

About a nonsemantic component of linguistic information

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Abstract

The central idea of this paper is the existence of a nonsemantic component in the information conveyed by speech. This component is composed of bits of nonsemantic information that are part of the structures formed by their quantitative and elective (carrying directed substitution) relations. Such structures serve as specific parameters of word meanings used in speech and are utilized as language description units. The nonsemantic component of such word classes as verb, noun, interjection and numeral is a subject of interest of the paper as well as the role of this component in sentence formation. The importance of nonsemantic information is that it acts as a background, a foundation of sentence grammar. The paper deals with such issues as the sign and its relation to meaning in speech, meaning and information.

About a non-semantic component of linguistic information

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1 Introduction

How do speech grammaticality and semantics correlate? Are these two autonomous systems or is grammar necessarily tied to lexical units that serve as a support for syntactic constructions (what is assumed by or underlies existing theories)? The article substantiates the existence of an autonomous mechanism underlying the grammatical correctness of a sentence.

Let us turn to such a class of units as interjections. Interjections are meant for a compact expression (but not denotation) of emotions, feelings or reactions to the surrounding reality. Like any sign, they have a recognizable conventional meaning, but less "precise" compared to words that have a constant denotative meaning. Speaking of interjections, David P. Wilkins (1992) notes that "their interpretation is largely dependent on the time and place at which they are uttered. In linguistics, interjections can also be considered a form of deixis" (125). And further: their "referent changes, dependent on the context of the utterance" (142). The subject *I* considers himself an unchanging reference point in changing space and time, and at the same time, he develops, towards the objects of all information that comes to him, his attitude in the form of emotions, feelings and assessments. Thus, the subject who is implementing a chronotopic deixis, while observing what is objectively happening outside his Self, expresses his evaluation attitude to what is happening, making decisions in accordance with it. This state of affairs is reflected in the existence in speech of the corresponding units – interjections. This class of units in whose meaning emotions starting from the subject and the deixis oriented towards him are combined is considered universal. "It is perhaps true that apart from nouns and verbs, interjections... are another word class found in all languages. ... Indeed, as Schachter rightly observes: 'Although there are a good many linguistic descriptions that fail to mention interjections, it seems likely that all languages do in fact have such a class of words' " (Ameka 1992: 101). The fact that the class of interjections as well as the classes of nouns and verbs are universal leads to

the idea of genesis of these three classes within the same mechanism. The simplest mechanism explaining their genesis is, as we found, two coupled operations, which we present below and show what elements they consist of. These elements do not manifest themselves. It means that these elements represent non-semantic information bits, which are unsigned, i.e., lack a sign, and denote nothing, and therefore are not noted by researchers. But at the same time, they form structures that provide, as we are going to show, the existence of the three word classes and grammaticality of speech by establishing a link between word meanings. In no other way do these *operational structures* affect word meanings. The causation of sentence grammar with operational structures enables us to answer positively the question of grammatical autonomy.

If operational structures are unsigned and non-semantic, then how can one know they exist and how can one reveal their existence? If one can show that operational structures determine the belonging of every word to a class, being connected to word's meaning, and above that create a mechanism for word syntactic connection, it will be convincing evidence of their presence in speech. In addition, we will show a technic for revealing operational structures covertly functioning in speech.

The area of study we are going to present encompasses grammatical facts. However, in accordance with our task, we will analyze lexical meanings only from the point of view of the effect on them of the operational structures, which accompany them as a non-semantic component, and not from the view of their connection with grammatical forms. In this sense, we will say that we study linguistic information in isolation from grammatical forms. So, we don't turn to a new field of linguistics, but we do turn to a new aspect of analysis. This analysis describes linguistic information with more details than the traditional grammar but differently than the fields relying on semantics. Let us take, for instance, the sentences

- (1) (a) A ball rolls.
- (b) The man stands like a kouros.
- (c) Two and two make five.
- (d) I apologize for my behaviour.

(British National Corpus 2014). All the sentences have the same subject and verb structure from the point of view of traditional grammar. If we take into consideration denotative meaning, we will see the difference between the sentences: The sentence (c) is false, (d) is a performative utterance, (b) contains a stative verb unlike (a), which contains an action verb. Just as the traditional grammar, the non-semantic component analysis shows no difference between them. But this analysis identifies, for example, three types of sentences with a direct object (they are cited in the Section 6), while the traditional grammar doesn't distinguish them, and they have no semantic basis for classification.

The discovered aspect of grammatical study has no background in existing branches of linguistics but appears to serve itself as a background, a foundation of grammar. This aspect of analysis was not studied earlier. That's why the references in the paper don't reveal its content and concern only particular cases.

Word classes are uniquely determined only in speech. By speech we mean a language in verbal communication opposed to the language in the narrow sense, "Langue" (a statically organized repository of everything that is necessary for producing speech and can be represented in it). As the effect of operational structures connected to the word meanings can only be detected in speech, of what we will say next, we accept that operational structures are also connected to word meanings in speech. The benefit of this approach is that sentence grammar is seen as a unified whole formed on a common foundation. In this paper, we consider, first, the coupled operations and the elements of which they are composed. Then we will present the structures formed from these elements and consider their role in the sentence. Finally, we will demonstrate a method for revealing operational structures functioning in a sentence.

To determine the place of this research among the areas of academic context is a difficult task. We inevitably deal with phenomena being under study in other areas. However, none of those areas provides a theory that might be a starting point for this research and none contains a combined research base on which it could

rely. The best way to present the place of this study is, in our view, to show its difference from the research areas whose object we deal with. To do that, we must clarify the following notions: sign and its relation to meaning in speech; meaning vs. information.

There are different approaches on sign and its relation to meaning in speech. Wallace Chafe (2018) considers the relation between sign and meaning, first of all, for the speaker from a whole thought to overt phonology via a semantic structure: "... organizing thoughts and pairing them with sounds defines what language is" (27). One can validly object that this figure [thoughts - sounds] ignores a listener's task of moving from sounds back to thoughts, but understanding language depends on having something to understand in the first place" (28). "The process ["verbalization"] is set in motion by a thought" (30). The next stage is semantic structuring of thought, then it is a syntactic structure, which is symbolized by an abstract phonological structure, then it is overt phonology, "which then provides the input to sound" (30). André Martinet (1967) suggests the following segmentation of language: "The first articulation of language is that according to which any experience to be transmitted, any need that one wishes to make known to others, are analyzed in a series of units each endowed with a vocal form and a sense" (13). The "monème" is a minimal sign which "cannot be analyzed in a sequence of signs" (15). Thus, A. Martinet talks about a sequence of units, so that the sequence itself as well as its smaller components have a sound form and a sense. Ray Jackendoff (2010) considers the interface between levels of mental representation: "In the Parallel Architecture, the combinatorial properties of meaning are not derived from syntax; they arise from autonomous conceptual combinatoriality. ... Part of the mapping [between meaning and sound (in either direction)] is provided by the words, which are interface rules between small-scale pieces of meaning and sound. The remaining part of the mapping is the encoding of the semantic relations *among* the words: the function-argument, head-modifier, and binding relations" (20). So, R. Jackendoff sees two modes of mapping between meaning and sound: pieces of meaning and sound in words, and semantic relations and sound above the words. To express our view on sign and its relation to meaning in speech, let us cite Ferdinand de Saussure's well-known statement: "The acoustic signs have only the time line; their elements appear one after the other; they form a chain" (103). Given the views above, we can say that speech develops gradually being built up with signs, that is, units endowed with a sense. The speaker articulates his/her thought using successively emerging signs. A required condition to understand it is sharing sound forms and meanings theoretically identical for both speaker and addressee. A listener hears speech segments increasing sign by sign and gets a partial understanding of speech as it gradually develops in figuring out the upcoming sentence meaning and anticipating it.

In constructional semantics as Ada Rohde (2001) says, "In general, constructions are seen as form-meaning pairings that link a specific syntactic structure to abstract meaning components. Constructions are thus not different in kind from lexical items, they are simply more abstract representations. ... One of the defining properties of constructions is that their meaning is not entirely predictable from their component parts. Strict compositionality is thus excluded by definition" (37). Thomas Hoffmann and Graeme Trousdale (2013) notice that "... the analysis of syntactic structures as form-meaning pairings was commonplace in traditional grammars. ... Consequently, he [Paul Kay] makes a distinction between constructions as fully productive processes that are part of a speaker's grammar, on the one hand (such as the All-cleft construction), and semiregular processes such as the 'A as NP'-pattern (as exemplified by dumb as an ox, dead as a doornail, or green as grass), on the other, which he sees as mere patterns of coining (and which are part of metagrammar, i.e. "a compendium of useful statements about the grammar")." In this regard, let us note for now that when meanings enter a construction in speech, not only meanings but also semantic information is involved (see also R. Jackendoff above).

The relation of information and meaning is defined from quite different angles. Loet Leydesdorff (2016) mentions that "As is well known, Shannon first focused on information that was not (yet) meaningful: 'Frequently the messages have meaning; that is they refer to or are correlated to some system with certain physical or conceptual entities' (3). ... one can distinguish between "meaningful information" — potentially reducing uncertainty — and Shannon-type information that is by definition equal to uncertainty. ... Meaning is provided to the information from the perspective of hindsight (of the "later event" — that is, a system of reference) (4). On the one hand, Luhmann defined information as a selective operation and stated that

“all information has meaning. (15)” “As will be shown in the following definitions of information concerning Wiener and Shannon,” writes Kane X. Faucher (2013), “none of these have anything to do with knowledge claims and or semantic meaning; they are largely mathematical concepts. ... information is *made* material when incarnated in artefacts, objects, and entities. In this way, information is what “haunts” matter, while depending on it (8).” According to John Mingers (1995) “... *meaning is created from the information carried by signs* . The consequences are that information is objective, but ultimately inaccessible to humans, who exclusively inhabit a world of meaning. Meaning is essentially *intersubjective* – that is, it is based on a shared consensual understanding (3). This explanation reveals the relationship between information and meaning (import) – objective *information* is converted into (inter)-subjective *meaning* through a process of digitalization (11). Information is an objective, although abstract, feature of the world in the same way as are physical objects and their properties (12)”. Our own understanding is different from the cited ones. The choice of our notion of linguistic information is based upon the phenomenon of disconnecting meanings from the words in speech (see the next paragraph): We believe that the meaning of a word becomes information only in this case. We also take into account the distinction between meaning as a means of identifying (the denoting property is a characteristic not of a word as pure form but of its meaning – it is meaning that enables naming), which we can call semantic information, and meaning as a subject of study. Semantic information turns to external reality and is connected with our knowledge of the world we live in, whereas in analyzing meaning as subject of study we must reveal its own characteristics and not what it denotes.

Finally, we would like to notice some important distinctions of the proposed approach from the available linguistics studies. This research is not part of traditional grammar, but it is also distinct from modern theoretical grammar in the object of study. In contrast to them, the proposed approach deals with non-semantic entities. This approach can’t be defined as a formal system either because these entities are embedded in linguistic information. In Cognitive Linguistics, as Fauconnier (2014: 2) says, “Cognitive capacities that play a fundamental role in the organization of language are not specific to language”. Regardless of the Cognitive Linguistics findings, the studied level formed with operational structures is specific to speech process. In Cognitive Linguistics, as Geeraerts and Cuyckens (2007: 5) say, “Language is seen as a repository of world knowledge, a structured collection of meaningful categories that help us deal with new experiences and store information about old ones”. What interests us here, is just how the utilized meanings interact in speech through non-semantic characteristics and not how a meaning correlates with other meanings or knowledge.

2 Meanings and information units

We know from physics that quantity is a universal characteristic of the real world. However, quantity could not be perceived without another universal characteristic, which is the property to be substituted and which we will call *electivity* . Let us show their mutual need by a simple example of perceiving a spatial object. One can estimate an object’s size, that is, its quantitative value as its spatial extension, thanks to its boundaries in space. Here we leave aside that the perceived size of objects depends on a number of factors. See, however, Tal Makovski (2017), “investigating how the boundaries of an object and, particularly, the absence of these boundaries, impact its size perception”. (whether they are its external line, its color, matter, texture, form or structure). The mutual need of an extension and boundaries consists in that an extension doesn’t exist without boundaries, as well as boundaries don’t exist without extension. But their characteristics are different: When determining an object’s size in this way, we assume that quantity has a property which distinguishes it from what we call electivity. An extension, characterized by quantity, has the property to be accumulated: The smaller is included in the larger. A boundary (we consider it ideal, that is, without extension), which separates two extensions, on the contrary, can only be substituted by another one and so electivity has the property to be substituted.

Information refers to that from which it is an abstraction sent. Spatial objects are displayed in language by concrete noun meanings, which contain information transmitted by these objects. So noun meanings refer to objects. Quantity observed in spatial objects can also be displayed in language, but the only quantity abstraction is the state of being included, which is what refers to the quantity. Unlike meaning, the abstract

state of being included cannot be conscious. In what follows, we will show that this state is displayed in an operational structure, which accompanies the meaning in speech. Actually, in contrast to quantity, abstract state of being included characterizes neither an individual object nor a meaning. A spatial object, as we have shown above, is characterized not only by quantity, but also by electivity. Electivity is also an abstract concept. Electivity is referred to by its state of being substituted, which is displayed in an operational structure too.

The concepts of inclusion and substitution are naturally derived from two simple operations in which the derivative element is formed from the initial one in such a way that the difference between inclusion and substitution is determined in the absence of any content for the elements, i.e., without reference to outside objects and not due to the content of the elements themselves (in order not to “multiply entities without necessity”). The difference created in this way is provided by the fact that the operations are formed by elements determined by the operations themselves. We do not know in what form and at what stage of human genesis these operations exist and whether they exist materially at all. But the structures formed by these operations exhaustively explain the defining characteristics of the three universal word classes, in relation to which they act as the same kind of abstraction as inclusion and substitution in relation to quantity and electivity, respectively. As for the relationship between quantity and electivity that exists in the real world, it is displayed in the combining of operations, i.e., in that they are carried out coupled. So, there are *aquantitative* and an *elective* operation.

The quantitative operation introduces a relation $q_0 \mid Q$, where q_0 (initial element) is a quantity being part of the quantity Q . One can see quantity determined as above in brain. Signals perceived by our five major senses represent object’s quantifiable parameters – bright or dim light of a particular colour, loud or soft sound of a particular pitch, strong or not strong touch, strong or weak smell, intense or poorly perceived taste. Quantitative parameters are integrated in a process of recognition – as a shape and colour of the object, as a cumulative effect caused by stimulation of olfactory receptors, etc. (derivative element). We don’t use the symbol $\mid$ as mathematics to mark that one number is less than another. It means here that the quantity Q has q_0 as its accumulated part. The elective operation performs a substitution $e_0 - E$, where the initial element e_0 is a substituted element, E , a substituting derivative one. The elements brought out from the operations become static and constitute bits of non-semantic information. We will call these elements operational *states* and the combination of the operational states accompanying a semantic information in speech, *operational information*. The operational states can be used in semantic information while remaining coupled or separately (ceasing to be unobservable, see further). So, the quantity operation means that the initial quantitative state q_0 is included in the including derivative quantitative state Q . The terms “includes, including” and “is included” are chosen because they express the gist of respective operational relations and are in no way related to set theory. and the electivity operation means that the initial elective state e_0 is substituted by the substituting derivative elective state E . If the initial states of both operations are determined by the opposition of a static element to the operation as a process, the derivative states, in addition, are characterized by a different relation to the initial states. If the derivative quantitative state can be determined as including, the initial state remains undetermined in the operation. Outside the operation, it always accompanies the derivative state and that’s what makes it involved in quantity. Similarly, if the derivative elective state can be determined as substituting, the initial state remains undetermined. Outside the operation, it has no quantitative characteristic and on this basis is defined as elective.

The starting point in analyzing the meaning of a sentence is the meanings of the words that make up the sentence. The available means of describing linguistic meanings, in particular by means of componential analysis, semantic decomposition or through their definition, disintegrate the meanings via other whole meanings to reveal their structure (when we say “whole”, we mean that any meaning is expressed by a separate word). But are there other entities in speech besides meanings that are related to them and responsible for their relationship in a sentence?

Aphasia demonstrates that meaning and its form diverge in certain circumstances. Dronkers and Baldo (2009: 343) describe patients with anomia as follows:

When searching for a word, some patients with anomic aphasia paraphrase using words that they can easily retrieve. For instance, a patient shown a drawing of a pair of tongs said “You pick up things with it.” Such circumlocutions demonstrate that patients with anomic aphasia have lost neither conceptual understanding nor the ability to build coherent sentences and phrases. Whereas circumlocutions may be a characteristic feature of the speech of some patients with anomic aphasia, the main characteristic displayed by other patients may be periods of slow and halting speech as they search for the correct word. For instance, when shown a picture, a patient might say, “It’s a, ummm, uhhh, a, a, a ... I know what it is, it’s a ... Aww hell, it’s there but I just can’t get it.”

The message of the examples with aphasia is that the patients possessing the concept of the thing can’t remember the word whose meaning enables naming.

Now, let’s imagine that a word is omitted (or not heard), but we can, however, understand the sentence. Its understanding is possible if we turn to a meaning which is to a greater or lesser extent determined by the sentence or the context so that the missing word may not exist at all or, if it does, can be selected by its meaning. For example, to understand the sentence *Up the <...>, on the second floor*, we turn to the meaning ‘something we can climb to get on the second floor’ or to more specific meanings, which can be then expressed by the words *stairs, ladder, tree*, etc. W. Chafe (2018: 28) argues: “Because the thought-sound association is such a pervasive aspect of daily experience, it can be surprisingly difficult for anyone who is old enough to speak to separate the two. ... I recently had occasion to think over well-known film director whose name ... was briefly inhibited. ... I was conscious of everything about him except his name. It wasn’t long before the sound *Alfred Hitchcock* found its way back to my consciousness, but while it was absent the thought-sound association lacked its bottom half. ... Separating a thought from a sound can be experienced in the opposite direction in rote learning.” It is also known that polysemy is explained by the ability of a linguistic sign to accumulate more than one meaning under one form. But a word polysemous in dictionary loses its polysemy (or actualizes double meaning) in speech.

All this suggests that in comprehending the speech, the sound word becomes unnecessary for the addressee, and the addressee operates only with meanings that create a semantic whole. In other words, in meaningful speech, the meaning is separated from the phonetic word. We will call meanings in speech separated from signs *information units*. The information units get rid of the signs to become an informational continuum, a formulated thought.

3 Operational structures

The coupled operations give rise to three static structures: the derivative coupled states, the initial or both derivative and initial ones. Formed directly from the operations, the coupled states constitute *primary operational structures*. Operational structures endow information units with characteristics that correlate with the semantics of word classes. The two largest primary structures correlate with the parameters of objects and processes.

If all the states forming the operations (that is, the structure of both initial and derivative states) are used with an information unit, they characterize it as the information of a verb (any verb: action verbs, stative, physical, mental, modal, linking or others with respective denotata, which we will call process anyway) and correspond to the parameters of real processes. The parameters of phenomena perceived as process characterize it by a duration including previous moments provided that each previous moment is substituted by a following one. Now, let us analyze the properties of the operational structure so formed.

This structure can be represented as follows:

$$(2) \ e \ 0 \ q \ 0, \\ EQ, \\ (q \ 0 < Q)(e \ 0 - E)$$

(the symbol $<$ means the relation 'is included', and $-$ means the relation 'is substituted'). In (2), each of the elective states in coupling with the respective quantitative state corresponds to a succeeding moment of the lasting process: The substituted state corresponds to a preceding moment and the substituting one corresponds to a following moment. The quantitative states in coupling with the elective states correspond to an included quantity of time – duration. Both initial and derivative states form a structure of coupled sequences, which represents an inclusion corresponding to an extended duration and a substitution that corresponds to a sequence of moments. So, the coupling quantitative and elective states sequences corresponds to the double-natured character of verb information (v^i), which recognizes the temporal process as duration and as a sequence of moments.

If only the derivative states are used with an information unit, they characterize it as the information of a noun (spatial or temporal, concrete or abstract, common or proper, denoting objects or matter, which we will call object anyway) and correspond to the parameters of spatial objects. One can identify a spatial object only by separating it with a boundary from another object or space environment (see the example of a spatial object, section 2). The identified object can be of any form but implies some internal content, a quantity even if the object itself is an extended boundary (for instance, a boundary of light and shadow). The noun information (n^i) structure can be represented as follows:

(3) EQ ,

$Q > (q_0)$,

where EQ are coupled derivative states; the symbol $>$ means the relation 'includes' and implies an included non-coupled state q_0 .

If the initial states are used with an information unit, they characterize it as the information of an interjection (int^i). Coupling initial states leaves the operational structure incomplete due to lack of derivative states. Therefore, they leave the word meaning structurally indeterminate, thus hindering it from entering into relations with the structures of other word meanings, so that the interjection cannot independently fulfill its own syntactic function in the sentence. The result could be that the interjection either does not enter in the sentence structure¹¹See, for instance, Wharton (2003: 3): "These views can still be found in the contemporary literature: Quirk, Greenbaum et al. describe interjections as 'purely emotive words which do not enter into syntactic relations'; Trask describes an interjection as 'a lexical item or phrase which serves to express emotion and which typically fails to enter into any syntactic structures at all'...". and becomes tantamount to a proposal content, or is contained within a larger predicative structure²²See, for example Шведова (1957). or assumes a function resulting from the sentence structure³³See, for example Германович (1941).. The int^i structure can be represented as follows:

(4) $e_0 q_0$.

The structure of initial states does not correlate with realities of the external world. It characterizes the result of interlocutor's perceiving its internal information which represents *expressible* mental information: Any verbalized information, if its mental-linguistic processing has been performed, serves to express certain content (whether it is feelings, emotions, sensations, states of mind or a formed thought).

So, there are three primary structures (cited in 2011a, 2011b) to characterize word class information. A relationship between operational structures is carried out under the following conditions. An asymmetric relationship between quantitative states ($<$ or $>$) is set when a symmetric relation is implemented between elective states, namely, when an elective state is *unified* with another: $E_1 [?] E_2$. And an asymmetric relationship between elective states ($-$ or $-$) is set when a symmetric relation is implemented between quantitative states, namely, when a quantitative state is *equivalent* to another: $Q_1 = Q_2$ (the term "equivalent" and the symbol $=$ just mean that there is no inclusion between two states). The *method* we use in our approach consists in detecting elective and quantitative relations which exist between the operational structures of information units to find out how they interact and thereby participate in forming resulting sentence information.

Thus, operational structures allow revealing the links between information units which remain unnoticed by other methods and which, as we will show further, form complex operational structures underlying sentence grammar. The formation of complex operational structures is provided by six relations (4 asymmetric and 2 symmetric ones) between the states of simpler structures.

4 Complex operational structures

With a few exceptions (clichés, idioms, quotations, borrowed phrases, fragments seared into one's memory) information conveyed in communication is every time created from picked ad hoc meanings even though this is made easier by the fact that for each of the words there are many readily available examples of its use in combination with other words. Complex operational structures control this process together with the other well-known factors, such as grammar usage, semantics or stylistic and pragmatic factors. According to our research of the Russian language, complex structures cover the main ways of grammatical sentence formation, which we described with 37 groups of operational structures. The list of simple structures of a language and the modes of combining them to create complex structures form a closed system, which represents language distinctive characteristic. Relying on this research, we think that the analysis with operational structures is applicable to other languages too. Our supposition is based on the premise that the noun, verb and interjection are, according to typology data, universal from isolating to synthetic languages and so are their structures while the other operational structures are their derivatives.

There are two main ways of forming complex operational structures: by means of single (noncoupled) quantitative or elective operations, establishing a corresponding relationship between the operational structure of an information unit and a state of the operation, and by connecting simple structures. Although the single operations are carried out by non-semantic information, the necessity of their performing is mostly expressed by signs and therefore they are detectable in speech.

One of the single elective operations is negation. The negation $Ex - Ex^-$ of $av^i x$ means that it gets an elective state alone (without semantic information) that substitutes its derivative elective state. Coupled with the remaining quantitative state, the elective state of the operation characterizes a new unit x^- with *operational information*, i.e., an information unit in which instead of semantic information only its quantity is noted. Because of the asymmetric relation of the elective states, the quantitative states of the v^i and of the new unit are equivalent: $Qx = Qx^-$ (see the preceding section). In the sentence *Trust funds are not admissible*, for example, the lack of information of the elective state introduced by negation signifies cancellation of “are admissible” and introduction of operational information with a quantitative state equivalent to it. The presence of operational information is confirmed by the possibility of introducing the same quantity of semantic information (e.g., “are prohibited”) instead of it without violating the grammatical correctness of the sentence.

One of the single quantitative operations is *hyponymization*. There is no special symbol to express it in English, Russian and other European languages (cf. *izafat* in Persian or Turkic languages), but it plays an important role in forming complex structures and corresponding phrases.

The hyponymization of an information unit x is determined by the relation $Qx < Qx^<$, meaning that x gets an introduced quantitative state which is including with respect to its derivative quantitative state and characterizes missing information. Its hyponymization introduces a quantitative state without semantic information while the elective state remains the same ($Ex \text{ [?]} Ex^<$). So the hyponymized unit gets operational information with a quantitative state superior to the one of the semantic information. We will say that it gets an *operational information increment*.

It is important to emphasize that there is no question of real information resulting the hyponymization, it's just about operational, non-semantic information. Let us clarify our view in contrast to the available researches of quantitative relations in language. John Lyons (1977: 45) notes: “Signal-information content, as measured by the mathematical theory of communication, has frequently been referred to as surprise-value; and it is this aspect of the theory, if any, which links the two senses of ‘information’, which we are distinguishing by means of the terms ‘signal-information’ and ‘semantic information’. ... “Man bites dog”,

as they say, is a more significant item of news than "Dog bites man"”. In his *Axiomatic Semantics*, which “is a theory for the description of the wholly fixed-conventional information values of linguistic signs (in their capacity of being paradigmatic entities in grammar as well as fully fledged signs)” (p. XXVII), Sandor G.J. Hervey (1979) writes: “The relations of hypero-hyponymy, synonymy and paronymy are defined in “axiomatic semantics” in terms of set-theoretical relations holding between classes of entities — denotata (131)”. And further: “Thus, giving the information that a given sign belongs to one another of these classes proves to be an economical way of distinguishing the “meaning” of that sign from that of many other signs” (146). Then he inquires (see, for example, p. 162, 164) whether the word is used as a hyponym of another word. So, information quantity can be viewed either in regard to preservation of conveyed signal or as to degree of message novelty or else when comparing the meanings of different words. The relations between word meanings are numerous and vary from one part of speech to another. As Gabriella Vigliocco and David P. Vinson (2005) notice: “Huttenlocher and Lui proposed that these two content domains are differentially organized: words referring to objects would be organized hierarchically, whereas words referring to events would have a matrix-like organization without well-defined levels of structure” (19). The authors cite Miller, G. A. & Fellbaum, C. view: “In Wordnet, ‘nouns, adjectives and verbs each have their own semantic relations and their own organisation determined by the role they must play in the construction of linguistic messages’ (p.197). These relations and organisation are constructed by hand based on the relations that are believed to be relevant within a given class of words. For nouns the most important roles are typically played by relations including synonymy, hierarchical relations and part-whole relations. For verbs, instead, dominant are troponymy (hierarchical relations related to specificity in manner), entailment, causation and antonymy. Some evidence compatible with a different role of relations such as cohyponymy and antonymy for nouns and verbs comes from spontaneously occurring semantic substitution errors” (22). In contrast, we do not explore relationships that exist in language understood as *Langue* and are merely found in speech, but we do explore relationships that are formed only in speech.

Hyponimization can be caused by the presence of a subordinate word information. In this case its derivative state includes that of the principal word information and is equivalent to the state of its operational information. We will say that the principal word information is a hypernymic base of its increment with operational information. Only binary relations exist between operational states. Accordingly, operational information cannot be measured by a numerical value like the parameters of material objects.

In the sentence

(5) With a higher soil pH **the element phosphorus** and others becomes more available for absorption by plant roots

(borrowed from Meyer 1992: 20) it’s the noun information n^i *element* that serves as a hypernymic base for the n^i *phosphorus* and is hyponymized. In case of two information units which structures form a complex structure, their operational relation characterizes a syntactic link between them. In the phrases *an oak tree*, *a fruit tree*, *a forest tree* the n^i *tree* is hyponymized. In all these phrases the subordinate word information derivative state includes that of the principal word information and the subordinate word information has the principal word information (*element* and *tree*, respectively) as its hypernymic base. In the phrase *good boy* the adjective information (adj^i) Δn (which, unlike n^i , does not have its own hypernymic base) serves as the n^i ’s increment equivalent: $n^{\Delta \nu}$. The adj^i ’s hypernymic base is determined by the n^i . An increment information equivalent has an influence on the hypernymic base n^i and can leave it without change (e.g., *a white mouse*: the base ‘mouse’) or provoke its change and even its replacement by the increment information (*a mouse photographed*, *drawn* or *invented by a writer*: The base is ‘photo’, ‘drawing’, ‘image’, but not ‘mouse as a living creature’). Accordingly, the object recognized by n^i can change with the base: *a fake gun* (the example borrowed from Lakoff 1982: 37) is a forgery of the gun (resembling it but not a gun); *a wooden leg* is a device that compensates the lost leg (but is not a human leg). Hyponimization takes place if then n^i remains the base of the noun phrase information, i.e., if the n^i remains intact like in *white mouse*, or at least if the noun phrase information can’t be determined without the initial n^i , like in *fake gun*, *wooden leg* – cf.: *a hot dog*, where *dog* can’t be determined as a hypernymic base and therefore hyponimization is not

determined either.

So, the noncoupled single operations (we do not consider the rest of them in this article) establish a quantitative or elective relationship between the operational structure of an information unit and a single state by creating a new unit based on the substitution (negation) or inclusion (hyponymization) of states.

The other way of forming complex operational structures is the connection of simple ones.

One of complex operational structures formed by unification of simple structures characterizes the information of common noun-verb sentences. The n^i 's elective state is unified, first, with the verb information initial elective state and then with its derivative elective state. It means that the n^i has been substituted while the verb information (v^i) remains the same, denoting the object substitution (by itself, in particular). We will call a complex v^i - n^i structure forming the sentence information *integration* :

$$(6) \text{ } En \text{ } [?] \text{ } e_0 v \text{ ,}$$

$$En \text{ } [?] \text{ } Ev \text{ :}$$

$$(En \text{ } [?] \text{ } e_0 v) - (En \text{ } [?] \text{ } Ev) ;$$

$$Qn \text{ } [?] \text{ } Qv \text{ ,}$$

which implies that the n^i 's elective state unified with the v^i 's substituted state is substituted by the one unified with the v^i 's substituting state and which results so in a sequence of the unified states. Whereas in the case of hyponymization, one of the information units was principal, the v^i and n^i forming sentences are equitable. So, each in turn serves as a hypernymic base for the other (we have denoted it by their non-equivalence: $Qn \text{ } [?] \text{ } Qv$). The v^i - n^i integration is described by the same structural formula independently of their information (see the sentences [1]).

Due to the non-equivalence of the units' including states, then n^i in the sentence *A ball rolls* , for example, gets an increment information equivalent as $v^i : Qn < = Qn^v$ ('a rolling ball') and the v^i gets an increment information equivalent as $n^i : Qv < = Qv^n$ ('rolls like a ball'). An increment information adopts the structure of the hyponymized item, namely, (v) in n^v adopts the nominal structure of $adj^i : Q(v) = Q \Delta n$, and (n) in v^n , the structure of a parametric (gradable) adverb information $adv^i : Q(n) = Q \Delta v$. The resulting integral information recognizes a situation which represents the process as limited by the properties of the object, and the object, as passing succeeding moments of the lasting process. So, the increment information of n^i with v^i causes its increment also with nominal information $n^{\Delta v}$: The nominal information constituting the n^i 's increment recognizes qualities lent to the object by the process (i.e., n^i recognizes an object identified in process). Cf.: 'a man standing' (*The man stands*) and 'a man sitting' (*The man sits*), where different attributes of the man are recognized – his posture, holding on different body parts, different muscle tension, readiness for mobility, etc. The increment information of v^i with n^i causes its increment with verbal information $v^{\Delta n}$: The verbal information constituting the v^i 's increment recognizes qualities lent to the process by the object (how does the object do it?). Cf.: 'stands like a man' (*One player stands in the middle of the room*) and 'stands like a tree' (*The tree stands there*), where different attributes of the process are recognized – staying legs on the floor or roots in the ground.

5 To the description of physical equations

Physics formulates the universal laws of the real world by means of the language of physical equations. Both mathematical language in physical equations and verbal language are global, i.e., capable of cognition of the whole world. In this section, we are going to show that besides language the other global sign system involves operational structures too. We will show that the units that make up the equations enter into relationships that, like the word meanings in a sentence, are supported by operational structures. Physics describes not reality itself, whatever it is, but its quantitative aspect; that's why the description language of physical equations is mathematics. So physical equations describe quantitative reality. The physical equations include a limited number of quantitative parameters and describe the relations between them. Thereby, the physical description with equations reduces a large number of objects to a lesser number of

description units and so physics describes not just quantities of the parameters but the quantitative aspect of reality in its entirety. We will take here just a few simple equations with variables connected by arithmetic operations.

Not only non-coupled operations but also non-coupled single states are used with information units. Denoting nothing, single states nevertheless influence the semantics of the unit: They determine the starting point in its denotatum. The quantitative single state determines the ordinal scale of a quality denoted by the used unit and / or the initial amount of this quality on it.

A single quantitative state is incorporated into the meanings of parametric, or gradable, adjectives and nouns. Parametric adjectives are, for instance, *ripe*, *tasty*, *expansive*, *good*, *strong*, *massive*, *energetic* and parametric nouns are *force*, *mass*, *energy*, etc.

Let us call nouns and adjectives that contain a single quantitative state dimensional. Dimensional nouns n_q *quantity*, *degree*, *height*, *width*, *thickness*, *volume*, *weight*, *temperature*, *speed*, *kindness*, etc., are part of parametric nouns. Dimensional nouns differ from the other parametric nouns: The parameter they recognize is recognized not only by the corresponding dimensional adjective Δn_q but also by its negation Δn_q^- . Let us compare the dimensional noun *height* and the parametric but not dimensional noun *kindness*. *Height*: not only *high* but also *not high* means 'having some height'. *Kindness*: *not kind* doesn't mean 'having kindness'.

The dimensional adjectives *large*, *high*, *frequent*, *strong*, *deep*, etc. differ from the other parametric adjectives which recognize object parameters by recognizing not an arbitrary value of the quantitative parameter but a value that is implemented on only one of the opposite parts of the parameter values' range. So, *high* means not merely 'having height' but 'having a great height'; *smart*, not just 'having mind' but 'having a great degree of mind'; *low*, 'having a small height'. One can explain this characteristic of dimensional adjectives by the assertion that a dimensional adjective meaning comprises a single quantitative state $|Q|$ which forms quantitative information in the basis of its semantic information. If dimensional nouns are used with dimensional adjectives as words containing $|Q|$, they must have or be vested with $|q_0|$, which should be included in $|Q|$.

Single quantitative states in conjunction with single elective states participate also in forming numeral meanings, which become numeral information when used with a noun in speech. Numeral meanings are formed in interconnected semantic relations of single states where one implies the other. The single states are interconnected as following: The elective state $|E|$ recognizes the ordinal number k -th expressed by an ordinal numeral ΔK (related to a preceding ordinal numeral as "after") forming thenⁱ's increment if the quantitative state $|Q|$ recognizes the number k expressed by a cardinal numeral K (related to the corresponding lesser cardinal numeral as "more than") forming thenⁱ's alternative increment. Operational structures are involved here not in speech but to form numeral meanings. However, the meaning of an ordinal number is formed, as we have shown, in interconnection with the meaning of the corresponding cardinal number. This means that the need for operational structures arises not only in case of the interconnection of word meanings in speech, but also in the formation of interconnected meanings of a numeral of one category and the corresponding numeral of the other.

Units of measurement are used in equalities and equations. A noun used as a unit of measurement, like *foot*, includes a dimensional noun as its hypernymic base ('distance' in case of *foot*), which we will call dimensional base, and presumes the single state $|Q|$ of the cardinal meaning K . So, units of measurement are used mostly with a numeral and recognize the numerical value of the dimension recognized in turn by a dimensional base, for example, *seven miles* (in *distance*), *5 feet* (in *height*).

Units of measurement can have the same dimensional base, for example: ('distance') + ('distance') = ('distance'); ('distance') $\times$ 2 (a dimension base is absent: dimensionless coefficient) = ('distance'); 1,000 $\times$ ('weight') = ('weight'). Or they can have different dimensional bases, like in the equality: (dimensional base 'length') $\times$ ('width') = ('area') and the equations – geometric formulas and algebraic equations: V (l (dependent variable) = $a \, dm \times b \, dm \times c \, dm$, or (without units of measurement) $V = abc$, where

the variables a, b, c are edges ('length', 'width', 'height'), the variable V is the 'volume' of a rectangular parallelepiped.

Units of measurement have different dimensional bases in physical equations too: $s = vt$, where s is the 'way' of a body moving with uniform velocity (e.g., s nautical miles), v , 'velocity' (e.g., v knots), t , 'time' (e.g., t hours); $pV = \text{const}$, where p is 'pressure', V , 'volume' of an ideal gas.

Here, we will not analyze units that include a single elective state $|e\rangle$. We only note that it can be part of v^i and of n^i operational structures pointing to the starting point in the time sequence.

6 Verbal reconstruction

Unlike single operations and states, the operational structures formed by coupled quantitative and elective states are not directly detectable in speech. Their existence is substantiated by means of a technique, making possible the *verbal reconstruction* of sentence operational structures, that is, their representation through lexical means. In this case, the operational structure subjected to verbal reconstruction must be equivalent to the operational structure of the original sentence and, therefore, the verbal reconstruction must reproduce the meaning of the original sentence. The words by which verbal reconstruction is to be carried out are "existential" and process nouns and the verbs *to be* and *to have*. The process nouns are those that have the hypernymic base 'process' and are integrated with verbs like *accomplish*, *fulfil*, *proceed*, *undertake* introducing nouns which can denote events but not things. The existential nouns, also formed with verbal information, are those that have the hypernymic base 'timeless object' and are integrated with the verb *exist* and denote only things.

As an example of verbal reconstruction, we will take Russian sentences with transitive verbs. We will not present their operational structures, as this would lead to unnecessary complication of the article and an increase in its volume. With these examples we will just show that the verbal reconstruction of the operational structure of a sentence reproduces its meaning. For instance, the operational structure of Russian sentences such as

(7) *Она имеет кольцо* 'She has a ring'

has the verbal reconstruction «она не есть атрибут: кольцо есть атрибут» 'she is not an attribute: the ring is an attribute', where *атрибут* 'attribute' is an existential noun. The operational structure of Russian sentences such as

(8) *Никарагуа все еще производит свой собственный кофе* 'Nicaragua still produces its own coffee'

has the verbal reconstruction «производство не имеет Никарагуа: производство имеет кофе» 'production has no Nicaragua: production has coffee', where *производство* 'production' is taken as a process noun (cf. the existential noun *product*). And the operational structure of Russian sentences such as

(9) *Джеймс толкает Сандру* 'James pushes Sandra'

has the verbal reconstruction reading «Джеймс не имеет толчок: Сандра имеет толчок» 'James has no push (as a fait accompli): Sandra has a push', where *толчок* 'push' is taken as an existential noun.

So, an approach with verbal reconstruction allows us to see how sentence meaning is structured not by analyzing semantic content but through operational structures. This approach allows us also to group speech items on the basis of operational structures and not on a semantic one; at the same time, these groups are then determined by semantically distinctive features. For example, the transitive verbs in sentences like (8) have no information about actions that are performed by the subject to produce the object (the listener doesn't know what Nicaragua does to produce coffee). In sentences like (7), the existential noun "attribute" is also the verb's object: «Она имеет атрибут» 'she has an attribute'. And the existential noun in sentences like (9) becomes the object's attribute: «Сандра имеет толчок» 'Sandra has a push'.

There is one more circumstance that convinces us of the operational structures' real presence in speech. It is that one can see the grammar as a whole all the parts of which are linked by uniform relations of the states

forming operational structures. The interconnection of many grammatical facts is being discovered within the framework of the theory by reducing them to a common basis. This is also an important indicator of its truth.

7 Concluding remarks

We have shown that there is an autonomous mechanism underlying the grammatical correctness of a sentence. This mechanism is operational structures that determine information unit's class and above that create a way of word syntactic connection. We also showed as far as possible in an article a mechanism of interaction of information units through operational structures, the result of which can be traced semantically. Operational structures act covertly in speech, but they can be revealed by means of verbal reconstruction or due to their influence on the semantics of a lexical item. All this proves the validity of our assumption about the existence and role of operational structures in speech.

The developed approach brings us to the yet unexplored aspect of the language, which allows taking a fresh look at the process of formation of grammatically constructed language in communication. The role of operational information depends on whether the states are coupled or not. Being coupled, operational states determine the grammatical correctness of the sentence providing syntactic links of the meanings as word classes. The noncoupled single operations (negation and hyponymization) provide information units with operational information. The single quantitative states determine quantitative characteristics of a group of adjectives and nouns. Used as alternative increments of the same noun, the single quantitative and elective states underlie the linguistic meaning of the class of numerals.

By observing how simple operational structures form complex ones, one can determine the interaction of information units in the sentence and so undertakes a language description with operational structures. The operational structure method allows a uniform analysis of grammatical phenomena, ensuring its precision and rigour, and so grammar is seen as a unified whole formed on a common ground. In this way we have found out in our research of the Russian language that operational structures are a successful method to describe grammatical phenomena from the noun plural and the verb aspect-tense forms to the syntactic use of words like infinitive, prepositions, conjunctions or nouns in the indirect cases. Operational structures apparently represent a universal non-semantic mode of sentence formation.

The analysis with operational structures has led us to several particular discoveries. In this paper, we have given only three of them: a complex structure of negation, hyponymization and differences found between Russian transitive verbs. Hyponymization is a covert grammatical phenomenon symmetrical to negation with the difference that negation is based on an elective relation and hyponymization is determined by a quantitative relation. The differences of Russian transitive verbs, which also affect semantics, are determined by different operational structures characterizing substitution of a negative structure by the positive one.

Having the example of our research of the Russian language, on which this article is based, we can see that there is a limited number of operational structures and relations they form in a language. So, language description with operational structures is able to reduce the large number of information units to a small number of description units, which is the goal of any scientific description.

Describing the quantitative aspect of the real world with equations, physicists describe the world itself. In contrast to the physicists' description, operational structures are not directly applicable to the real world. If real objects can be measured, i.e., determined with numerical quantities, information units can be determined by only one of the two quantitative relations of their operational structures – inclusion or equivalence – and so can't be measured in that way. Unlike semantics, the main interest of which is how language is related to the things in the extra-linguistic world, we introduce operational structures, which describe not the world or understandings of experience but information itself independently of the real world.

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