Lazebna N. V.
Zaporizhzhia Polytechnic National University

SPACE AND TIME AS CONCEPTUAL DOMAINS IN ENGLISH-LANGUAGE SCIENTIFIC DISCOURSE

Purpose. The purpose of this study is to identify time/space as conceptual domains in the English-language scientific discourse.

Methods. Both qualitative and quantitative research methods are used. Theoretical and experimental bases are mentioned. Descriptive method, comparative and contextual methods are implemented.

Results. The relationship between two conceptual domains of space and time is usually discussed in terms of language and cognition. Time is often represented in the studies as the phenomenon secondary to space. The paper outlines the absence of direct interdependency between time/space terms as they are defined by exact contextual environments and differentiated from one another in the natural environments. Based on modern studies and studies on temporal and spatial representations of previous years, we have examined the linguistic basis to prove the fact of spatial and temporal co-existence in terms of English-language scientific discourse. Moreover, considerations from cognitive science, psycholinguistics, and neurolinguistics are also relevant to further differentiation between spatial and temporal textual reflections. This study opposes the generally accepted methodological paradigm and it is claimed that spatial/temporal terms chosen above are independent terms with complete semantics. It is claimed that there is no need to investigate a temporal or spatial basis of these terms because initially the spatial domain is perceived as definite and the temporal domain is known as the abstract one. Terms denoting space are concrete objects and the terms denoting time are abstract events. Concerning the fact that it is easier to deal with concrete entities than with abstract ones, concrete entities can be determinant domains for clarifying abstract experience.

Conclusions. Time experience is better perceived in terms of experience gained within the accessible domain of space. It is relevant to investigate the possibility to identify specific limits between spatial and temporal reflections within the considered textual space.

Key words: time, space, concept, metaphor, scientific English-language discourse.

Introduction. Human perception of time is related to space conceptualization. It has been always underlined that time representation depends on space. In terms of psychological studies, it has been always claimed that it is natural for children to mix up the spatial and temporal reflections. Clark [7] was the first who claimed that temporal language is based on spatial language and that English temporal prepositions are based on front and back. Clark talked about the "moving time" metaphor and "moving ego" metaphor and underlined that, for example, before is derived from in front of and after is derived from in back of, i.e. he correlates these two terms with the "moving time" metaphor [7].

Nevertheless, it is worth remembering that there is no one basic conceptual metaphor defining further metaphorical representations of a certain domain. This research is anchored to the theory suggested by Jean-Marie Guyau, it follows: only time representations reflect time dependency on space; time can be measured by space; "events" can measure time; the past is "behind us" and the future is "in front of us" [14].

Purpose of the study is to apply a chosen metaphorical approach to the investigation of spatial and temporal relations in the English-language scientific discourse is justified. It is relevant to discuss the relation between time and space taking into account that there are numerous similarities and differences in representations of time and space concepts.

Time and space as conceptual domains in linguistics. The spatial basis of temporal terms has been often supported by the majority of scientists and researchers [4, c. 245; 7; 13]. A consistent basis of a metaphor has been often underlined by Lakoff and Johnson [6, c. 413]. Therefore, it is necessary to underline that representations of concepts in a metaphorical language are also possible beyond any language, or in other words, it is possible in an independent manner. Still, there is a need to talk about the following peculiarities of metaphorical

representations: metaphors are compatible with different domains though they do not have a scope covering different aspects of one domain and thus do not embrace the whole target concept. From another perspective, it is suggested by Habel & Eschenbach that space should not be considered as "a concrete source domain from which the more abstract concepts of time are consistently derived. Instead, space and time share a range of representational structures, which are systematically reflected in language" [11]. Thus, it is relevant to talk about the coexistence of spatial and temporal relationships rather than their interdependencies. By Tenbrink in some spatial relationships, it is impossible to relate clauses to each other, and in verbal expression of events or objects, temporal relational expressions may occur [17]. It is relevant to talk about spatial and temporal markers and their conjunctional nature in the process of comparing time and space domains. Moreover, it is relevant to consider time in terms of space using the supposition that "time is space metaphor". By the scientists exploring the conceptual basis of metaphor, such as George Lakoff and Mark Johnson, it is seen that "speakers use concepts referring to concrete, physical experiences to understand (and express) concepts referring to more abstract conceptual domains" [1, c. 187]. The time-space continuum of texts in English-language scientific discourse can be correlated with time-space metaphorical domains.

Methodology. The notion of time is used as a term covering some more conceptual metaphors and it is thus easier to understand time as a tangible spatial phenomenon. As it is suggested by the researcher Bert Capelle [5], it is relevant to focus on more specific time metaphors, such as the following: *Times are objects moving towards you; Times are locations in a landscape over which you move; Events are moving objects; Change is motion, Causes are forces* [5]. With this regard, it should be noted that time or events are perceived as stationary or moving objects and thus an interlocutor's attitude to time may be different in terms of English-language scientific discourse. Usually, a temporal content of expressions is reflected via spatial relationships.

For example, *The end of the experiment is getting closer* and *This experiment has slipped away swiftly* represent conceptual metaphor *Times are moving objects.*

Another metaphor *times are locations in a landscape* can be illustrated in the following way: *I am approaching this coming research* and *We didn't make it to the coming lab* (At the same time, when an interlocutor is discussing short/long duration of time or says *within* the next few weeks, it is also relevant to be assigned to Times are locations metaphor).

To illustrate the metaphor *Events are moving objects*, such kinds of sentences may be given: *The interesting facts are passing by me* or *Her scientific investigations were continuing on and on*. Therefore, a conceptual metaphor of time suggested by Bert Capelle [5] is explained in the following way: human minds can perceive a category of time only via concrete experiences from their lives. There is no exact correlation between space and time, but there is a direct connection between the existence of specific physical objects explaining a category of time to the individuals or facilitating their communication about time.

Results and discussion. Still, to prove the possibility of the independent existence of temporal and spatial relationships, it is necessary to see the way they are reflected in the minds of speakers. It is possible to see how these categories are reflected in human minds using the preposition *in*. This preposition is often used in a spatial context (e.g. in the report) and a temporal context (e.g. in a week). Thus, speakers, for example, may memorize and apply a spatial meaning of the preposition *in* and at the same time develop their understanding and the principles of further application of the preposition *in* in a time context.

This idea is also supported by Bert Capelle [5] when the scientist talks about the mental representation of the *Times-are-locations* metaphor. In case a speaker memorizes and further applies the temporal sense of *in*, then it would not be derived from the spatial time of *in*. The speakers do not have to draw a metaphoric parallel between spatial and temporal use of these conceptual terms of time and space.

Moreover, Croft [10] supports this idea and claims that: "Speakers do not necessarily make the relevant generalizations, even if clever linguists can. Cognitive linguists , like other theoretical linguists, must be aware of this fallacy" [10, c. 168]. On the example of the spatial or temporal use of the preposition *in*, we can see that it may be used in either one or two contexts (spatial or temporal). Nevertheless, we should memorize that it depends on a model chosen by the speaker. On the one hand, it is a "single-entry derivation model" and on the other hand, it is a "homonymy model" [15, c. 210]. In case the former model is chosen, the preposition *in* reflects a spatial sense. In case the latter model is chosen, the preposition can be applied in spatial and temporal contexts independently.

In the modern context of English-language scientific discourse, the second model, or homonymic model, is relevant. This fact can be explained in the following way: though historically temporal and spatial relationships were considered as interrelated, psychological peculiarities of modern speakers enable them to differentiate between spatial and temporal relationships. To prove this supposition, it is necessary to correlate this claim with psycholinguistic and neurolinguistic evidence.

In the psycholinguistic research conducted by Landau and Jackendoff, the temporal use of prepositions was studied. Such kinds of prepositions as *in the daytime, in a week,* etc were analyzed. This research has not proven that there is a direct relation between time and space. Spatial and temporal relationships were not differentiated by English speakers. In the neurolinguistic research conducted by Kemmerer, it was claimed that: "although the spatial and temporal meanings of prepositions are historically linked by the TIME IS SPACE metaphor, they can be (and may normally be) represented and processed independently of each other in the brains of modern adults" [5]. Therefore, our initial supposition that temporal and spatial relationships may be represented independently is proven in the neurolinguistic and psycholinguistic paradigm.

The distinction between spatial and temporal relationships can be also proven by linguistic evidence. Capelle [5] claims there is a need to differentiate between directional and aspectual particles: They came into the lab – there is a directional preposition and They filled in the form – there is an aspectual particle. This differentiation between particles is supported by Bolinger, who talked about the following: "There is a deep-seated relationship between notions of action, state, progression, inception, completion, and the like, on the one hand, and notions of direction and position on the other – a kind of geometry of semantics" [2, c. 110].

At this point, it is even possible to ask the question about whether spatial and temporal relationships distinguish between different natures of prepositions. Thus, is the preposition *on* is used in a temporal context defines one sense, and when it is used in the spatial context it conveys another sense.

Furthermore, it is relevant to provide the following linguistic evidence that the single-entry metaphor-based model is irrelevant in modern English-language scientific discourse. In the experiment conducted by Moore so-called congruity test was made. During this experiment, the scientists had to measure a degree of an abstract concept understanding in

terms of a more specific concept. There are both linguistic and psycholinguistic findings in the study by Jackendoff and Aaron [15, c. 210]. They used as an example a template of the sentence to find out an overlapping between two different concepts (e.g. relationships and moving objects). For example, *our research partnership has vanished.* And initially, no motivated metaphor is applicable for this sentence. Though in the second part of the sentence there is a certain overlapping that makes sense of the whole sentence. Partnership as a relationship cannot be considered as a moving object. Still, for the second part of the sentence a conceptual metaphor A RELATIONSHIP IS A MOVING OBJECT may be applied.

Concerning such a kind of conceptual metaphor application, Goddard implies the name of "*active metaphors*". He proves that there are "metalinguistic tags" between such kinds of moving metaphors. In other words, there are unseen rules of use for moving metaphors [9, c. 1215].

Moreover, the second linguistic argument about the temporal context of a particle is the following. One may suggest using only one lexical name for *on*, used in spatial and temporal contexts. On the example of the preposition *on*, it is seen that in the temporal context on can never coexist with a direct object (e.g. *read (the guideline) on) and spatial on can be used*; turn *(* the machine) on*, while spatial *on* can be represented as follows (e.g. move the vehicle on). There are a certain argument and structural difference. It may be supposed that there is an initial necessity to preserve temporal and spatial relationships. This phenomenon is further explained by Capelle as the following: "The idiosyncratic grammatical difference between *on* used for the spatial continuation and *on* used for temporal continuation excludes the possibility that spatial *on* is basic and that aspectual *on* is merely an expected metaphorical extension that need not be stored in the mind" [5]. Therefore, temporal contextual meanings of prepositions shown above are extended from spatial meanings. English speakers supposedly can store temporal meanings separately from spatial meanings. That is why we can currently claim for sure that there is no unarguable correlation between space and time as it has always been before. Nevertheless, it is necessary to take into account other ways of representing spatial and temporal relationships in the linguistic and cognitive science paradigm.

Temporal and spatial language
Time features are expressed in language. Time relationship is usually perceived in the following terms: "they reflect speakers' underlying conceptions of the relations between events, which are generally

not purely temporal but are also perceived as connected in some more or less direct way" [5]. In the English language, the time relationship is usually expressed in terms of anteriority or posteriority. Nevertheless, the time relationship expressed in English is not only restricted by these terms. There is also an association of sequentiality or proximity [18].

Semantics in time contexts is limited by time frame. For example, two adjacent clauses are supposed to describe causally related events even in case explicit causal markers are absent [18]. Partially, it is possible to describe this phenomenon in terms of the relationship between two abstract concepts: time and causality. The presence of causality is often discussed about the usage of "after": *After they finished their research, they filled in the reports*.

In the case of "before," it is rather hard to draw a causal relationship between two events. Causal and quasi-causal relationships are further discussed in the following contexts: concerning presuppositional effects; non-veridical interpretations together with *before* [5]. Nevertheless, from our perspective, it is relevant to consider the spatial and temporal relationship in terms of pragmatic discourse.

It has been further claimed that English speakers do not use the temporal relationship to describe unrelated events. This fact can be explained in the following way: the English language provides speakers with different options to express temporal relations (such as tense, temporal adverbials, or clause order) [1, c. 191]. In the case of temporal dimensional terms usage, the speaker may have an intention to transfer more information than simply temporal information. Still, different conceptual relationships can be reflected using temporal dimensional terms. At this point, it is relevant to talk about a causal relationship. From the perspective of cognitive linguistics, the relationship between time and causality can be explained in the following way: there is a naturally close relationship between causal and temporal relations.

Spatial language

To determine a spatial relation between two objects, it is relevant to refer to locative dimensional terms. Thus, one object is "relatum", and the other is placed within a certain space surrounding a focal axis with a certain relation to the relatum, based on the conceptualization of a reference system [4, c. 245].

The most interesting area for discussion is an area that concerns the reference system and perspectives. A spatial term can be often interpreted in many different ways and it is a well-known fact. Following Levinson there are many confusing terms, such as "*deictic*, *extrinsic*, and *intrinsic*" [13]. It is common to mix up deixis with perspective because there is a common basis for both of them, i.e. actual situation.

Levinson's claim should be considered as a central one for further discussion. The study by this researcher focuses on the following claim: there is a possible interrelation between objects (limited by internal or external relationship). In terms of external relations, one object is located inside of another one. Thus, Levinson determines three different systems of referencing: *intrinsic*, *relative*, and *absolute* [13]. We would focus our attention on the location of one object, the location of another object (relatum), and the perspective used.

The choice of reference system by speakers is rather a controversial issue. Cantor and Thomas claim: the speakers prefer the listener's point of view in case they have reasons [4, c. 247]. The listener's perspective is often used to facilitate the process of cognition for the interlocutor.

It is relevant to mention a "global perspective" or an observer's viewpoint. In this case, the observed region is divided into sections described by spatial terms (front, back, left, right) [17]. There are also other approaches in the field of spatial relationship, such as the spatial templates approach (e.g. Carlson-Radvansky and Logan 1997), *functional features* of objects (Coventry & Garrod 2004), and *interaction-related* as well as *discourse task-related aspects* of the application [16].

In the linguistic paradigm, it has been often claimed that either temporal or spatial relationship may exist without reliance on each other. Moreover, English speakers usually differentiate between their spatial or temporal relationships conceptual or linguistic choices by the presence or absence of other objects.

Cognitive science about the temporal and spatial relationship

Time and space though reflected to a certain extent in a specific manner in the language (considered above) are also specially represented in human cognition. In cognitive science, it has not still clearly defined the way people perceive time or estimate duration. It has been claimed by Zakay and Block [1, c. 190] that "people may estimate filled durations as being longer than empty durations, but sometimes the reverse is found. Duration judgments tend to be shorter if a more difficult task is performed than if an easier task is performed, but again the opposite has also been reported" [1, c. 193]. Moreover, following Zakay and Block [1] time is not perceived through the senses. Time is often perceived as a sensory process. Two following examples illustrate this supposition:

A) They moved the exhibit forward two meters.

B) They moved the negotiations forward for three hours.

Thus, the exhibit is a physical object moving through space and an individual can hear or see its movement from the initial to the endpoint. The second sentence does not describe motion itself. Abstract nature of events and the definite nature of objects prevent individuals from considering spatial rather than temporal relationships. The relationship between time and space can be defined by duration. Spatial representations conceptualize time, which is one of the many other domains of knowledge depending on "perceptual and motor representations built up via experience with the physical world" [1, c. 14].

In the experiments conducted by Tyler and Evans [18], it is claimed that temporal and spatial thinking is related [3, c. 15]. The experiments were based on showing people non-linguistic stimuli and they had to estimate either their duration or spatial displacement. Therefore, it was found out that temporal and spatial mental representations of people can be measured by three main approaches.

As it was claimed by John Locke (1689/1995) "expansion and duration do mutually embrace and comprehend each other; every part of space being in every part of duration, and every part of duration in every part of expansion" [18]. We can see the interdependency between time and space in our minds. There is also a possibility of asymmetric dependence between time and space [3, c. 25].

To illustrate the spatial and temporal relationship, we have chosen Experiment 5 out of 6 experiments conducted by Tyler and Evans [18]. During this experiment the subjects viewed a dot (10x10 pixels) moving horizontally crossing the midline of the screen. The participants needed to memorize the starting point of movement and the ending point of the dot's movement. Therefore, people appeal to spatial information more than temporal information to make further judgments. The experiment conducted by Cantor and Thomas [4, c. 247] was also focused on the fact that spatial information causes a great influence on temporal judgments. In the experiments conducted in the field of metaphor theory, a linguistic stimulus was used [3].

The psychological reality of mental metaphors is supported in these studies and it is claimed that people have an option to think about the abstract domain like time in a metaphoric manner. The above mentioned experiment is not based on linguistic stimuli and still, there is an interrelationship between space and time. It is natural for English speakers to describe the time in terms of space. These experiments have indicated

that there is an asymmetrical cross-dimensional interference between time and space. The effect of distance of time prevails over the effect of time on distance. Thus, in mental representations space affects time and spatial representations are integral for temporal representations. Time representation in a linear manner makes us representing abstract temporal events that humans cannot perceive directly. Through metaphors, mental representations of time and space are reflected in language. In other words, metaphoric speech is based on metaphoric thinking.

There is direct evidence that spatial cognition supports the development of abstract concepts. Spatial representations are crucial for abstract thinking. It has been claimed for centuries that abstract thinking was developed based on linguistic and psycholinguistic data [18]. The performance of psychophysical experiments underlines the fact that nonlinguistic representations of either concrete or abstract domains predict the fact that humans think in mental metaphors. Spatial words are used by people for abstract representations. There is a strong interaction between language and nonlinguistic representations. Following the experiments, it is clear that "language not only reflects the structure of underlying mental representations, it can also shape those representations in ways that influence how people perform even low-level, nonlinguistic, perceptual and motor tasks" [18]. Despite the earlier studies, the prevalence of language that influences the formation of nonlinguistic representations is underlined by Tyler and Evans [18].

An integrative approach to consider spatial and temporal relationships focused on the prevalence of spatial representations was also conducted by Boroditsky [3]. It has been found that spatial relationships should be considered as default relationships in human mental representations of concrete objects. The author also claims that previously it was relevant to correlate temporal and spatial relationships. Moreover, it is claimed that there is integration between temporal and spatial relationships. Macey [14] has also underlined that spatial maps are not always relevant to discuss mental representations.

From another perspective, it has been presented that space and time are not abstractions, but are necessary parameters for human brains [14]. Therefore, we have shown a scientific tendency to show that language is the first and then discussion comes to cognitive science. In other words: linguistic representations of time and space influenced cognitive formation and reflection of these representations. We would rather argue that cognitive development comes first and then

follows language. This claim was also suggested by Casasanto, Fotakopoulou, and Boroditsky [3] when they conducted their experiments with the help of children who were asked to differentiate between the temporal or spatial relationship between moving stimuli. Therefore, cognitive mechanisms influencing the formation of spatial and mental representations may differ or coincide with linguistic mechanisms of these representations.

Temporal and Spatial Terms: a comparative approach

By our main claim that spatial and temporal relationships can exist separately, there is still the main linguistic argument that their correlation is also possible and can be met very often. Temporal terms are applied when a speaker wants to define an interrelationship between events and their influence on the interlocutor: "Thus, temporal dimensional terms are employed whenever two events need to be juxtaposed that are conceptually interrelated in some way, which is often causal in some sense" [17]. It is possible to underline a definite temporal relationship between some events when this type of relationship is focused on duration description between the events, for example. From another perspective, temporal relationships when reflected using indirect linguistic means (tense, clause, etc), the interrelationship between events is expressed as a secondary conceptualization. Nevertheless, concerning the temporal relationship between events, explicit expression of time conceptualization is appropriate. When the English speaker wants to show a stronger relationship between events, then temporal relationships would be expressed in a broader context and a wider discourse. When we talk about spatial relationships, we can see that the matter is about a threefold relationship: the discourse task, the functional relationship, and an underlying reference system.

For example, in a wider context, an interlocutor may choose a specific reference system or syntactic form of expression. Therefore, in the English language spatial relationship is focused not only on object identification but also on the description of spatial relationships. With this regard, it is possible to claim that areas of applicability of spatial relationships are often influenced by functional relationships between spatial objects.

Conclusions. With this respect, temporal and spatial relationships in English-language scientific discourse may be differentiated on the ontological basis that limits objects and events. In the linguistic perspective, following the ideas of researchers, objects are directly perceivable and therefore in some cases do not need to be specified linguistically, while events are more abstract and must therefore be retrievable from or delimited by the discourse itself. In both cases, the interlocutors do not necessarily differentiate possible interpretations between spatial and temporal relationships. The representation of this relationship in the discourse underlines that there is no direct dependency between the domains described and they can exist separately from each other. Moreover, unlike previous studies where it has been often underlined that there are no time relationships without spatial ones, this study shows that temporal relationships are beyond dimensional terms. In such a way, a modern linguistic paradigm should consider temporal and spatial relationships in a broader context.

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Лазебна Н. В. ПРОСТІР ТА ЧАС ЯК КОНЦЕПТУАЛЬНІ ДОМЕНИ В АНГЛОМОВНОМУ НАУКОВО-ТЕХНІЧНОМУ ДИСКУРСІ

Мета статті – співвідношення часу/простору як концептуальних доменів у англомовному науково-технічному дискурсі з погляду мови та пізнання. Теоретичний та експериментальний базис наукової розвідки аранжовано описовим, зіставним, контекстуальним методами дослідження.

У результаті теоретичного та емпіричного аналізу тимчасових та просторових уявлень розглянуто лінгвістичні основи і доведено співіснування просторових та часових відношень в англомовному науковому дискурсі. Наукові розвідки з когнітивістики, психолінгвістики та нейролінгвістики створюють важливий базис для подальшої диференціації просторових та часових відношень. Стверджено, що просторові/часові терміни є незалежними і немає необхідності досліджувати їхню часову або просторову основу, оскільки спочатку просторовий домен сприймається як визначений, а тимчасовий – як абстрактний. Терміни, що позначають простір, є конкретними об'єктами, а терміни, що позначають час, є більш абстрактними подіями. Ідентифікація конкретних сутностей порівняно з абстрактними є визначальною для уточнення абстрактного досвіду. Часовий досвід визначається в доступній сфері простору. Отже, пошук конкретних меж між часовими та просторовими відношеннями в англомовному науково-технічному дискурсі потребує подальшого вивчення. На відміну від попередніх досліджень, де часто підкреслювалося, що без просторових зв'язків не існує часових зв'язків, визначено, що часові зв'язки мають різні межі порівняно з просторовими зв'язками.

Отже, у сучасній лінгвістичній парадигмі необхідно розглядати часові та просторові відношення в широкому контексті. На особливу увагу заслуговує комунікація у межах глобального англомовного науково-технократичного текстопростору, зважаючи на контекстуальні маркери для конкретизації абстрактного досвіду, уособленого у досліджуваних типах текстах.

Ключові слова: *часопросторові співвідношення, концептуальний домен, метафора, англомовний технологічний текстопростір.*