On Some Applications of Extended Mereology[1]

Jerzy Pogonowski

Department of Applied Logic
Adam Mickiewicz University, Poznań, Poland
www.logic.amu.edu.pl

By extended mereology we mean the system presented by Alfred Tarski in the famous Appendix E to Woodger's *Axiomatic Method in Biology* (Woodger 1937). The system extends the original mereology of Leśniewski by taking into account — besides the relation $\boldsymbol{P}$ of being a part — also the relation $\boldsymbol{T}$ of precedence in time. We are going to discuss applications of this system to the study of natural language. The paper consists of three parts. First, we recall the original axiom system of Leśniewski-Tarski using the contemporary notation. Second, we report on an application of this system due to Tadeusz Batóg and devoted to segmental phonology (Batóg 1967). Finally, we comment on the role of extended mereology in an approach to natural language called by us combinatory semantics (Pogonowski 1993).

Extended mereology of Leśniewski-Tarski

The original system of mereology has been proposed by Leśniewski in 1916. The system was thought of as an alternative for Cantorian distributive set theory. For several reasons it has never fully served that purpose. However, it has many advantages from the point of view of applications to empirical sciences. Leśniewski's mereology can be presented in many settings depending a.o. on the choice of primitive terms of the system. Originally, the only

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primitive term was that of being a part of, denoted by $\boldsymbol{P}$. Thus an expression of the form $x\boldsymbol{P}y$ should be read: the thing x is a part of the thing y. Tarski extended the system by adding time dependencies to it. The second (and last) primitive term of extended mereology is the predicate $\boldsymbol{T}$ corresponding to the relation of precedence in time. Thus, $x\boldsymbol{T}y$ means that either the whole thing x precedes the whole thing y in time or that the last slice of x coincides in time with the first slice of y. Below, we sometimes use the terms *thing* and *object* interchangeably.

Before we state the axioms of extended mereology let us introduce a few auxiliary definitions. If R is a binary relation, then $R^{\vee}x$ and $R^{\wedge}x$ denote the sets of all R-predecessors and of all R-successors of x, respectively, i.e.

$$R^{\vee}x = \{y : yRx\}$$
$$R^{\wedge}x = \{y : xRy\}.$$

If $R \subseteq X \times Y$ is a function from X to Y then the value of R on an argument $x \in X$ will be denoted by $R^{*}x$.

For any set of things X, let $\boldsymbol{P}\langle X\rangle$ denote the set of all parts of elements of X, i.e.:

$$\boldsymbol{P}\langle X\rangle = \{y : \exists z \in X \; y\boldsymbol{P}z\}.$$

We say that the object y is a *mereological sum* of the set of things X (in symbols: $X\boldsymbol{S}y$ if and only if the following conditions are satisfied:

1. $X \subseteq \boldsymbol{P}^{\vee}y$
2. For any z such that $z\boldsymbol{P}y$, $\boldsymbol{P}\langle X\rangle \cap \boldsymbol{P}^{\vee}z \neq \emptyset$.

It follows from the axioms of extended mereology that for any non-empty set of things X there exists exactly one thing y such that $X\boldsymbol{S}y$. This permits us to use the functional notation: $y = \boldsymbol{S}^{*}X$ means that the thing y is *the* mereological sum of the set of things X.

For any objects x and y we define their *mereological union* $x \oplus y$ and *mereological product* $x \otimes y$ in the following way:

$$x \oplus y = \boldsymbol{S}^{*}\{x, y\}$$
$$x \otimes y = \boldsymbol{S}^{*}(\boldsymbol{P}^{\vee}x \cap \boldsymbol{P}^{\vee}y).$$

Points are objects which do not have proper parts, formally:

$$\boldsymbol{pn} = \{x : \boldsymbol{P}^{\vee}x = \{x\}\}.$$

A thing is *momentary*, if its beginning coincides with its end:

$$\boldsymbol{mo} = \{x : x\boldsymbol{T}x\}.$$

The relation of *coincidence in time*:

$$x\boldsymbol{C}y \equiv x\boldsymbol{T}y \text{ and } y\boldsymbol{T}x.$$

Maximal (in the sense of relation $\boldsymbol{P}$) momentary things are *momentary world sections* or, simply, *moments*:

$$\boldsymbol{ms} = \boldsymbol{mo} \cap \{x : \boldsymbol{C}^{\vee}x \subseteq \boldsymbol{P}^{\vee}x\}.$$

We can now state the axioms of extended mereology:

Axiom 1. $\boldsymbol{P}$ is transitive.
Axiom 2. For any x, y: if $\{x\}\boldsymbol{S}y$, then x=y.
Axiom 3. For any X: if $X \neq \emptyset$, then $\boldsymbol{S}^{\wedge}X \neq \emptyset$.
Axiom 4. For every x, $\boldsymbol{pn} \cap \boldsymbol{P}^{\vee}x \neq \emptyset$.
Axiom 5. $\boldsymbol{T}$ is transitive.
Axiom 6. $\boldsymbol{T}$ is dense.
Axiom 7. For any x there exist y and z such that neither $y\boldsymbol{T}x$ nor $x\boldsymbol{T}z$.
Axiom 8. For any $x, y \in \boldsymbol{ms}$: either $x\boldsymbol{T}y$ or $y\boldsymbol{T}x$.
Axiom 9. There exists a denumerable set $X \subseteq \boldsymbol{mo}$ such that for any x and y: if $x\boldsymbol{T}y$ does not hold, then there exists $z \in X$ for which neither $x\boldsymbol{T}z$ nor $z\boldsymbol{T}y$.
Axiom 10. For any x, y: $x\boldsymbol{T}y$ if and only if for all $u \in \boldsymbol{mo} \cap \boldsymbol{P}^{\vee}x$ and all $v \in \boldsymbol{mo} \cap \boldsymbol{P}^{\vee}y$ we have $u\boldsymbol{T}v$.
Axiom 11. If $x \in \boldsymbol{pn}$, then the set $\boldsymbol{pn} \cap \boldsymbol{T}^{\vee}x \cap \boldsymbol{T}^{\wedge}x$ has the power of continuum.

The first three of the above axioms correspond to the axioms proposed in 1916 by Leśniewski in his system of mereology. Axioms 2 and 3 could be replaced by one axiom stating that mereological sum is a function; however Tarski has decided to keep these axioms in order to simplify proofs of some theorems.

Axioms 1–10 do admit non-isomorphic models. However, the presence of Axiom 11 makes the system *categorical*, i.e. admitting only one model (up to isomorphism).

The mereological sum of the universal class is the *whole world*:

$$\boldsymbol{w} = \boldsymbol{S}^{*}\boldsymbol{V}, \text{ where } \boldsymbol{V} = \{x : x = x\}.$$

Tarski has introduced also the relation $\boldsymbol{Z}$ which he called *time*:

$$x\boldsymbol{Z}y \equiv \neg\exists u\exists v(u\boldsymbol{P}x \wedge v\boldsymbol{T}u \wedge v\boldsymbol{P}y).$$

The relation $\boldsymbol{Z}$ with its domain and counterdomain restricted to the momentary world-sections is order-similar (isomorphic) to the relation $<$ in the field of real numbers.

The relation of *being a slice of* is defined as follows:

$$y\boldsymbol{Sl}z \equiv y \in \boldsymbol{mo} \cap \boldsymbol{P}^{\vee}z \wedge \boldsymbol{C}^{\vee}y \cap \boldsymbol{P}^{\vee}z \subseteq \boldsymbol{P}^{\vee}y.$$

One can prove that momentary world-sections are exactly slices of the whole world in this sense:

$$\boldsymbol{ms} = \boldsymbol{Sl}^{\vee}\boldsymbol{w}.$$

Some further relations of precedence in time will appear useful in applications below:

Complete precedence in time:

$$x\boldsymbol{T_{cp}}y \text{ if and only if for any } u, v\text{: if } u\boldsymbol{P}x \text{ and } v\boldsymbol{P}y\text{, then not } v\boldsymbol{T}u.$$

Immediate precedence in time:

$$x\boldsymbol{T_{im}}y \text{ if and only if } x\boldsymbol{T_{cp}}y \text{ and there is no } z \text{ such that } x\boldsymbol{T_{cp}}z \text{ and } z\boldsymbol{T_{cp}}y.$$

One more relation, necessary for technical reasons:

$$x\boldsymbol{T_{e}}y \text{ if and only if either } x\boldsymbol{T_{cp}}y \text{ or } x = y.$$

Axiomatic phonology

Tadeusz Batóg has developed a fully formalized version of segmental phonology in the sixties of the last century. We have presented a comprehensive synopsis of his phonological systems elsewhere (cf. Pogonowski 1997). Here we are going to limit ourselves to discuss the role of extended mereology in Batóg's approach. Thus, we will not discuss all the details of his constructions. It should be pointed out that Batóg's axiomatic phonology is the best elaborated (to our knowledge at least) axiomatic system describing the phonological system of natural language.

The central role in Batóg's approach plays the system presented in Batóg 1967. We will focus our attention on this system. Later improvements of it proposed by Batóg are interesting from the point of linguistic adequacy, but they do not differ essentially from this core system as far as the role of extended mereology is concerned.

We have three primitive terms of the system: $\boldsymbol{I}$ (the set of all *idiolects*), $\boldsymbol{K}$ (the family of *kinds of phonetic features*) and $\boldsymbol{O}$ (the set of all *pauses* or *zero segments*).

Elements of $\bigcup \boldsymbol{I}$ are called *utterances*. By *phonetic features* we mean elements of the set $\bigcup \boldsymbol{K}$, and elements of $\bigcup \bigcup \boldsymbol{K}$ are called *proper segments*. Finally, by *elementary segments* we understand elements of the set $\bigcup \bigcup \boldsymbol{K} \cup \boldsymbol{O}$.

In the formulation of the axioms we will use the concept of *linear object* introduced by Tadeusz Batóg:

$\boldsymbol{ln} = \{x :$ for every $y \in \boldsymbol{ms}$ such that neither $y\boldsymbol{T_{cp}}x$ nor $x\boldsymbol{T_{cp}}y$ we have $x \otimes y \in \boldsymbol{pn}\}$.

Intuitively speaking, linear objects are continuous in time and not extensive in space.

We formulate the axioms of Batóg's system in English. This should not lead to any confusion — the corresponding symbolic formulation can be easily found.

Axiom 1. There exists at least one idiolect.

Axiom 2. Every idiolect is a finite non-empty set.

Axiom 3. Every utterance is a linear object.

Axiom 4. Any part of an utterance overlaps at least one elementary segment (proper or not) completely contained in this utterance.

Axiom 5. No utterance consists entirely of pauses (i.e. every utterance contains at least one proper segment).

Axiom 6. For any utterance u of a specific idiolect there exist two points x, y which are parts of u, so that all points which are parts of u and which precede or coincide in time with x are parts of certain zero segments, and similarly all points which are parts of u and follow or coincide in time with y are parts of certain zero segments.

Axiom 7. Elementary segments of every utterance are linearly ordered by the relation $\boldsymbol{T_{cp}}$.

Axiom 8. Every non-empty set of elementary segments has the first and the last element (in the sense of the relation $\boldsymbol{T_e}$).

Axiom 9. Any two utterances which share at least one proper segment are themselves parts of some utterance.

Axiom 10. Elementary segments are non-momentary parts of utterances.

Axiom 11. No pause has any part in common with any proper segment.

Axiom 12. Any distinct kinds of phonetic features are disjoint sets.

Axiom 13. For any kind of phonetic features, every elementary segment is an element of some phonetic feature of this kind.

Axiom 14. Any distinct phonetic features of the same kind are disjoint.

The formulation of Axiom 15 of the system requires a series of definitions and will not be presented here.

Observe that the following statements are simple consequences of the axioms:

1. Every kind of phonetic features is a classification of the set of all proper segments. These classifications do not have any common members.

2. The sets: of all utterances, of all proper segments, of all kinds of phonetic features, of all pauses are all non-empty.

3. No distinct proper segments have any parts in common.

4. For any kind of phonetic features, every elementary segment belongs to exactly one phonetic feature of this kind.

5. No proper segment is a pause.

6. Every utterance contains at least three elementary segments. In particular, every utterance starts and ends with a pause.

Batóg has shown in 1969 that the concept of the pause becomes definable (in terms of the set of all idiolects and the family of kinds of phonetic features) if we add to the above axioms an extra postulate which requires that no utterance contains two pauses occurring immediately one after another.

In such a case, axioms 4 and 11 become superfluous and can therefore be omitted.

A few words of intuitive explanation concerning the primitive terms of Batóg's system are in order. Idiolects may be thought of as totalities of speech activity. Thus, all that I have uttered in Polish in the last year of my adult life is an idiolect. The totality of all utterances of all speakers of a fixed dialect of German in the last century is an idiolect, too. One can think of all the dialogues from all Shakespeare's plays as an example of an idiolect as well (if you do not like Shakespeare, take The Beatles' songs as an example of an idiolect). It is obvious that one should work with idiolects which are to a certain degree homogeneous. But this is something which lies beyond the formal machinery used in this axiomatic approach. It is assumed that idiolects taken into account are homogeneous, in some reasonable, intuitive, linguistic sense. It is partly because this intuitive understanding of the concept of idiolect that this very concept is primitive and not defined term of the system. (For more information concerning the linguistic content of the term idiolect see Batóg 1967, 27–28.)

Utterances are treated as individual things, spatio-temporally fixed. Thus one should think of them as tokens, representing (or simply being) the result of speaker's activity. Utterances can be divided into parts. Those parts of utterances which are minimal with respect to phonetic features associated with speech are elementary segments. Again, this concept is not very easy to be defined formally. Its content should be explained in terms of phonetic features, i.e. certain theoretical constructs. Phonetic features may be of different character — they may be articulatory, acoustic, auditive or even based on neurophysiology. From the formal point of view it is important that phonetic features, as well as kinds of phonetic features, are treated extensionally here. Thus, any kind of phonetic features is something like a parameter (similar, e.g. to an attribute in information systems). Its elements, i.e. phonetic features are themselves thought of as sets of elementary segments (possessing this very feature). For more intuitions concerning this concept see Batóg 1967, 31. It follows from the axioms that any elementary (proper) segment belongs to exactly one phonetic feature in each kind of phonetic features. Hence, one can associate a fixed bundle of phonetic features with any elementary segment. In still other words, each elementary (proper) segment is associated with exactly one choice function whose values form a set of phonetic features (one feature from every kind of phonetic features).

Pauses correspond to moments of silence in speech. Their role in this system is an auxiliary one — they serve simply as markers of boundaries of the investigated linguistic units. Their duration in time does not matter here. Thus, a pause of duration of one second is equivalent — from a phonetic point of view accepted here — to a pause whose duration is measured in centuries.

Batóg proposes to treat utterances as linear objects, continuous in time and not extensive in space. This is a kind of idealization of physical phenomena occurring while an utterance is produced by the speaker or received by the hearer. In other words, we are dealing here with some formal representation of speech events. It is convenient to assume that this representation has a linear character. Moreover, the linguistic units taken into account are treated as finitary objects. More exactly, any utterance is a mereological sum of a finite number of elementary segments only.

Batóg aimed at a formal description of segmental phonology. Thus, the prosodic features of speech are beyond his approach. In this system of phonology we are interested only in sequences of segments of utterances (ordered by the relation of precedence in time), whose elements are described by bundles of phonetic features.

The most important result obtained by Batóg is (besides the construction of the axiomatic system of segmental phonology) his formulation of the definition (by postulates) of the concept of a phonemic basis of an idiolect as well as the formulation of the fundamental hypothesis of phonology (stating the existence of a phonemic basis). Moreover, it became evident only after the construction of the system in question that the existence of a phonemic basis is a mere hypothesis and not a linguistic dogma, as it has been claimed previously in phonology. The same concerns the uniqueness of phonemic basis.

Batóg makes an essential use of extended mereology in his definitions of numerous phonological concepts. Mereological relations based on precedence in time are responsible for linear ordering of parts of utterances. In particular, such important — from a linguistic point of view — relations as *free variation* and *complementary distribution* can be defined in mereological terms. It may be worth noticing that these distributional terms are usually defined with the help of algebraic notions — e.g. those of context and of being a subword in a free semigroup.

Mereological relations and operations serve as a basis for definitions of linguistically relevant parts of utterances, e.g. those of a *phonetic chain, phrase, word* (of a given idiolect), etc. These objects are all tokens, i.e. individual, spatio-temporally fixed objects. In order to be able to talk about abstract phonetic objects Batóg introduces suitable equivalence relations and defines the corresponding types as equivalence classes of those relations. The most important kind of phonetic indistinguishability relation is that of *homophony*. Batóg describes homophony in terms of phonetic features. Thus, certain phonetic units (parts of utterances) are homophonous if they are indistinguishable with respect to sequences of phonetic features associated with their consecutive parts. Of course, all these informal characterizations we are presenting here have precise definitions in Batóg's system.

Basic phonological (abstract) units are *sounds* and *phonemes*. Speaking very roughly, sounds are obtained from elementary segments (as well as from some complexes of elementary segments) as certain constructs based on homophonic (and distributional) indistinguishability. With the construction of sounds one enters phonology proper, so to speak (the previous investigations should be called phonetics). Now, the most important task of segmental phonology is to establish the inventory of phonemes, i.e. (*informally* speaking!) those minimum linguistic units which are responsible for meaning differentiation. Batóg has proposed the following solution of this problem. Phonemes are classes of sounds. In order to put two sounds in the same phoneme one should check whether these sounds are functionally indistinguishable (in a given idiolect). This indistinguishability (which, by the way, is the complement of the relation of *phonological opposition*) is characterized by a set of postulates. In the system from Batóg 1967 we find the postulates of: classification, free variation, complementary distribution, distinctiveness and economy. In Batóg 1976 (where some semantic notions are added to the previous system) we find one more postulate, viz. that of differentiation. Any family of sets of sounds which fulfills these conditions is called a *phonemic basis* and its elements are called *phonemes* (of that basis). Let us recall the postulates (without explaining all the necessary technical details):

Classification. Phonemes (of a given basis) form a partition of the set of all sounds.

Free variation. Any free variants belong to the same phoneme.

Complementary distribution. Any two sounds belonging to the same phoneme are either mutual free variants or are in complementary distribution.

Distinctiveness. For each phoneme X of any phonemic basis there exists a class of phonetic features (the so-called *distinctive features*) such that each sound that belongs to X has all the features of this class, and each sound that does not belong to X lacks at least one of these features.

ECONOMY. No two different phonemic bases of a given idiolect are summably reducible to each other.

DIFFERENTIATION. The phonemic structure of a given phrase uniquely determines (up to free variants) its phonetic structure.

Of course, in order to understand fully these postulates one should know the definitions of all the concepts involved. We are not going to present them here — cf. Pogonowski 1997 for a short synopsis or Batóg 1967 and Batóg 1976 for full exposition.

Now, the sentence that for every idiolect there exists at least one phonemic basis of this idiolect is called by Batóg *the fundamental hypothesis of phonology*. It can be easily shown that it does not follow from the accepted axioms (one can find a model of those axioms satisfying this sentence as well as another one, which satisfies its negation). Though independent from the axioms, the fundamental hypothesis of phonology seems to be strongly confirmed by empirical data: there are no reports about languages whose sounds can not be classified into phonemes. On the other hand, it is not always clear that a given linguistic description of an idiolect can fit into the formal framework proposed by Batóg. This, of course, is a methodological (and as a matter of fact, minor) problem. More important is the problem how to find all the possible phonemic bases of a given idiolect. The difficulty lies in the fact that the number P_n of all classifications of a given set with n elements grows rather rapidly. It is given by the inductive definition:

$$P_1 = 1, \quad P_{n+1} = 1 + \sum_{i=1}^{n} \tfrac{n!}{i!(n-i)!} P_i.$$

Thus, the number of all classifications of an inventory of, say, 60 sounds exceeds 10^{36}. However, there exist algorithms (Batóg 1992) as well as computer programs (Lapis 1997) which generate all the phonemic bases of a given idiolect.

We think that Batóg's axiomatic approach to phonology can be further developed in both aspects — purely formal as well as a linguistic one. Thus, it may be interesting to look for necessary and sufficient conditions for the existence (as well as uniqueness) of a phonemic basis. Then, one could ask which part of extended mereology is really necessary to develop Batóg's approach. Finally — and this is indeed a tough challenge — one may try to apply extended mereology to phonological investigations which include prosodic phonology.

Combinatory semantics

The system we call combinatory semantics has been influenced by the above discussed Batóg's approach. Actually, Tadeusz Batóg's works in axiomatic phonology have been of uppermost importance to the development of logic-oriented linguistic research conducted in the last three decades in Poznań. This is true first of all of Jerzy Bańczerowski (cf. Bańczerowski 1980). The present author tried to follow the methods and ideas proposed by Batóg and Bańczerowski.

The system we are going to talk about below originated in Pogonowski 1981 which, in turn, was a companion to Bańczerowski 1980. The most elaborate version of the system has been presented in Pogonowski 1993. As in the case of the discussion of Batóg's approach presented above we limit ourselves here to comments concerning the role of extended mereology in our system.

The system of *combinatory semantics* has the following primitive terms:

- the family of all semantic parameters ***prm***
- the relation of (extended) hyponymy ***hpn***
- the relation of homophony ***hph***
- the family of all lexical parameters ***lxc***.

Semantic parameters are kinds (sorts) of information conveyed by linguistic units. Among such parameters one can list such as e.g. Tense, Case, Person, Aspect, Nominal Classes, Cognitive Accessibility, Ontological Category, Shape, Size, etc. Depending on a given language, some of those kinds of information are being gramaticalized, some are lexical.

Extended hyponymy is the relation of semantic subordination. It is supposed to be a generalization of lexical hyponymy, including the latter as a special case. The fundamental dogma in this approach is that certain syntactically complex expressions are semantically subordinate to some of its parts. It should be stressed, however, that we are fully aware of the limited scope of syntactic constructions of this kind. Let us allow ourselves two short self-quotations, in order to explain the concept in question (the unfortunate terms *actual lex* and *actual syntagma* have been replaced in Pogonowski 1993 by *word-token* and *syntagma-token*, respectively:

> Actual syntagmas are interpreted as syntactically complex entities. Essential constituent parts of actual syntagmas are actual lexes. The fundamental property of actual syntagmas is their semantically endocentric character: any actual syntagma is a hyponym of exactly one of its constituent actual lexes. Thus, actual syntagmas satisfy, in a certain sense, Frege Principle which says that the meaning of a complex expression is a function of the meanings of its parts. Here are a few examples of actual syntagmas in English (in each case we specify which actual lex is the hyperonym of a given actual syntagma):
>
> **the** oldest **son**
>
> **he** is coming to the library
>
> **Mary** is walking in the garden
>
> **is running** very quickly.
>
> Pogonowski 1981:13

> Syntaktisch komplexe Segmente sind bereits durch die Relation der semantischen Subordination eingeführt. Man soll diese Relation als Subordination des Inhalts der Segmente verstehen: semantische Subordination gilt zwischen Segmenten x und y, wenn der Inhalt von y in dem Inhalt von x enthalten ist (d.h. wenn x mehr Information als y trägt). Hier sind einige Beispiele der Segmente, die durch semantische Subordination verbunden sind:
>
> *Dackel — Hund, rote Rose — Rose, läuft schnell — läuft, Die schwarze Katze schlaft auf dem Sofa — Die Katze ist auf dem Sofa.*
>
> Aus diesen Beispielen kann man klar erkennen, daß die semantische Subordination eine Verallgemeinerung der lexikalischen Hyponymie ist. Sie trifft aber nicht nur zwischen lexikalischen Einheiten, sondern auch zwischen syntaktisch zusammengesetzten Segmenten zu. Wir betrachten nur eine Sorte von solchen Segmenten, nähmlich Syntagmen. Sie definiert man als solche Segmente, die nur eine Komponente des Graphs der semantischen Subordination enthalten.
>
> Pogonowski 1985:145

Homophony is an equivalence relation which holds between those linguistic units which are indistinguishable with respect to their phonetic form.

Lexical parameters form a subset of the set of all semantic parameters. We just want to distinguish between two kinds of semantic information: lexical and grammatical. The latter is characterized by its obligatory presence in utterances of a given language and by the fact that it is expressed in a regular way.

Most important linguistic units considered in this system are: word-tokens, vocable-tokens, syntagma-tokens. We call them all *meaningful segments*. They are thought of as individual, spatio-temporally fixed objects. Word-tokens are elements of the union of the union of the family of all semantic parameters (thus, we follow Batóg in his construction of elementary segments). Syntagma-tokens are special linear-like individual objects. Their parts are word-tokens (which, in turn, have vocable-tokens as their parts). Word-tokens are thought of as minimal linguistically relevant units complete with respect to both kinds of information: lexical as well as grammatical. Vocable-tokens correspond to minimal free forms in the sense of Bloomfield. Any syntagma-token has exactly one of its word-tokens as the immediate hyperonym (i.e. semantically superordinate unit).

The axioms of the system characterize the primitive as well as the above mentioned defined terms in a rather general way. So, the axiom characterizing semantic parameters resembles Batóg's axioms for kinds of phonetic features. Homophony is a special equivalence relation between individual meaningful segments; its properties are partly responsible for the finitary character of utterances. It satisfies also suitable congruency conditions with respect to mereological operations. Its equivalence classes give rise to construction of several type-units (e.g. words, vocables, syntagmas). Extended hyponymy is a partial ordering of the set of all meaningful segments, with some extra properties necessary from the point of view of linguistic adequacy.

It seems that a nice property of this system is the proposal of formal, precise definitions of several dozens of commonly (and often vaguely) used linguistic concepts. May be, this conceptual order will appear useful for somebody interested in formal semantics of natural language. Let me also stress one more design feature of the system, i.e. its *metatheoretical* character — combinatory semantics was not proposed as a formal description of any fixed language (e.g. English, Japanese or Mohawk), which is clearly reflected by the non-fixed nature of the family of all semantic parameters.

However, I would also like to stress some important disadvantages of the system. Actually, just two.

Combinatory semantics, as well as the original systems of semantics and syntax of Jerzy Bańczerowski does not deal directly with extra-linguistic reality. It describes only the plane of expression of natural language. There is no developed model theory for it. And it is not at all clear (to me at least) how it could be done. The relation of semantic subordination between linguistic units should correspond to some ordering of the referents of these units. As one considers extended hyponymy here (thus holding possibly also between syntactically complex expressions) reistic-like (objects and relations between them) ontology for this system is very unlikely to be found. Then, may be one should look for an appropriate eventistic-like ontology. Or, perhaps, develop a new kind of ontology based on properties. As far as I know, Jerzy Bańczerowski tries to work in that direction, I do not know the details.

The use of extended mereology of Leśniewski-Tarski in the system of combinatory semantics has appeared very fruitful as far as precise definitions of numerous linguistic concepts are concerned. However, treating linguistic data which are supplied with meaning as individual objects has also a major disadvantage: the concept of *context* of an utterance disappears completely, in the sense, that contexts are inseparably connected with utterances understood as individual objects. Remember, that we do not have any ontological representation at our disposal in the system yet. And then we are not able to *calculate* anything. Moreover: meanings as equivalence classes of expressions? Sounds suspicious.

Frankly speaking, I've got mixed feelings looking at combinatory semantics today. I hope, I haven't made much damage publishing my (not numerous, fortunately!) works on it (and further linguistic topics as well).

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