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LANGUAGE AS A SCALE-FREE NETWORK

The article deals with linguistic synergetics as a new multidisciplinary research approach to the study of language complexity and language development. The author shows that language is a synergetic system; and as such, it can be described in the terms of synergetics. From a synergetic perspective, human language is considered an open, dynamic, non-linear, self-organising system with all its hierarchical subsystems and elements coherently interconnected and controlled by governing parameters. The concept of a scale-free network with a cluster structure is used to represent the notion of non-linearity inherent to language subsystems, especially the word-stock, and to explain the highest rate of changes within the latter.

Key words: synergetics, linguistic synergetics, language complexity, language change, non-linearity, a scale-free network, a synergetic system.

Стаття виконана в руслі лінгвістичної синергетики як нового міждисциплінарного дослідницького підходу до вивчення мови та її розвитку. Відстоюється теза про те, що мова є синергетичною системою, а тому може бути описана в термінах синергетики. З синергетичної перспективи, мова є відкритою, динамічною, нелінійною, саморегульованою системою, в якій ієрархічно пов'язані компоненти контролюються параметрами порядку. Для репрезентації поняття нелінійності, притаманного підсистемам мови, зокрема її вокабуляру, і поясненню високої динаміки змін пропонується застосувати поняття безмасштабної мережі з кластерною структурою.

Ключові слова: синергетика, лінгвістична синергетика, мовна складність, мовні зміни, нелінійність, безмасштабна мережа, синергетична система.

Introduction. Linguistic synergetics is a new multidisciplinary research approach to the study of language complexity and language development. It emerged in the 1990s and considers a human language as a hierarchically organised megasystem, in which all the components (elements, subsystems, parts, etc.) are coherently linked on all structural levels. Among new concepts, introduced by synergetics to language studies, is that of non-linearity. The aim of the article is to disclose the notion 'non-linearity' and to show that language is non-linear and can be modelled as such.

Discussion. From a synergetic perspective, human language is considered an open, dynamic, non-linear, self-organising system with all its hierarchical subsystems and elements coherently interconnected and controlled by governing parameters.

As seen from the above definition, one of the most important notions of synergetics and features of a synergetic system is the notion of non-linearity, i.e. a kind of hierarchical organisation with a wide variety of potentially possible ways for the development of an open system, with the irreversibility of

changes, and with the variation of degrees of intensity of the processes taking place in the given system during its self-organisation.

Non-linearity is a mathematical concept and as such it stands for a certain type of mathematical equation that may have several absolutely different solutions. The non-linearity of a language system is revealed in the dependency of features and functions of the system on the behaviour of each component. The notion of linearity is probably applicable if we want to denote the order of language elements in a speech chain.

Non-linearity is revealed at different levels of its organisation. Thus, the number of morphemes is always less than the number of words formed out of them. The number of words in a language is always less than the total number of their meanings. Within a sentence, the number of links among the words always exceeds the number of the words. On the text level, words and word-combinations, as well as sentences and super phrasal units, realise numerous prospective and retrospective links, as if cementing the given text into a certain complex hierarchically organised system. There are many other examples of non-linearity of language.

The application of synergetic methods of analysis is essential for understanding the very notion of non-linearity. It is even more important for modelling the latter. Models are useful not only for specific purposes. They can also serve as a methodological and/or philosophical basis for research.

It is possible to represent the notion of non-linearity with the help of the so-called scale-free network with a cluster structure. The very term scale-free network was coined and introduced in 1999 by the American physicist Albert-László Barabási to denote a network whose degree distribution follows a power law. A.-L. Barabási discovered that the websites of the World Wide Web form the network not chaotically but following a certain generative mechanism, which he proposed to call 'preferential attachment'. The same mechanism applies to neuron networks, computer networks, social networks and the like, that are characterised by a cluster structure and follow a power law distribution. The latter implies that nodes with fewer ties are more numerous than hubs, i.e. nodes with a great number of ties. The network pattern has made it possible to explain emergence of social communities and natural systems.

As seen in Fig. 1, a scale-free network has a cluster structure and is formed out of nodes, representing certain elements of the given complex system, and ties among the nodes, demonstrating a variety of relationships among the system's components. Such a network has a complex inner structure determined by the number of nodes with a few ties and those with a greater number of ties (hubs). Nodes are connected with one another within the network. However, such connections are far from being random. Rather, according to A. – L. Barabási, they display generic organising (topological) principles shared by rather different systems. Peculiarities of such interconnections predetermine features and functions of the whole system.

The notion of a scale-free network may be applied to the study of social interactions. Thus, a society may be represented as a complex network in which nodes stand for individuals connected with one another. Nodes within the network of motorways are cities and towns joined by these roads. Networks of airlines connecting cities of the world are scale-free, too. Scientific citations, as well as co-author scientific networks, can be modelled as scale-free networks. Similarly, it is possible to construct a network of inter-personal ties among literary characters within a novel, etc.

The notion of a scale-free network may also be applied to the study of a human language. In 2001, American scientists studied combinatory links among words on the basis of The British National Corpus. As a result, a network of 440,902 word-nodes was constructed. In some other research, the network method was used to analyse 23,279 synonymic words of the English language. It turned out that they make up a huge cluster containing 22,311 word-nodes [ibidem].

It seems obvious that the vocabulary of a language is a dynamic megasystem of scale-free networks reflecting a wide variety of relationships among words of the given language. Parts of speech, such as the noun, the verb, the adverb, etc., differ from one another in their combination patterns. Each part of speech has a certain cluster structure displaying the coherence of the given word class. The number of nodes in a cluster indicates valence features and combinability of the lexemes.

Verb clusters (hubs) and noun clusters are the largest. Moreover, they are the basic clusters. Such an interpretation fully agrees with the psychological principles of the construction of sentences. In the words of Steven Pinker, though sentences are strings of words, our mental algorithms for grammar do not pick out words by their linear positions, such as 'first word', 'second word', and so on. Rather, the

algorithms group words into phrases, and phrases into even bigger phrases, and give each one a mental label, like 'subject noun phrase' or 'verb phrase'.

The combinatory potency of word classes is not the same: some parts of speech possess the so-called active valence and demand structural-semantic complements, while others have the so-called passive valence and function mostly as dependent components in phrases and combinations. It has been revealed that the verb has a far wider range of structural-semantic ties than any other word class. The verb may be considered a condensed proposition, the nucleus of the semantic and syntactic structure of a sentence which determines the overall slot model of a sentence. It is noteworthy, that the verb valence only predetermines its potential combinability; in a sentence (utterance) not all of the possible valence slots of a given verb are filled, but only those that are included into the communicative and/or pragmatic intention of a speaker. The larger the context (a verb phrase → a verb sentence → a text), the more slots within the verb valence frame are taken.

Our research into the combinability of the English verb has made it possible to classify verbs according to their valence features into the following groups:

- monovalent, i.e. having only one possible slot – the subject slot. Here belong intransitive verbs, or more precisely, verbs in their intransitive usage;
- divalent, i.e. having two possible slots, one of which is the subject slot. This group includes several subgroups depending upon the type of the final slot that may be taken either by a predicative, or an object, or an adverbial complement;
- trivalent, i.e. having three possible slots, one of which is the subject slot. This group is also subdivided into several subgroups according to the grammatical (syntactic) properties of the components in the valence frame;
- tetravalent, i.e. having four possible slots, one of which is the subject slot. Again, this group is not structurally homogeneous, as it is represented by a few patterns;
- pentavalent and hexavalent, i.e. having five and six possible slots respectively, one of which is the subject slot and the rest are taken by semantically and syntactically different components.

In other words, the number of valence slots of the verb lies in the range from 1 to 6.

There are no zero-valent verbs in the English language. It should be noted that the most numerous is the group of divalent verbs. This is followed by the group of trivalent verbs. Together, these two groups include the majority (almost 90%) of the verb layer of the English word-stock.

Our research provides evidence that there exists a reverse relation between the number of valence slots and the number of verbs possessing that exact number of slots. The more valence slots (or nodes) a verb frame has, the smaller is the number of verbs fitting the frame. In terms of modern science, the verb is a hub in a scale-free network of the word-stock as it concentrates (and realises) numerous ties with other language units.

However, a scale-free network is not a frozen graph. Being an open system, it undergoes certain changes caused by external influences, hence constant variations in the outer configuration of the graph.

An evolving open system may lose its old ties and acquire new ones. However, new elements are not joined chaotically, but follow the principle of preferential attachment. According to this principle, a degree of appearance of new ties is directly proportional to the growth of the number of ties. In other words, hubs are more likely to grow in size and to attract new ties than nodes with few connections.

The appearance of new ties may be caused by alterations of the distributional environment of the analysed component, its usage in a new context, in another semantic role or syntactic function, etc., which cannot but reflect a shift in quantitative and/or qualitative characteristics of this component's valence frame.

Summing up, the issues of valence and the combinability of various word-classes highlight only one of the many sides of lexical dynamics.

Conclusion. Synergetics has suggested a new approach to the object of analysis, new methods of investigation, and a new wider repertoire of concepts and categories aimed at helping the researcher reveal new aspects of the phenomena investigated. A synergetic view of a system allows the inclusion of new senses into the notion of a system. It seems insufficient to imagine a system as a certain isolated set of components. The new definition of a system and that of a language system should include the notion of non-linearity. The non-linear character of language system can be modelled as a free-scale network with a cluster structure. This model not only represents a great variety of relationships among the system's components but also accounts for its dynamic nature.

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FUNCTIONAL FEATURES OF THE INVERTED WORD ORDER IN THE ENGLISH DISCOURSE OF FICTION

The article deals with the analysis of the peculiarities of the inverted word order functioning in the English discourse of fiction. The research is focused on the identification of the functional load and the purpose of the inversion use by the author in a particular content. Patterns and classification of the inverse word order are under examination. In the English discourse of fiction inversion is a widely used stylistic device that offers both simplification and enrichment of English. That is why the focus is on analysing this particular discourse in terms of the inversion. Having analysed the typology of inversions used in the English discourse of fiction, it was revealed that eight types of inversions are represented in this type of the discourse: local, exclamative, in questions, with the construction there, negative, for equilibrium, with established structures, heavy. Moreover, in the course of the analysis it was found out that each type of inversion performs certain functions in the sentence. The topic under consideration is of immediate interest due to the need to deepen and systematize knowledge about the phenomenon of the inverted word order and its functional features by reasons of the lack of study of some aspects within this issue having regard to dissimilar semantic load and different significance of given aspect in analytic and synthetic languages. In addition, insufficient source base represented by the availability of different approaches, offered by researchers and deficiency of complete data systematization, was of particular difficulty in the process of research.

Key words: inversion, word order, functional load, emphatic function,