METAPHORS OF INCLUSIVE SEMANTICS
IN THE LANGUAGE OF SCIENCE

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Scientific discourse is viewed as a specific object of linguistic analysis in light of cognitive-discursive paradigm. Categories are integral parts of the scientific discourse, yet there is no full list of such categories. Insufficient studies of the category of inclusiveness, as one of the categories that has not come under linguistic scrutiny, specifically, in modern English scientific discourse, call for investigating this category and its elements. The paper deals with the analysis of the metaphors of inclusive semantics to convey the category of inclusiveness. Empirical material of our study involves Anglo-American articles in the field of information and communication technologies, as this research domain deals with the latest cutting-edge technologies that influence virtually all spheres of human life due to the potential of such technologies to dramatically reshape information society in the age of digital revolution. We have outlined the following types of inclusive metaphors in the language of science: the metaphor of CONTAINER that is expressed through a bunch of linguistic devices (nouns: container, envelope, family, house; verbs: to house, to wrap up); the metaphor of CIRCLE (nouns: circle; verbs: to circle, compass, to compass, to encircle, to enclose, to surround, set phrase: to range from…to); and the metaphor of CONTENTS. The obtained results have shown that the metaphor of CONTAINER is the most frequently used one.
Keywords: scientific discourse; language categories; information and communication technologies; inclusiveness; metaphor; container; circle; contents.

Introduction. Perhaps one of the best accounts of the enormity and vastness of the language of science is the one by professor Steven Darian (2003): "The language of science…is an enormous undertaking, with a nearly endless variety of audiences and participants, purposes, and degrees of complexity. A work encompassing this would be a lifetime's task…all we can do within that universe of discourse is to catch glimpses of our topics." (p. ix-xi). Our topic of interest within the realm of scientific discourse is the study of **the category of inclusiveness**, and the ways it could be conveyed in the English language of science.

Why study language categories? First and foremost, they help us to understand the world better (Smith, 1981). As such, they help us to provide some sort of classification that lies behind the workings of the mind. Language categories have been studied by many researchers (O. Jespersen (1958), G. Paul (1960), E. Benveniste (1974), I. Meschaninov (1981), W. Chafe (1975), G. Lakoff, M. Johnson (1980), O. Bondarko (1976), V. Akulenko (1990), S. Shvachko (1981), S. Katsnelson (2001), O. Ilchenko (2002), O. Shalya (2011), to name a few. But when we talk about categories and metaphors, it is the name of George Lakoff that first comes to mind. In his seminal works, the now-classic "Women, Fire, and Dangerous Things. What Categories Reveal about the Mind" (1987) and "Metaphors We Live By" (Lakoff & Johnson, 1980), he changed our understanding of metaphor and cognition. George Lakoff and Mark Johnson have redefined the term metaphor. They argue that human thought processes are largely metaphorical, and that the human conceptual system is metaphorically structured and defined. Metaphor is no longer a way of expression, but also a way of conceptualization. The term metaphor has come to mean "a cross-domain mapping in the conceptual system" (Ibid). Hence, in the contemporary paradigm, metaphor is studied as the system of human conceptualization, operating deep in human thought and cognition. The **novelty** of our research is to determine the main metaphors that render inclusiveness in modern Anglo-American scientific discourse.

The **object** of our investigation is the study of the category of inclusiveness as one of the main categories of modern English scientific discourse because of its universal nature to all scientific endeavors. According to Greenberg (1978), the category of inclusiveness, as well as the category of quantity and the category of person are linguistic universals that can vary in certain languages as they obtain different embodiment in different languages (p. 178). Yet, few attempts have ever been made to consider inclusiveness in the language of science thus far. As a cognitive category, inclusiveness

has been studied in psycholinguistics as a way of structuring and understanding the cognition and as a way of mental processing of the new information. Bornstein & Arterberry (2010) put an emphasis on different aspects of categorization such as specific character of information processing and structuring (p. 352). Their approach deals with hierarchical inclusiveness and taxonomic organization (Collins, 1969; Murphy, 2002). Also, it has been found out that the category of hierarchical inclusiveness presents different levels of reality (Berlin, 1992). The category of inclusiveness has been addressed in professor Zhabotynska's paper (2013) in the context of inclusiveness-possessiveness. She described the methodology developed for conceptual analysis of linguistic meanings (semantics of lingual networks) and outlined five basic frames. One of them is a possessive frame that can be divided into possessive schemes of partitiveness, inclusiveness and possession. She argues that a part always belongs to a whole (partitive scheme); content (as independent part) can be whether inside container or outside container (scheme of inclusiveness) (pp. 47-76). On the other hand, a group of US researchers – Frels, Onwuegbuzie & Slate (2010) have conducted the study of verbs typology in scientific writings. They argue that the verbs are the most important way of communication because a reader can understand the sentence only if a writer uses correct verb (p. xx). The researchers classify the verbs into four main groups, namely, statement verbs, cognition verbs, knowledge verbs, action verbs. A group of verbs that express statement includes implicit, explicit and inclusive verbs. The latter is used for the description of connection among the elements of a whole (Ibid., p. xxiii). Another evidence of the importance of inclusiveness is corpora research. Corpus linguistics studies reveal that the verbs of inclusive semantics such as "to group," "to system," "to include," "to involve" are among the most frequently used words in 120 billion words COCA (Corpus of Contemporary American English) Academic vocabulary lists of English (Davies, 2012). However, previous studies haven't addressed the category of inclusiveness as a specific category in modern scientific discourse. Moreover, there is no definition of inclusiveness per se, so we suggest our own take on it: if one thing (part) is the element of another thing (whole), is included in other thing (whole), if one element (part) is grouped with other elements (parts) to form a bigger thing (whole); or if one thing (whole) is composed of a number of smaller things (parts), then such interrelation is called inclusiveness. In our previous research, we have already defined several explicit, implicit, as well as non-verbal ways of expressing inclusiveness in the language of science (Bedrych, 2014). In this paper we address the basic metaphors of inclusive semantics in scientific discourse, hence **the subject** of our study.

Methods. To do our research, we used the language material selected from Anglo-American articles in the field of information and communication technologies, such as Telecommunications Policy (TP) (2013-2014), Journal of Telecommunications System & Management (JTSM) (2013-2014), The International Journal on Advances in Internet Technology (IJAIT) (2010-2015), The International Journal on Advances in Systems and Measurements (IJASM) (2010-2015), The International Journal on Advances in Telecommunications (IJAT) (2010-2015), The International Journal on Advances in Intelligent Systems (IJAIS) (2010-2014), The International Journal on Advances in Networks and Services (IJANS) (2010-2015), IEEE Communications Magazine (CM) (2008-2014). An overall number of such articles is 1686, or about 8 billion words. The first stage of our research was to define the main lexical units of inclusive semantics that are used as metaphors. The second stage was to study their semantic and lexical features and functions in the articles. Next, we grouped the metaphors into bigger groups according to their lexical meanings. Finally, we counted the absolute numbers of metaphors in the articles and then used a quantitative method to count the percentage of the metaphors employed.

Results. For easier comprehension of obtained results, we presented them in tables.

Table 1

Metaphors in the articles

№	Metaphors	Absolute number of metaphors
1.	surround	438
2.	container	432
3.	house *(noun)*	359
4.	circle *(noun)*	337
5.	envelope	321
6.	contents	273
7.	range from…to	266
8.	family	211
9.	compass	54
10.	enclose	54
11.	house *(verb)*	46
12.	circle *(verb)*	20
13.	wrap up	7
14.	encircle	4

Table 1 shows the absolute number of metaphors in our empirical material.

Table 2

Percentage of metaphors in the articles

№		Absolute numbers	Percentage
	Absolute number of words in the articles	8459768	100%
	Groups of metaphors		
1.	The metaphor of CONTAINER	1376	0.02
2.	The metaphor of CIRCLE	1173	0.01
3.	The metaphor of CONTENTS	273	0.003

Table 2 shows the percentage of metaphors according to the groups of metaphors in our material.

Discussion. We have found different lexical units that are used metaphorically to indicate inclusiveness. They are: verbs "to wrap up", "to house", "to circle", "to encircle", "to enclose", "to surround", "to compass"; nouns "container", "envelope", "family", "house", "circle", "compass", "contents"; lexical bundles like "to range from…to...".

We have grouped all metaphors in three large groups according to the meanings they convey. They are:

1. The metaphor of CONTAINER.
2. The metaphor of CIRCLE.
3. The metaphor of the CONTENTS.

Let's consider each of them in more detail.

1. The metaphor of CONTAINER. It is conveyed mainly with the help of the noun <u>container</u>. S. Zhabotynska (2013) has considered "container" and its "content(s)" in the context of frames as a possessive scheme of inclusiveness, and has pointed out that content is a separate part, and that it can be placed not only inside the container, but also outside the container (p. 60). Our material confirms this statement. Consider the following two instances:

*For example, an "insert" primitive will involve adding one or more rows and columns to the bitmapped matrices, as well as adding one or more entries **to the** Node Set **container** (IJAIT № 1-2, 2014, p.2).*

*Finally, to remove the node **from the** Node Set **container**, the system performs one work unit after locating the record of the target node (line 15) (IJAIT № 1-2, 2014, p. 6).*

In these examples, we can see that the noun "container" is used metaphorically, and indicates a whole. Parts (entries) are involved in the container (1-st example) or part (the node) is removed from the container (2-nd example). In both cases, the "container" does contain some parts.

Let's consider one more case:

*A session is a communication descriptor that contains everything needed for linking entities, applications and devices together in a flexible way. A session can be viewed **as a container** storing the identity and the management information of a given communication (IJAIT № 1-2, 2012, p. 12).*

In this example, the noun "session" is identified with the noun "container" with the help of the preposition as, which confirms the possibility of expressing absolute identity among things, suggested earlier elsewhere (Shalya, 2011, p. 57).

The noun envelope is related to the metaphor of container. The American Heritage Dictionary of the English Language (AHD) (2009) provides the following definition: envelope – a flat paper container, especially for a letter, usually having a gummed flap. Here we notice the implication of a container or a cover. We can consider an "envelope" as a "container" for some parts, as in the following example:

*For example, the SAML SOAP binding specifies how a SAML message is encapsulated in a SOAP **envelope** (IJAIT № 1-2, 2011, p. 20).*

Here, the noun "envelope" is used as a metaphor and denotes a whole (SAML SOAP) with some part (SAML message).

At this point, let's turn to other examples:

*The only communication between boxes is done by sending **envelopes** (communication units containing data) along their outgoing edges. Each **envelope** consists of several columns and each column contains a certain number of data items. The data type of items in one column must be the same in all **envelopes** transferred along one particular edge; however, different columns in one **envelope** may have different data types (IJAIS № 3-4, 2012, p. 303).*

In this case, the word "envelope" metaphorically denotes a whole (communication units containing data) that consists of some parts (several columns). Besides, parts are also composed of several other parts: each column contains a certain number of data items, so here we observe the so-called "nested dolls effect."

The noun family can be used not only to denote family members like father, mother, daughter etc., but also to denote family as a whole – container for parts. For example:

*Additional terminology in this **family** of dynamic networks includes disruption-tolerant networks, intermittently connected networks, and opportunistic networks (CM № 7, 2012, p. 155).*

In the above example, terminology of dynamic networks denotes a family (a whole) that comprises several parts (disruption-tolerant networks, intermittently connected networks, and opportunistic networks.)

The noun house can also be used as a metaphor to denote a whole that includes a large number of parts. Example:

*Cyber attacks can also cause catastrophic failures: in September 2012, an unclassified computer network for the office that handles all military-related functions at the White **House**, including nuclear war plans, was targeted by unidentified attackers (CM № 5, 2014, p. 236).*

The White House (the official residence of the president of the United States) consists of a large number of rooms (for example, East Room, Green Room, Blue Room, Red Room, State Dining Room, Family Dining Room, The White House Master bedroom, the Queen's Bedroom etc.), actually implying several parts of a whole. In the following sentence, the phrase "student house" is used to denote container for students:

*On Sundays, faculties are closed and only the library and the student **house** are open (IJAIT № 1-2, 2011, p. 43).*

The verb to house is also used metaphorically. As a verb in active voice, "house" denotes the process when a whole is composed of some number of parts, for example:

*The third track (cf. Fig. 10) was measured inside the Hochschulfond Building (HF), which has been built in the year 2003. Because it is mainly dedicated to practical research, it **houses** technical laboratories, offices and storage spaces (IJANS № 1-2, 2011, p. 146).*

When used in passive voice, this verb denotes the process when parts are included in a whole, as in the following example:

*The SAA module **is housed in** the OBC of the payload (IJANS № 1-2, 2011, p. 97).*

If the verb of inclusive semantics <u>to wrap up</u> is used as a metaphor, it can denote the process of formation of a whole, with some parts placed within, for example:

*The simulation layout is 10 by 10 hexagon cells **wrapped up** to avoid boundary effect (CM № 11, 2010, p. 78).*

2. The metaphor of CIRCLE. As a noun, <u>circle</u> can be used for a region bounded by a circle; a group of people sharing an interest, activity, or achievement; a process or chain of events or parts that forms a connected whole; cycle (AHD (2009). The metaphor of "circle" can be defined as a possessive scheme of partitiveness (Zhabotynska, 2013, p. 60). Typical examples:

*On the display side, a specific adapter was written to convert Tic Tac Toe Model to a Display Source: the tic-tac-toe state change events are converted to drawing commands such as drawing **circles** (IJAIS № 3-4, 2012, p. 252).*

*Let us assume user A (whose related messages are numbered within **circles** in the figure) and user B (in squares) are two buddies using the system (CM № 7, 2010, p. 104).*

As a verb, <u>to circle</u> can be used to denote "to enclose in a circle"; "encircle" (AHD (2009). Example:

*The node carrying the messages could, for instance, be a fast-moving UAS, which **circles** a larger area and gathers information (CM № 10, 2013, p. 45).*

The verb <u>to encircle</u> belongs to this group of metaphors. The main meaning of this verb is "to form a circle around"; surround" (AHD (2009). In this case, parts are always within the circle. For example:

*The **encircled** car in the figures shows the location where the driver is offered to pick up the passenger (IJAIS № 1-2, 2012, p. 108).*

The verb "to encircle" has a synonym <u>to enclose</u> that means "to surround on all sides; close in" (AHD (2009). Both can be used either in Active or Passive voice. For example:

*MicaZ motes **were enclosed** in plastic boxes to act as a protective casing, with the antennas protruding (CM № 4, 2010, p. 72).*

*In the XML code, the Properties element **encloses** all properties of a segment, which are in this particular case two Quantitative QoS elements of the mentioned QoS parameters that are identified through their QoS ID (IJANS № 3-4, 2011, p. 310).*

The verb <u>to surround</u> has the meaning "to extend on all sides of simultaneously; encircle; or to enclose or confine on all sides so as to bar escape or outside communication" (AHD (2009), e.g.:

*PES dynamically, automatically, and intelligently reconfigures the electronic, electrical, and mechanical equipment **surrounding** a user according to his/her preferences based on the current user's location and his/her current mental/emotional state (CM № 6, 2010, p. 68).*

The word <u>compass</u> as a noun has the following basic meanings: 1) (*mathematics, often plural*, also called: pair of compasses) an instrument used for drawing circles, measuring distances, etc., that consists of two arms, joined at one end, one arm of which serves as a pivot or stationary reference point, while the other is extended or describes a circle; 2) limits or range, (e.g.: within the compass of education; the broad compass of the novel). As a verb, the word <u>compass</u> means "to comprehend; to grasp (as with the mind)" (AHD (2009). Linguistically speaking, it has the following implications: 1) limits or range; 2) grasping something.

The phrase <u>to range from…to</u> is concerned with the metaphor of "circle" and defines the borders where the parts are placed. For example:

*That maximum power can **range from** below 0 dBm to cover apartments (in the absence of a strong macro interferer) **to** 10 dBM or more to cover houses (CM № 9, 2009, p. 94).*

3. The metaphor of the CONTENTS deals with parts of a whole. The noun <u>contents</u> surely belongs here. The American Heritage Dictionary of the English Language (2009) gives the following definition: contents – everything that is inside a container. We consider the noun "contents" to denote some parts that are included in a whole, for example:

*Instead of manipulating **the contents** of io CMD Bat databases level, our approach suggests to perform such alter nations through specified functional areas, as we outline in Section IV-D (IJAIT № 1-2, 2012, p. 42).*

*In addition, we have defined frameworks to offer a visual feedback to the user via displays. This includes 2D and 3Dgraphical objects rendering and multimedia **contents** such as videos (IJASM № 1-2, 2014, p. 11).*

In the second example, we observe the combination of explicit way of rendering inclusiveness, like the verb "to include" and the noun "contents" used as metaphors to indicate some parts of a whole.

Conclusions. In this paper, we have addressed metaphors of inclusive semantics in modern Anglo-American scientific discourse. Implicit, metaphoric ways of expressing inclusiveness, alongside some explicit linguistic devices (words "to involve", "to include" and the like) enrich scientific language immensely. They reflect the metaphoric nature of scientific thought. We have outlined three basic groups of metaphors that convey the idea of inclusiveness in the language of science – the metaphor of CONTAINER that is expressed by the nouns "container", "envelope", "family", "house"; verbs: "to house", "to wrap up"; the metaphor of CIRCLE that is conveyed through the nouns "circle"; "compass"; verbs: "to circle", "to compass," "to encircle," "to enclose," "to surround", set phrase "to range from…to…"; and, finally, the metaphors of CONTENTS. We have calculated the frequency of occurrence of such groups of metaphors, and found out that the metaphor of CONTAINER is the most frequently used one. Further research might well elucidate the subtleties of metaphoric expression of inclusiveness and cognitive metaphor in scientific discourse and general English, as well as the interplay of the category of inclusiveness with other language categories.

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