A Contribution of a Multi-Viewpoints Semiotics to Knowledge Representation Issues

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Abstract. This paper intends to show how a semiotic model akin to a dyadic semiotic can contribute to knowledge representation issues. In particular we hope that it offers a viable alternative to triadic semiotic models usually evoked to build conceptual structures and knowledge representations.

Keywords: semiotics, triadic models, dyadic models, conceptual structures, knowledge representation, multi-viewpoints semiotics.

1. Introduction

The relation that attaches the notion of concept to the philosophy of language, based upon a triadic model is already present in the works of Aristotle (384 BC – 322 BC). [1]

CS Peirce with his semiotic and phenomenological (phaneroscopy) theories introduced a triadic model of the sign in which each of its three components (*representamen*, *interpretant* and *object*) is itself a sign.

Anything which determines something else (its interpretant) to refer to an object to which itself refers (its object) in the same way, the interpretant becoming in turn a sign, and so on an infinitum. (See [2].12 - 1902 - C.P. 2.303 - Dictionary Baldwin - "Sign")

However if this grand theory differs from the Aristotle's model or from triadic models such that involved in the semiotic theory of Charles Morris, it shares the fact that "the sign stands for something, its object" even if as Peirce stressed it "It stands for that object, not in all respects, but in reference to a sort of idea, which I have sometimes called the ground of the representamen".(see [2], 9 - v. 1897_- C.P. 2-228 - Division of signs)

A few authors pointed out that the semiotics of Peirce is a theory of knowledge. J. Fontanille for instance noted in [3] (p. 60) that Peirce in his theory offers three

[1] In the beginning of "On interpretation" Aristotle states that: "Spoken words are the symbols of the states of the soul and the written words are the symbols of the spoken words. Just as writing is not the same for all the men, so the spoken words are not either the same even though these states of soul, which these expression directly symbolize, are the same for all, as are also those things of which our experience are the image"(see [1]. pp. 77-78 (I, 16a, 3-8)).

different modes of grasping the signification. That is three different ways organized into a hierarchy in such a way that we can know the world of meaning.

Indeed when considering *phaneron*, that is "the collective total of all that is in any way or in any sense present to the mind, quite regardless of whether it corresponds to any real thing or not". (see [4]. Adirondack Lectures, CP 1.284, 1905), Peirce classed them into three categories: *firstness*, *secondness*, and *thirdness*.

B. Bachimont ([5]. p. 309) noted that thirdness is the category of intelligence and mind, the category of knowledge.

Whereas according to C.S. Peirce and after him, B. Bachimont, "Knowledge is indeed mediation between a subject and an object" ([5]. p. 309), we will propose a different view in this key issue. In the approach which will be introduced later, knowledge needs to be defined among a group of interacting subjects equipped with a semiotic competency.

Which sort of competency is it? We adopt the stand that this competency is akin to a linguistic one. Admitting that no piece of knowledge can emerge in the absence of a human group and that knowledge is manifested through interactions among the subjects constituting that group, have consequences that we will develop later. One of the most noticeable is the possibility to define knowledge without any prior hypothesis about the existence of a corresponding object.

2. Natural Language and Knowledge: a few Issues

2.1 The Role of Natural Language in the Expression of Knowledge

Common sense knowledge is usually expressed in natural language. As far as one considers that literature conveys knowledge about human experience in the broad sense, we must admit that the coding of this knowledge uses natural language. Most of the philosophical works are written down using almost exclusively natural language. Even more generally, most of the texts of humanities are based upon natural languages and so are based the knowledge they convey. The same is true too a large extent of social sciences even if formal languages can sometime be used. Using natural languages to express knowledge varies within empirical sciences and is debatable in the case of deductive sciences.

On the other hand conceptual modelling presents itself as natural language modelling. "With a direct mapping to language, conceptual graphs serve as an intermediate language for translating computer-oriented formalisms to and from natural languages" [6].

However a conceptual conception of language that underestimates the role and the complexity of the plane of expression (associated with the signifier) in the analysis of the signified (which belonged to the plane of content) has been seriously criticized by F. Rastier. He also reminds us of the observation of E. Benveniste [8] that the Aristotle's categories often used as universal ones, were only the adaptation on the philosophical plane, of categories attached to Greek. ([8], p.73).

The Question of the Reference in Linguistic Semiotics

Since a linguistic semiotics in the sense, for instance, of Saussure or of Hjelmslev, depends on a conception of signs that does not require an extra-linguistic reference, the issue of the reference is addressed as a 'meaning effect' or as a 'referential impression'.

"What we call here *reference* is not the relationship between a representation and things or the state of things, but the relationship between the text and the non linguistic part of the practice where this text is produced and interpreted.

However even if this definition of *reference* avoids a relationship between representations and things or state of things, it cannot avoid mentioning interactions with the physical world (i.e. percepts). Therefore, the definition of *reference* calls together different domains of knowledge: a semiotic sphere (associated with the linguistic level), a representation sphere (belonging to the psychological sphere) and a physical sphere (accounting for the "objects") ([9], p.19).

In order to avoid any reference to non linguistic references we proposed to consider them differently: they are phenomena that do not belong to any semiotics insomuch they **are not** reducible to a **unique** semiotic analysis and description. This precision allows us to transform the old question of the relation between "Words and Objects" (Quine) into a question about the meaning of a co-presence of different semiotic systems (ranging from sociolects to idiolects) expressed through the utterances and the enunciations. This issue is the target of the multi-viewpoints semiotics.

3. Multi-Viewpoints Semiotics

3.1 A Constructivist Motivation

In previous works (see [10]) we argued that complex systems such as space systems are better understood when we admit that it is not possible to describe them within a unique discipline which would cover all its dimensions. For instance, instead of considering the space system designed by a team of designers from a single point of view (e.g. from a functional point of view or from an economical one) we proposed to consider the system just as a *signifying object*, the signification of which is to be a "space system" whichever the viewpoint we choose to observe it. This means that the system is only *virtual* when it is observed from a single point of view. It is *virtual* and not *actual*, because it lacks all its other dimensions (= the other viewpoints). Only all its dimensions can give an actual character to the system.

It would not be satisfying to pretend for instance that a 'space system' or a part of it – its satellite'– are a meaningful or correspond to concepts only if there already exist corresponding objects. Even if they are actualized within different elements (such as contracts, requirements, models, simulations etc.) they are in no way realised before the launching phase. Sometimes the space system is completed on the last phases of the mission.

These empirical considerations lead us to favour a constructivist epistemology. In such an epistemology the objects are not supposed to exist before one can formulate question about their existence. In its most radical form, such an epistemology stipulates that the objects we study result from the theory we use to "describe" them.

A triadic semiotics as far as it supposes the existence of an object, deviates from this posture[2].

3.2 Definition of a Viewpoint

In an intuitive manner we define a **viewpoint** as the way that an individual or a group of people (corresponding respectively to *individual* and *collective* viewpoints) forms a signification.

Let us make clear that this formation is related to the plane of content. Here ***content*** is opposed to ***expression***. This distinction, although simple to understand is important for any linguistic semiotics. Let us give an example: the expression 'dog' (in English) the expression 'Kringmerk' (in Eskimo), the expression **سگ** (in Persian) or the expression कुक्कुर (in Sanskrit) all four have the content *dog*. The content of an expression corresponds to the ***signified***. The expression of a content corresponds to the ***signifier***.

Let us give a simple example in order to give an intuitive idea of what the viewpoint concept includes.

Example: Even if each of the above expressions means *dog* in all the four languages that we choose, they do not imply that a native writing or uttering it has the same view whichever his/her language. An English man or woman even would have in mind a domesticated animal trained for hunting or watching or maybe, used as a companion animal. But other semantic definitions are possible quite different from the previous one. In Eskimo society the [content] *dog* is equivalent to *working dog* used as a *sled dog*. The Persian would define it as a sacred animal. Hindu people on the opposite would have a pejorative definition of it as a pariah. (see [11], p.61). In this example we have at least four definitions of the content 'dog' each of them being a view produce from a different viewpoint. Hjelmslev says that these different meanings that occur on the plane of content according to the culture of the speakers correspond to as many *substances of content*. Let us note that we did not consider above metaphorical or informal usages at least in English of the expression 'dog' but its literal usage.

Let us now introduce another notion: that of *form*. It is well known after Saussure that language is built upon differences. In "La structure morphologique" [11] L. Hjlemslev introduces a nuance: "The famous maxim according to which *every thing is bound in the system of language* has often been applied in a too rigid, too mechanical and to absolute manner. […]. It matters to acknowledge that everything is

[2] Let us note by the way that the mentioning of three levels of existence does not imply that we are dealing with a triadic semiotics, we are simply faced with different modes of semiotic existence as pointed out by J. Fontanille: "Peirce does not differs from Saussure's, Guillaume's or Hjelmslev, with his ternary structure: although the theory he derives from that is very different, he also presents the different steps of a modal development of signification" [3] p.63.

bound, but that everything is not bound in the same way, and besides interdependencies, there exists purely unilateral dependencies as well as [non constrained relations]". (p. 123). The structure that is the constituting feature of a language "must not be confused with the interdependency; the very notion of structure implies the possibility of a relative independence between certain parts of the system. Describing the system is both to account for dependencies and independencies" (pp. 123-124)

With this conception, language corresponds to a *pure form* which is defined independently of its social realization and of its material manifestation. In that case language is in Hjelmslev's terms, a linguistic *schema*.

In order to make it clearer, we can add that the schema is both opposed to the norm and to the usage, that Hjelmslev defined in the following way: when language is considered as a material form, defined by social realization but still independent of details of its manifestation it is a (linguistic) *norm*; when it is considered as a set of habits adopted by a given society and defined by the observed manifestations. It is a (linguistic) *usage*. ([11], p.83)[3]. The substance of content (as well as the substance of expression) is an entity that belongs to the usage.

The ***form of content*** is an entity that belongs to the ***schema***. The ***signification of a substance*** is the function which associates a form to a substance. The form is said to be *manifested*, the substance is said to be *manifesting*. Once a form is established in cohesion with other (formal) entities of the same plane, possible manifesting substances are discarded.

For instance in the expression "a piece of furniture made of wood" the substance *a hard fibrous substance comprising the largest part of the stems and branches of trees and shrubs* manifests the form of content associated with the expression and therefore excludes the substance *a collection of growing trees.*

In summary the *definition of the viewpoint* we have proposed when considered from the Hjelmslevian terminology, receives a more precise meaning. However this definition remains rather general.

Let us end this section by noting that "what" a semiotics uses as data is *text*[4]

Despite its apparent concrete character, *text* is an elusive "thing" which is grasped only through the conjoint analysis of the two planes, *content* and *expression.* According to Hjelmslev, the very terms of plane of expression and of plane of content and in a more general way, of expression and content, have been chosen according to

[3] Let us give an example situated on the plane of expression by considering three different way to define the French 'r': Considered within the linguistic ***schema*** 'r' (a) belongs to consonants (as opposed to vowels (b) can be in first position (as in *rue*) or in last position (as in *partir*) (c) ... This definition is based upon dependencies. Within the linguistic ***norm***, the description of 'r' in French is limited to minimal indications about its phonic manifestation, but no precision is given about its articulatory points. This definition depends upon a social realization. Within the linguistic ***usage***, the definition of 'r' in French is realized through all the qualities usually observed in the pronunciation of it; in particular its articulatory points. This definition used observed manifestations.

[4] "The theory of language is concerned with texts and is goal is to give a procedure in order to the recognition of a given text thanks to a non contradictory and exhaustive description of this text. But it must also indicate how we can in the same way recognize any other text of the same supposed us nature by giving us useful tools for such texts". ([11] pp.26-27)

their usual usage and are quite arbitrary[5]. It is why, it is acceptable to consider that a text *is* the result this analysis and does not exist outside any analysis of this sort.

3.3 Elements of a Multi-Viewpoint Semiotics

In very general terms a ***multi-viewpoints semiotics*** can be defined as a conceptual building, which aims at clarifying the condition of grasping and of production of the meaning of "being in the presence of other viewpoints".

These conditions involve considering (in case of two viewpoints) the dependencies (interaction) that exists between the different strata involved in the description of texts with respect to each viewpoint and between these viewpoints through the corresponding strata.We say that exist a ***confrontation of two viewpoints*** whenever we can analyze the dependencies that exists between the two viewpoints according to the analytical method we outline and in particular by being compatible with the description of the texts. **A view from a viewpoint** is the manifestation of a substance in a form, in other words it is a signification.

The **correlation of viewpoints:** two viewpoints that have been considered within a confrontation are correlated, provided, it is possible (after a negotiation process), to produce views from each viewpoints which are semantically and logically compatible with respect to the other viewpoints. Let us remark that semantic and logic assessments are relative to the *substances* and not to the *forms* (in Hjelmslev's terms)

3.4 Definition of Knowledge within a Multi-Viewpoint Semiotics

Within this theoretical framework, it is possible to define the concepts of *information knowledge* and *data* which corresponds to *views* produced by viewpoints at different stage of the process of interaction of the viewpoints.

- A piece of ***information*** is a view with respect to a viewpoint when a confrontation with other viewpoints occurs;
- A piece of ***knowledge*** is a view with respect to a viewpoint as a result of a negotiation process with other viewpoints, assuming that a confrontation took place before.
- Provided we can consider that confrontation of a given viewpoint with other viewpoints is a non evolutionary process, then regarding confrontation these other viewpoints can be put in parentheses (or considered as so). In such a circumstance a view from the given point of view is defined as a piece of **data**.

The producing of a piece of knowledge therefore takes place during a negotiation process. This process is interpretable as the repairing of the *identity* (see [13]), the identity of the object: (a) being designed or (b) manifesting an anomaly the cause of which is looked for, or (c) being the target of a risk analysis process.

[5] "According to their functional definition, it is impossible to sustain that it is legitimate to call one of this entity expression and the other content and not the way round. They are defined as interdependent and neither one nor the other can be defined more accurately. Considered separately, they be defined only by opposition and in a relative way, as [terminating elements] of a same function which are opposed one another" ([12] .p. 79).

4. Knowledge Representation

What knowledge representation and concept modelling mean within such a framework? Being defined with respect to a context (viz. the viewpoints which get a correlation) a piece of knowledge (with respect to one of these viewpoints) may regress to the status of a piece of information even to the status of a piece of data, if the viewpoints that constitute this context evolve, disappear, or are joined by new ones. Everyone knows that such evolutions necessarily occur within any complex system. This means that one objective that we must set to knowledge representation and concept modelling, is to define and to achieve the minimal set of conditions which can make possible the reconstruction of knowledge (with respect to at least one viewpoint).A part of the answer to this issue is given by mathematics and the texts they produce. In what follows we will just skim the remarkable semiotic study of algebraic topology that Alain Herreman produced [14]. In the first pages of his study he wonders if the abstract character of mathematics is relevant to describe a text, a mathematical concept or an historical development in that field. He concludes that the concept of abstraction and its avatars do not enable us to deal with these issues nor to study the mathematical texts from this respect. It does not even enable us to compare them to each other, nor finally establish historical or epistemological assessments" ([14], p.10). In order to carry out his project he turns to the semiotic theory of Hjelmslev. His corpus is made of the three texts of Henri Poincaré (1895, 1899, 1900), one of Oswlad Veblen (1922), one of James W. Alexander (1926), and one of Solomon Lefschetz (1930). All the texts are about algebraic toplogy. The structure of a sign through out all these texts is generally the following: ([14], p.20) : a *natural expression*, a *notational expression*, a *content*, a *semiotic function* [between the form of the expression and the form of the content]

He observes that depending on the authors, several planes of content intervene through out their writings: ([14], p.23): a *geometric content*, an *arithmetic content*, a *set-theory content*, an *algebraic content*. A few planes are usually combined within a text. These combinations characterize a text and/or an author.

Besides these semiotic elements, he points out procedures that the authors use in order to establishing semiotic functions, setting expressions and contents organize the [semiotic] system of his text. ([14], p.39). A. Herreman calls this practice the *semiotic conditioning*. For instance semiotic operators are present in sentence such: "I name …", "I call …", "I note …", "An n-dimensional complex C_n consist of …".

A. Herreman concludes his study noting that: "The mathematical texts seem enriched by a large semiotic diversity: their signs could be complex, they are not of the same nature, and they can differ from one text to another. In addition, the study of the semiotic conditioning, shows that the signs are not the only a means of expression but that the mathematician can pay attention to them and produce utterances for their elaboration". ([14], p.324).

What is observed by A. Herreman in the case of mathematical texts can be translated within the semiotic framework we propose. A mathematical text manifests the presence of several viewpoints (geometric, arithmetic, set-theory, algebraic and the one that correspond to the semiotic conditioning). Each author organizes these viewpoints, or at least a few of them, in a manner that is characteristic of his "style" and of his scientific intention. The readers and among them the author himself, have

no choice but correlate these viewpoints including his/her own viewpoint in order to produce views that have the expected status of knowledge. This situation differs from engineering and technology where such sophistications do not exist. This suggest that a better understanding of viewpoints interactions in the expressions of knowledge will help in building more robust knowledge representations and conceptual modelling of artificial systems.

5. Conclusions

In this paper we examine how a multi-viewpoints semiotics can contribute to the issue of knowledge representation. A linguistic semiotics offers a convenient framework for analysing natural languages. But it needs to be more elaborated in order to dealing with the question of reference. Within a multi-viewpoints semiotics that we outlined, it is possible to define knowledge without any prior hypothesis about the existence of an object. We address the question of knowledge representation within this framework. The case of mathematical texts offers suggestion toward more robust knowledge representation and conceptual modelling.

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