Neurolinguistics, Language and Time: investigating the verbal art in its amplitude

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Abstract
In this paper, we depart from the two-dimensional structure of language, as proposed by Jakobson, in order to conduct an investigation in which Neurolinguistics and Mathematics are articulated with the purpose to discuss issues involving the study of language disorders. The language of mathematics allows for portraying the real as a process. And that was the means by which, instead of establishing reflections about language in the two-dimensional structure, we proceeded to study it under a three-dimensional perspective that takes into account the factor time in the vector space, characterized as a space of probabilities. We have established a counterpoint between truncated enunciations by subjects with language disorders and enunciation according to the poetic function as defined by Jakobson. Although Jakobson refers to language (with its standing structure) and neglects speech in the bipolar structure, in this study, we propose the articulation of speech to the element time, thus providing the structure of language with a third dimension. We concluded that language learning places enunciation in a structure where time counts; the temporal element crosses linguistic particularities and inserts a value in enunciation, thus opening possibilities in meaning change (an event, according to Pêcheux, 2002), and this makes the subject viable by guaranteeing him quality of life.

Keywords: Neurolinguistics, Mathematics, subjectivity, language disorders, poetic function

Introduction
The freedom to which the phrase above (Dwight Eisenhower) refers has been understood, in current scientific production, as an opportunity for interdisciplinary research to be conducted. Ledford (2015) published the article “How to solve the world’s biggest problems” in Nature and cited Theodore Brown (vice-chancellor for research at the University of Illinois at Urbana-Champaign in the early 1980s) in order to justify the need for interdisciplinarity in scientific research: “The problems challenging us today, the ones really worth working on, are complex, require sophisticated equipment and intellectual tools, and just don't yield to a narrow approach”. Also, according to Ledford, “because industry is often focused on real-world problems that cross disciplines, an interdisciplinary programme could foster more collaborations with business”.

To such concern about freedom in how research is conducted we must add the observations by Whorf ([1942] 2017), who points out an even deeper issue, that of language, which imposes limits to the point of view that we have adopted: “every language [...] incorporates certain points of view and certain patterned resistances to widely divergent points of view [...] restraining the scientific spirit as a whole from taking the next great step in development—a step which entails viewpoints unprecedented in science”.

In 1942, Whorf already stated that “It needs but half an eye to see in these latter days that science [...] has reached [...] a frontier”. And he pointed out the fact that “one of the important coming steps for Western knowledge is a re-examination of the linguistic backgrounds of its thinking, and for that matter of all thinking”. How can thought be reformulated? Should the adoption of interdisciplinarity do it? Whorf ([1942] 2017) believed that there must be change in the “realm of patterned relations”, which has an affinity with the systematic organization of language.

Michel Pêcheux (2002), a French philosopher and founder of the Discourse Analysis theory, was intrigued by the evidence “embedded” in discursive practices (Pêcheux, 1988, p. 159 and ss.) and preferred to exercise his reflections “in between”, that is, out of the pre-established regions of knowledge. In his book “Discourse: structure or event?”, Pêcheux (2002) relates the logically stabilized universes to those of equivocal formulations and concludes that some discourses are not more real than others. The author asks himself about a semantically “normal” world which, since it does not take into account the existence of equivocals (op. cit., p.9), instrumentalizes processes in such a way that eventually directs, with defined crite-
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*How far can scientific thought overcome the pressure of grammatical patterns?*


The basis for our reflections on the verbal art lies on the precedent that it is possible to describe the real as a process (Pêcheux, 2002) and on the idea, brought by Whorf ([1942] 2017), that, through mathematics, we can make the approach to reality. It is in this way that we propose to describe some language phenomena: by means of mathematics. According to Whorf (op.cit.), “mathematics is a linguistic apparatus, and [...] mathematics [...] is a specialized formula-language” which, for example “enables a physicist to adjust some coils of wire, tinfoil plates, diaphragms, and other quite inert and innocent gadgets into a configuration in which they can project music to a far country”. To the author “mathematics is a special kind of language, expanded out of special sentences containing the numeral words, 1, 2, 3, 4 . . . . x, y, z, etc.”, which makes it a “a far-reaching system” and enables us to understand patterns in a limited way by using mathematical or grammatical formulas, replacing formulas into words, values, quantities etc. (Whorf, op. cit.). David Schramm (1995, p. 38) puts: “the beauty of the mathematics and physics that describe nature is repeatedly noted by scientists and mathematicians. One’s impression is that in the past it was not uncommon for intellectual leaders in the humanities to appreciate it as well”. Concerning that subject, Levitt (1996, p. 41) adds that:

> It might be noted that, much as the medieval scholar doted on mathematics, he viewed it as rather a static and settled matter, a body of law that had been divinely set down by prophets, Evangelists, and Apostles [...] Nonetheless, the view of “mathematics” as an open-ended, creative process, capable of indefinite expansion and of being applied to detailed explication to a vast range of natural phenomena, was not that of the European Middle Ages.

Levitt (op. cit., p. 46) suggests the term “mathematician” in a wider sense than the current academic sense (“anyone who is familiar with a body of nontrivial mathematics”), which is: mathematician as embracing “physicists and computer scientists, but also most other physical scientists and engineers, many biologists, psychologists and linguists and [...] a host of economists, sociologists, demographers, and professional gamblers”.

Having established mathematics in this wider sense, we seek to understand the functioning of language operating on the metaphorical (y-axis) and metonymic (x-axis) axes, according to a two-dimensional scheme proposed by Jakobson. In this article, we theorize the inclusion of one more axis, the z-axis, thus making the functioning of language three-dimensional, that is, in addition to the metaphorical axis and the metonymic axis, we consider the element *time* under given conditions. The articulation of these three axes has the purpose to understand the functioning of language of children and young individuals with hydrocephalus. Their brain dysfunction interferes with enunciation by giving it particular aspects (truncated enunciation), and our assumption is that such aspects are closely related to the fact that these hydrocephalic children and youngsters have not developed a capacity for temporal perception. This investigation is ongoing, and it has the final purpose to propose pedagogical attitudes that will help these subjects in social living by providing them with quality of life.

1. Changing the two-dimensional system into a three-dimensional system

In this study, our attempt is not focused on mathematics, but on the fact that how much mathematics can help us understand what goes on in the world. Such reasoning can help us keep away from a reducing thought of reality to “disjointed collections of odd, unaccountable ‘facts’, naked propositions without context, logic or elegance” (Levitt, 1996, p. 46) and, eventually, make us understand that

> such a cultural possibility exists because history shows us cultures where it has been realized. There have been times and places where mathematics was a vital element in the play of ideas that edified and enriched the entire society, where it lent a quality of usefulness and repose to thought, where it obliged thinkers of all kinds to be more elegant and accurate. There is no royal road that will swiftly transport our contemporary culture to a similar state of grace. But we ought to be scrutinizing our cultural road maps for whatever guidance they can offer, in hopes of finding an accessible pathway (Levitt, 1996, p. 51-52).

A good start for the reasoning about the verbal art which is not reality-reducing is that of the transformation of such reality (three-dimensional) into a two-dimensional plane. Allying mathematics with linguistics was the first step. How can geometrical spaces be transformed into Cartesian coordinates? The answer lies in describing
reality in sets. That was what Jakobson did when he described the sets of the paraphrastic axis and of the metonymic axis as we know them. The way that he used to make such transformation into algebra was through the definition of “geometrical objects as sets of points” (DPMMS, 2017): Very often such an object is a set taken together with a mathematical structure imposed on it, which takes the form of certain relationships amongst the elements of the set [...] Sets are also very useful if one is trying to do metamathematics, that is, to prove statements not about mathematical objects but about the process of mathematical reasoning itself. For this it helps a lot if one can devise a very simple language - with a small vocabulary and an uncomplicated grammar - into which it is, in principle, possible to translate all mathematical arguments. Sets allow one to reduce greatly the number of parts of speech that one needs, turning almost all of them into nouns. (DPMMS, 2017, p. 3, our emphasis)

Two-thirds of smokers start before the age of 18 and in Essex we have a particular problem with 6% of 15 year olds smoking regularly and 4.5% smoking occasionally (Health and Social Care Information Centre, 2015). The Future in Mind Report (2015) stressed that ‘failure to support children and young people with mental health needs cost lives and money’ (Lee, 2015, page 13) The knock on effect on individual’s and their families’ emotional wellbeing also carries a heavy burden. There is a captive audience of patients of tomorrow within secondary schools yet it seems by not providing them with the education in these matters to the best of our ability an opportunity is being missed. The Royal Society for Public Health (RSPH) said there is a need for, ‘...radical upgrading in prevention and public health’ (RSPH, 2014, page 1) calling on all those who have knowledge and ability to positively impact on the nation’s public health.

Metaphorical and Metonymic poles: Saussure and Jakobson

Jakobson ([1956]2017, apud Nicholas, 2017) was a Russian formalist of the Prague School of Linguistics and in his Essay “The Aspects of Language and Two Types of Aphasical Disturbances”, he developed a structural analysis to state that there are two structural mechanisms underlying how language works. Saussure, another linguist, divided language as a two-fold character: Syntagm and Paradigm. Syntagm comes to form a phrase and Paradigm involves a selection of a noun from the inventory of the language. Jakobson realized that the combination (Paradigm) and Selection (Syntagm) play a fundamental role in language. Studying Aphasia, Jakobson described two functions in language: the similarity disorder, in which a patient loses capacity to select and substitute elements (he/she makes mistakes with content words or cannot recognize words without content); and the contiguity disorder, in which the patient fails to put words together to produce meaning. Jakobson states that the similarity disorder is an ally to metaphor (lexicon), and the contiguity disorder is an ally to metonymy (syntax). To exemplify this relation between metaphor and metonymy Jakobson uses two axes of language.

He (Jakobson, op. cit) argues that these two axes of language (paradigmatic-syntagmatic) cover two realities of language - operational and structural, selecting both realities in two sets: elements associated by similarity and elements associated by contiguity. The author (op. cit.) was concerned with language in operation and with language in drift, when he observed language disorders produced by aphasic patients. The questions involving the study of language disturbances are not simple questions, and this requires the coordination of various disciplines dealing with data that come from outside the traditional field of linguistics.

Jakobson (2010, p. 206, our emphasis) already sought to “claim for linguistics the right and the duty to undertake the investigation on the verbal art in all its amplitude and in all its aspects”. Such objective became the guiding point of this study: in search of such amplitude, we allied linguistics with other branches of science in order to study the enunciation of subjects with brain injury, observing how the formative mechanism of language takes place in these subjects as well as how the “exchange” between the principle of similarity and that of contiguity occurs, since they constitute the two basic poles of human language (Jakobson, 2010, p. 14 and 2). From Jakobson’s idea of establishing the paradigmatic axis (vertical) and the metonymic axis (horizontal) as the axes of language, we sought to investigate how the constitution of the subject in language takes place and what the importance of the temporal element in this relationship is.

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Based on the studies by Whorf, Jakobson and Pécheux (1988, 2002), we move away from traditional methods of study of language, which can be characterized as patterned resistances, in an attempt to discern the articulation between Neurolinguistics, Language and Time in a broader fashion so as to understand and even extend Jakobson’s thought about the relationship between language and the paradigmatic (y) and metonymic (x) axes (which operate in the two-dimensional space) by bringing to such relationship our considerations about the function of one more axis, that is, the z-axis, which represents the element time (considering a three-dimensional space).

1. Language in algebraic structure

According to Belgacem and regarding the phenomena presented above, in order to understand the third dimension, we need to understand the motion of an ant on the ground or a spider on the wall, or even someone’s handwriting on the board - the ground, the wall
or even someone’s handwriting on the board - the ground, the wall or the board, in this case, are measured in terms of \( x \) and \( y \), meaning if we can locate (choose) a point of origin \((x=0, y=0)\). Then the moving object (ant, spider or hand) can be located as a function of time within the frame \((x, y)\), so we have \( f(x=\text{length}, y=\text{width or height}, z=\text{time})\).

The standard practice, however, is to leave \( z \) for the third-space dimension and use \( t \) for time. So, if the object starts at the origin \((0,0)\) at time \( t=0 \) (we start the clock), then, it reaches the point \((2,3)\), say after 1 second or minute or hour, (depending on the units used). Then the function \( f(x,y,z=t) \) would describe the path of the particle/object as it moves from the origin to the point \((2,3)\) in the time period allowed, and of course that path can cross itself once or few times because there is no reason why the object cannot go back to a previous location (Belgacem, 2017). Jakobson (apud Caton, 1987, p. 227) believed that “the holistic (or structuralist) view of language was more insightful than the atomism of the nineteenth century [...] was a fuller and more explicit realization of Saussure’s dictum that linguistic form is abstract”. From the description of the Jakobsonian model of the \( x\) and \( y\)-axes, we added, in the figure below, the element time, related to \( z\)-axis in its relationship with the paraphrastic \((y)\) and metonymic \((x)\) axes:

![Simulation of 3D Point Rotation](Image 98x338 to 222x458)

From that point on, we will show the functioning of these three axes, considering all of them \((x, y, z)\) as elements of language. We will outline some particularities about the element time (related to the \( z\)-axis) in its relationship with the other two axes, and then draw some conclusions about the importance of time in language, since, as we have already mentioned, mathematical language enables the construction of the “physical real as a process” (Prêcheux, 2002, p. 38). Based on the reasoning about the “many algebraic structures as sets of functions” (DPMMS, 2017), Cabella states that we can think of time as something that discriminates, that makes the two-dimensional system \((x,y)\) work. According to the researcher, time interferes with whether or not a relationship is equivalent; it is time that will make the system behave as a system, discriminating an equivalent state from a non-equivalent state; time can occur between \( x \) and \( y \) when there is a displacement in the plane. According to Colin James III, the vector space (space between Cartesian coordinates \( x, y \) and “occupied” by the element time represented by \( y \)) does not provide bivalent values of true or false, but rather a probability for falsity or truth. For the author, “a vector space is probabilistic and not bivalent and hence not exact” (James III, [2009]2017).

2. Simultaneity and the principle of equivalence: \( x=y \)

In addition to the vector space described above, the concept of simultaneity, developed by Jakobson when he described the poetic function, gains a place of interest in this study so as to make a counterpoint in the analysis of the data. Simultaneous events are so called when there is “a chosen reference frame if and only if the chosen coordinate time has the same value for both of them; and this condition allows for the physical possibility and likelihood that they will not be simultaneous from the standpoint of another reference frame” (Wikipedia, 2017). According to Belgacem, to think simultaneity related to axes \( x \) (metonymy) and \( y \) (metaphor) (representing time in a chosen reference frame if and only if the chosen coordinate time \( z\)-axis has the same value for \( x \) and \( y \); and this condition allows for the physical possibility and likelihood that they will not be simultaneous from the standpoint of another reference frame), “coordinates \( x \) and \( y \) are measuring the location as a function of time”. So it is possible for \( y=x \). In this case, the object is moving in a straight line as a function of time (Wikipedia, 2017). Jakobson’s principle of equivalence in poetic structures shows metonymy and metaphor at a coordinate time, producing a pattern or significance in which the points intersecting are of similitude. That works on how words are put together. Jakobson (2010, p. 166) defended that “poetic language projects the principle of equivalence, from the axis of selection \((y)\) to the axis of combination \((x)\)”.

In algebraic language the role of the \( z\)-axis is a function of time on language producing metaphor and metonymy at the same time. According to Colin James III, “the only role of the \( z\)-axis, such as to measure time, is when in a poetic utterance, the selection and combination coincide with time as a relative measure”. If, to Jakobson (2010, p.14), the language-formation mechanism occurs in the functioning of the metaphorical expression (paradigm, \( y\)-axis) related to the syntagmatic faculty (metonymy, \( x\)-axis), to us, based on the Discourse Analysis theory (Prêcheux, 1988) and on Lacanian Psychoanalysis ([1949]1998), metaphor and metonymy are linguistic phenomena that act in the organization of the subject, allowing the subject's topology to be perceived.

Thus, we realize that an oral or written phrase is not just a “phraseological unit”, but it can express a creative sense, something that is undergoing a process of change. This change, by the way, is not in the structure of these phenomena. There is a lapse of time when these changes occur. These changes are not governed by statistical laws. We hypothesize the influence of the \( z\)-axis on Cartesian coordinates \( x \) and \( y \) to give a new dimension - the third dimension - to the axes of language defined by Jakobson. This insertion
may be a controversial issue, but it certainly provides the verbal art with a domain that is reserved for the element time, which cannot be overlooked. The observation of element time (z-axis) in its relation with the axes of language (x and y) during the analysis of the data on the speech and writing of hydrocephalic children (who do not have the ability to evaluate time) has led to the following result: as the speech is truncated, without construction of meaning in the metonymic chain, the z-axis (time) happens to be located very close to the y-axis (metaphorical: children replace words but cannot construct meaning in the metonymic chain). These children’s enunciation has a very small projection on the x-axis (there is little or no displacement on the metonymic chain, x-axis).

In contrast, we can observe the poetic function according to the principle of equivalence developed by Jakobson: the substitution of words (metaphor, y-axis) finds its maximum sense by interfering in the metonymic chain (x-axis). In this case the meaning finds its most extensive application in poetry. We can also affirm that it is at this moment that the subject’s topology reaches its greatest extent. We recall Jakobson’s statement (2010, p. 35) that “only the existence of invariant elements [and time, according to Cabella, is an invariant element in mathematical language] allows us to recognize these variations”. Although Jakobson studies language, in this article, we use his findings to help investigate the question of the subject, since the latter is constituted in language (Elia, 2004). The z-axis, representing the invariant element, allows us to recognize the variations in the subject’s topology in the space between the y- and x-axes, which is referred to as the vector space and, as previously stated, is a space of probabilities. According to Jakobson (2010, p. 37), with respect to the axes of language, “syntax is concerned with the axis of threads (concatenation) [x-axis]; semantics is concerned with the axis of substitutions [...] Concatenation implies substitution”.

In the specific case of the poetic function (Jakobson’s principle of equivalence of), we follow Belgacem’s reasoning (2017) to reach some conclusions: x, y and z represent similar things: location in one direction of space, each, so they cannot be assigned to different “natures” metaphorically, while time is different from them as it measures the clicking of a chosen clock, per se. The function F(x,y,z) represents a picture, a single frame of the graph or curve performed by the particle as it moves (like in a video). Dependent on the particle motion described by a space-time dependent function f(x,y,z, t), the relation of each coordinate to time can take various forms. For instance, these can be parametrized as say: x = 4t, y = 3t, z = sqrt(t), or say x= cos(t), y= sin(t) and z= t, or simply x= y= z= t if the motion indicates it. They give different curves in space as t moves from 0 to t = a chosen stopping time, to result in a video of the motion of the particle in a space during the period prescribed. Pictures, on the other hand, represent an instantaneous copy of that graph taken at an instance of time chosen by the observer (the photographer), or possibly a musical note among many of a song or a beautiful symphony.

We conclude that the poetic function interferes with the discursive chain as “F(x,y,t)”, and its representation in the discursive chain occurs in accordance with the movement that results from the same interference (the representation of the poetic function on the discursive chain is performed by the movement that the poetic function “imposes” on the discursive chain). Depending on the motion of the senses, the metaphor axis can be “parametrized” by the metonymic axis, resulting in different meanings, in accordance with the movement that the metonymic axis imposes. What is registered on the discursive chain due to the poetic function can be considered “an instance of time chosen by the observer (the photographer)” (Belgacem, 2017). We have described “an instance of time” in another article as when “photography gives a non-stabilization to the sense and makes a new sense, an unexpected sense” (Pimenta&Monte-Serrat, 2015).

The Prague School “claimed that, in the poem, ‘the poetic function dominates over the strictly cognitive function’ [...] making the poem more autonomous than other communicative events.” (Caton, 1987, p. 242).

3. Neurolinguistics in the dynamic symmetry of language

Part of neurolinguistics deals with the task of identifying which aspects of the mechanism of language functioning are affected when a subject has brain injury. Language impairment and brain injury are directly related. Speech disorders affect,”to varying degrees, the individual’s ability to combine and select language units” (Jakobson, 2010, p. 51). It is not our purpose to list the speech or writing disorders here, but we intend to interfere with them, trying to understand the organization and functioning of language when the brain is injured, and we seek to understand the consequences of that injury in the subject’s constitution when he enunciates.

In the study of language and the subject, the task of seeking elements in neurolinguistics to work on the language of an individual with brain injury is of fundamental importance, since the knowledge of linguistic constituents and the work on their combination according to a predetermined order, a specific repertoire and the rules of language, such as syntactic rules, for instance, can all interfere with the subject’s constitution, providing him with quality of life. While neurolinguistics has ignored “the freedom to compose totally new contexts” (Jakobson, 2010, p. 48), our job is to propose new knowledge so that the concept of authorship (Foucault, 2002; Tfouni, 2008) in the enunciation of subjects with brain disease becomes an evaluation criterion of language in order to promote social inclusion (Monte-Serrat, 2016; 2017a; 2017b). Jakobson (2010, p. 53) stated that “the more a word depends on others in the same phrase, and the more it relates to the syntactic context, the less it will be affected by the speech disorder”. Neurolinguistics is
markedly concerned about the predictable language, distancing itself from speech, which is understood as “disturbance” or something of less importance. We seek to make a counterpart between well-constructed sentences made by subjects without brain injury and truncated nonsense sentences produced by hydrocephalic subjects. We bet on the work on the phraseological structures (speech) of individuals with cerebral injury to interfere with their constitution as subjects. Our position is corroborated by research indicating that language learning interferes with an individual’s quality of life. In Solé-Padullés et alii (2009), we can observe the experience of learning to read and write as having the potential to cause modifications in the functional organization of the brain. For these hydrocephalic subjects, it is not a matter of working hard or studying more: it is all about learning how to work and study so that they can learn and apprehend knowledge and skills (Hydrocephalus Association, 2002, p. 5). “The loss of discourse is the loss of power to construct propositions [...] the inability to speak does not mean a total absence of words” (Jackson, H, 1915, opud Jakobson, 2010, p. 63).

It has been observed that, in hydrocephalus, although brain injury is restricted to specific areas, language mechanisms are performed under mental processes within a hierarchy, affecting other abilities (Hydrocephalus Association, 2002, p. 10, Dehaene, 2007). This chain reaction of the brain injury causes difficulties for children to evaluate distances and directions and to organize a sequence of movements. Also, in their speech, it causes difficulties in the task of separating relevant information from previous bases, thus affecting their ability to interpret meanings) (Oliveira&Pereira, 2013). These children focus on the literal interpretation of verbal communication because their ability of visual-spatial field organization, adaptation to new or unusual situations and of interpretation of non-verbal signals, such as body language, is impaired. The nuances between tone, intensity and rhythm of words in speech may go unnoticed by children with hydrocephalus, which is demonstrated by their difficulty in perceiving intonation or implied meanings. These factors show the need to develop a working strategy about the context and meaning in their use of language (op. cit.).

We understand that if there is an agrammatism, in which the subject cannot order the words due to some disturbance, it is to be expected that his constitution as a subject is impaired, thus affecting his quality of life, since he may be able to utter known words but which are not understood by himself or by others. We seek an approximation between what we observe in the speech and writing of hydrocephalic children with what Jakobson calls the “structure of poetry, [a] parallelism [which] results in [...] “the principle of equivalence” [...] projected ‘from the axis of selection into the axis of combination”’ (Caton, 1987, p. 240). From such approach, we intend to represent these processes on the paradigmatic ($\gamma$) and syntagmatic ($\chi$) axes of language. Verbal or non-verbal language presents a “bipolar structure” that points to a “competition between the two procedures, metonymic and metaphorical, and becomes manifest in any symbolic process, whether subjective or social” (Jakobson, 2010, p. 73). For Jakobson- A comprehensive view of the dynamic symmetry of language, implicating the coordinates of space and time, should replace the traditional model of descriptions arbitrarily limited to the static aspect (Jakobson, 2010, p.100, our emphasis, emphasis by the ‘author). As previously stated, it is in the vector space between the coordinates that enunciation takes place, and it is there that the subject is constituted (Elia, 2004). Language is constituted between the metaphorical and metonymic axes (Jakobson, 2010). Although Jakobson refers to language (with its standing structure) and neglects speech, his suggestion to relate space and time in the “bipolar structure” that he developed in relation to language opens a new perspective of study: that of articulating, in the subject’s enunciation, concepts of neurolinguistics, language and subject together with the elements “time and space” (time being = $z$).

4. Body and language: planes of the linguistic domain

Our work as a Collaborating Researcher at IEL-UNICAMP, in longitudinal a follow-up of hydrocephalic children whose brain lesions prevented the understanding of time, led us to observe that those subjects’ speech and writing did not follow a logical sequence. This particularity has led us (Monte-Serrat, 2016; 2017a; 2017b) to understand that the body (as approached by neurolinguistics) must not be forgotten, and it is crucial in this consideration: the body, which carries a brain injury, interferes with language in terms of anticipation “calculation” and surprise, as well as with the rhythms of speech.

Whorf ([1942] 2017) already considered the importance of the body when addressing the science of linguistics and stated that the linguistic domain forces us to recognize various planes: It is as if, looking at a wall covered with fine tracery of lacelike design, we found that this tracery served as the ground for a bolder pattern, yet still delicate, of tiny flowers, and that upon becoming aware of this floral expanse we saw that multitudes of gaps in it made another pattern like scrollwork, and that groups of scrolls made letters; the letters, if followed in a proper sequence, made words, the words were aligned in columns which listed and classified entities, and so on, in continual cross-patterning, until we found this wall to be a great book of wisdom! [...] First, the plane “below” the strictly linguistic phenomena is a physical acoustic one, phenomena wrought of sound waves; then comes a level of patterning in rippling muscles and speech organs, the physiological-phonetic plane; then the phonemic plane, patterning that makes a systematic set of consonants, vowels, accents, tones, etc. for each language; then the morphophonemic plane in which the “phonemes” of the previous level appear combined into “morphemes” (words and subwords like suffixes, etc.); then the plane of morphology; then that of the intricate, largely unconscious patterning that...
largely unconscious patterning that goes by the meaningless name of syntax; then on to further planes still, the full import of which may some day strike and stagger us. (Whorf, [1942]2017). Considering the body and language as a whole, we observed that grammar plays an important role in the monitoring of language learning by children with brain injury (Monte-Serrat, 2016, 2017b). This discovery led us to study the question of element time in its relationship with the axes (x, y) of language. To the bipolar structure of the language proposed by Jakobson, we then added the concept of vector (z-axis) and its respective function in the functioning of the former.

The observation by Boas (1938) about the function of grammar can help us to better understand the field of language. He describes grammatical function as that of selecting, classifying and expressing aspects of experience in order to finally determine “the aspects of each experience that must be expressed” (Boas, 1938, pp. 127-132, see Goldshmidt, 1959, our emphasis). He (Boas, 1938) further states that: “every difference in grammatical categories leads to semantic information” (apud Jakobson, 2010, p.118).

Patients with hydrocephalus cannot evaluate the time (Headinjury2015; Hydrocephalus Association, 2002). Their enunciation is truncated; they show (most of the time) a similarity disorder, losing capacity to select (they make many mistakes with content words or they utter without content). We can associate this situation with the issue of time (z-axis), which does not move, does not leave the 0 point. In this case time does not operate to make the system work and reach points 2, 3 etc. In order to counteract this observation regarding the truncated speech of children with hydrocephalus, we consider another fact based on Jakobson’s statement concerning the principle of equivalence in poetic structures, which works on how words are put together. Jakobson (2010, p.166) defended that “poetic language projects the principle of equivalence, from the axis of selection [y], to the axis of combination [x]”.

We understand that, in the latter case, the temporal organization of language is revealed in rhythm; it begins to assume, at the same time, a spatial extension in the sentence (syntax), forming new elements in the contiguity. The major importance in the poetic function is not in the choice of words, but in how to choose the words that were put together. Thus, the y-axis of metaphor does not cancel itself completely: there is a choice, but this choice is no longer so influential on the result. The x-axis, however, plays its role by interfering in the choice of elements based on the metonymic chain, interfering in the way how such choice will occur. There are several ways of producing rhymes, but what Jakobson proposes about the principle of equivalence is the fact that it interferes with the poetic structure of language (there is almost no place for developed lexation). This is what we can deduce from the following statement by Jakobson: We’ve been telling you that meaning is all about the axis of selection. But in poetic language, the syntagmatic relation (the axis of combination) is also a critical component of meaning. The fact that you’ve put together words that rhyme, or words that form a metre, or words that echo each other is just as important in the overall meaning as your initial choice of words (the strict meaning you intended to convey as a plain text communication). (Jakobson, 2010, apud Nicholas, 2017).

5. Time and subjectivity in language

Nous sommes mêlés au temps (Gonord, p. 12)
Le temps se manifeste prioritairement en nous…mais comme une réalité fuyante (p.13)
La conscience du changement qui révèle le temps (p. 15)
Le temps paraît surtout être un mouvement et un changement d’une certaine sorte (p.15)
Le temps est le nombre du mouvement selon l’antérieur-postérieur (p.16)
L’antérieur-postérieur signifie le sujet identique, l’unité fixe qui va permettre de mesurer un changement (p. 17)
Qu’est-ce que le temps? Nous – et que sommesnous? Du temps! Le temps fuse en nous, parce que nousfusons en lui (p. 27)
Le temps originaire commence avec la subjectivité, et la subjectivité est elle-même le flux constitutif du temps (p. 29)

The strategic configuration of language under the principle of equivalence (mentioned in the previous item) can be described, in mathematical language, as the articulation of the y- and z-axes on the x-axis, producing an intensification of the subjective aspect in the linguistic process. The interference of the z-axis (time), in case of operating the poetic function, is maximum. Describing the third dimension in mathematical terms we have:

A function \( f(x, y, z, t) \) measures the motion of a particle in time \( t \), in a Euclidian space \( (x, y, z) \), to describe the curve made by the particle in space, like that of a fly, or a plane. The coordinate \( x \) describes length, while \( y \) describes width, and \( z \) may be height. A point of reference, \( O (0,0,0) \), called origin, is designated, so with respect to it, the values \( x, y, z \) can take both positive and negative values or zero, if the particle stays at the origin. A particle that moves only the plane \( (x,y) \) will make a planar curve with respect to time. This is the case, for instance, of an ant searching for food in a planar area. In the case of bees, we cannot discount any of the three dimensions \( x,y \), or \( z \). An ant starting at the origin in the plane but moving such that \( x = y \), (equal increments in the x and y directions) would result in a planar motion in the straight line: \( y = x \). (Belgacem, 2017). We understand that the z-axis operates on the y-axis with an extension (which is a feature of the x-axis). The changes that occur on the subject’s enunciation, (which come from this extension assignment to \( y \)) are not in the structure of metaphor (\( y \)) or in the structure of metonymy (\( x \).
The changes occur due to time interference. Remembering that we quoted (on page 11) “the Function F(x,y, t) represents a picture of the graph or curve performed by the particle as it moves”, and “pictures […] represent an instantaneous copy of that graph taken at an instance of time chosen by the observer (the photographer)”. So we can state that when we have the poetic function, we have, on the discursive chain, something like an “instant moment” which embraces the notion of escape points, which are points where meaning “slips”, since when we choose a certain meaning, we feel as if we are chosen, displaced to unusual sites and other meanings that are different from those proposed by the photographic image, which captures something else. If photography is not only the static reproduction of reality, then it can be understood as an esthetic experience, as an art that establishes a connection between image and desires, interpretations, sensations, memory (Pimenta & Monte-Serrat, 2015, pp. 984-985). The principle of equivalence describes the situation in which the y-axis (metaphor), conceived as an operation of choice, is restricted to results determined by the x-axis (metonymy), resulting in: 

\[ y = x, \text{ that is, it is metonymy that will dictate the rhythm of the metaphorical choice, thus determining the poetic function (Jakobson, 2010).} \]

The z-axis operates on the y-axis by assigning the latter an extension (which is a characteristic of the x-axis). The changes that occur in enunciation, from this extension attribution to \( y \), are not in the structure of metaphor or in the structure of metonymy. The changes are in the course of time: “so the result is a time-dependent function \( f(x, t) \) if the motion is on line, \( f(x,y,t) \)” (Belgacem, 2017). In studies on language, it must not be ignored that the process of the latter is influenced by the unconscious (Lacan [1949] 1998; Dor, 1989; Monte-Serrat & Tlouni, 2012). According to Whorf ([1942]2017), “the linguistic order embraces all symbolism, all symbolic processes, all processes of reference and of logic”, turning the mind in the “great slayer of real”. Whorf (op. cit.) adds that each language performs this artificial chopping up of the continuous spread and flow of existence in a different way. Words and speech are not the same thing. As we shall see, the patterns of sentence structure that guide words are more important than the words. To explain a state in which “many mathematicians and scientific linguists must have the experience of ‘seeing’, in one fugitive flash, a whole system of relationships never before suspected of forming a unity”, Whorf ([1942]2017) quoted an Ouspensky’s (Lachman, 2003, p. 48) experience in which he pointed out that the shadows may look identical, yet these shadows are formed by different men or objects. Ouspensky pointed out “positivist science is concerned only with shadows, mistaking them for reality” and he “saw that there is something wrong with our ideas of time” [...] “Ouspensky realized that at any time our picture of ourselves or of others is limited by the moment in which we see it, but the ‘real’ individual is one’s life extended through time”. Ouspensky (apud Whorf, [1942]2017) said that “all we can study at any separate moment is a ‘snapshot’ of a person’s life, never the whole of it, which, like the rest of the world, is a constant process” [...] “in a condition of a constant change”.

### Conclusion

We observed the existence of a particular organization in the linguistic process, a “geometry” of language. According to Whorf ([1942]2017), “this organization is imposed from outside the narrow circle of the personal consciousness, making of that consciousness a mere puppet whose linguistic maneuvers are held in unseened and unbreakable bonds of pattern”, over-riding and controlling the lexation and sentences “as equations and functions”. The algebraic nature of language, according to Whorf is in between variable symbols and fixed quantities. Meanings are only relatively fixed. We may have consider time (z-axis) beyond axes x and y because “in word reference we deal with size by breaking it into size classes - small, medium, large, immense etc. - but size objectively is not divided into classes, but it is a pure continuum of relativity” (Whorf, [1942]2017). At the same time as language unfolds itself between the two axes (paradigmatic and syntagmatic) (Jakobson, 2010), it deals with time. Our bet is that we can conceptualize the element time as the language operator, as an instance that articulates its two planes (axes) and “gives the subject a place for the origin and a placement for the being” (Amor & Chatelard, 2016, p. 81). The temporal element must not be ignored in the study of the language of subjects with brain dysfunction. Jakobsonian legacy stimulated our study of the verbal art from the perspective of metapragmatic operations of language. The learning of language puts enunciation in a structure in which time counts; the temporal element traverses linguistic particularities and inserts a value in enunciation, opening possibilities in the modification of meaning (event, according to Pécheux, 2002) and making the subject viable, guaranteeing him quality of life. There is still much to be learned about Jakobson’s legacy. More and more sessions at the annual American Anthropological Association Meetings are devoted to language in its social context or to understanding culture in ways that we understand speaking or verbal art. As long as this trend continues, the influence of Jakobson’s ideas will continue to be felt in the years to come. (Caton, 1987, p. 253)

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investigating the verbal art in its amplitude

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