron y los Colegios de Cartógrafos levantaron un Mapa del Imperio, que tenía el Tamaño del Imperio y coincidía puntualmente con él. Menos Adictas al Estudio de la Cartografía, las Generaciones Siguientes entendieron que ese dilatado Mapa era Inútil y no sin Impiedad lo entregaron a las Inclemencias del Sol y los inviernos. En los Desiertos del Oeste perduran despedazadas Ruinas del Mapa, habitadas por Animales y por Mendigos; en todo el País no hay otra reliquia de las Disciplinas Geográficas. (847)

Borges implies that those who expect absolutely exhaustive descriptions of facts and phenomena are as naïve as the obsessive cartographers of that Empire. Lamb's conception of the "maps" of the pathways of the brain provided by relational networks also discards the illusion of perfect and complete descriptions. "No one could ever draw a network that would provide a complete account, even after a lifetime of work" (*Pathways* 156).

3.5 Learning (building nections) is to forget differences

Ireneo Funes could not forget any difference. Therefore, he was not able to learn.

> Había aprendido sin esfuerzo el inglés, el francés, el portugués, el latín. Sospecho, sin embargo, que no era muy capaz de pensar. Pensar es olvidar diferencias, es generalizar, abstraer. En el abarrotado mundo de Funes no había sino detalles, casi inmediatos. (490)

Differently from Ireneo Funes (and, perhaps, also from Solomon Shereshevsky) "*we learn only what we learn*, not everything we experience" (Lamb, *Pathways* 340). The automatic functioning of the cognitive system of the brain thrives on similarity; it tends to find more similarity among diverse things than is actually there (Lamb, *Pathways* 247).

And what is memory? Faulty theses about symbols led to illusions of what memory is and how it works. If information were contained in the symbols, the symbols should then be contained in a memory. The memory should be then some kind of store room. But, as it has been said, in the neurocognitive conception there are no symbols. The network is what *interprets* symbols, which exist only *outside* the cognitive system. And the network *is* the memory. Relational network theory frees us from the illusion that memory and the information it contains are two separate dimensions.

4. (brief) conclusions

1. There are strong affinities between some fundamental and well-known ideas in the works of Borges and some basic hypotheses of Neurocognitive Linguistics. By means of a hyperbole, we could suggest that Borges was a neurolinguist *avant la lettre*. On the other hand, neurocognitive linguistics can be considered relevant not only for linguists and neuroscientists, but also for literary critics, writers, and readers interested in the work of Borges.

2. Evidence provided by neuroanatomy demonstrates that the brain is a network of interconnected neurons. In addition, the study of linguistic

evidence also demonstrates that the linguistic system is a network of relationships. This hypothesis may be surprising for many linguists: its plausibility is accepted only by a tiny minority, since most linguists (for example, generative linguists) consider that the linguistic system is something like a set of rules, or principles, or syntactic operations applied to symbolic objects. In this paper, Figures 1-4 are examples which aim at supporting the hypothesis that the linguistic structure is a network of relationships.

Neuroscientists have obtained vast and deep knowledge of the physical structures in the brain. Nevertheless, this knowledge is far from revealing how the brain performs the processes used to produce and understand utterances. For example, the enormous and profitable development in modern brain imaging offers information about *where* things are going on, but not about *what* is going on. It is not hard to understand why neuroscientists will not provide the answers that linguists are trying to find: Neuroscientists do not study linguistic evidence (and they do not need to do so).

Thus it is not possible to understand how the brain processes language without understanding linguistics. On the basis of the complex evidence provided by neuroscience *and* linguistics, it is possible to build a bridge between neural networks and relational networks.

After accounting for the strong affinities between neurocognitive linguistics and Borges's writings, we finally arrive at a surprising conclusion: we can learn something about the structure and operation of the brain not only from linguistics, but also from literature.

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