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## THE FEATURES OF CAUSAL LINK IN TECHNICAL RESEARCH PAPERS

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According to the title the article deals with the causation in technical research papers. Such concepts as conditionality, participation, reason, reasoning, causality, causativity are reviewed. Conceptual and language categories connected with them are discussed. Special attention is paid to the origin of those categories, their nature, and relationships between them. Causation is considered to be a special case of conditionality. Other types assume the presence of causation. Different types of conditionality are divided into two groups depending on their modality. In technical research papers causal semantics is expressed at different levels of language. Thematical, chain and parallel types of connection within super-phrasal unity are mentioned as the means of relationships realization. Semantically equivalent transformations that can convert a simple sentence into complex sentence and complex sentence into super-phrasal unity and vice versa are described. The paper also shows the connection and difference between such processes as explanation and argumentation which are the forms of scientific discourse cognitive component. The model of scientific explanation is analyzed. Analogy is considered as a special technique of persuasion. The classification of analogy is presented. The article is illustrated with the examples taken from technical research papers in the sphere of acoustics.

**Key words:** conditionality, participation, reason, causality, causativity, super-phrasal unity, analogy, modality, transformation.

**Introduction.** As we know, scientific speech is characterized by logic nature of author's ideas. It means all its components are closely connected in particular with the help of causal connection. The presence of such connection serves as a criterion of argumentation.

**The purpose of the article is** to analyze the features of such tie in technical research papers, since it plays an important role in scientific argumentation.

**The category of conditioning and the concepts associated.** In ancient times the intellectual category of conditioning that integrates the dependent events in a

hierarchical way was formed basing on the concept of participation. There are different modes of participation, e.g. in relation to purpose, condition, reason and others. Therefore we suppose that reasoning is the special case of conditioning. The philosophical and logical category of reasoning is predicated on the category of reason. The meaning expressed by the latter connects two events to a single one semantically on account of temporal or causal relationships between them. At the notion level they create the conceptual category of causality corresponding to the category of causativity at the level of language [2, c.249-250; 1, c.250].

In the language aspect the category of conditioning is considered to be of functional semantic type. It is a subject of numerous investigations. On the one hand, the sentences with the meaning of conditioning are treated as the entire linguistic objects. On the other hand, the particular kinds of causal constructions are studied.

Furthermore, analyzing the association between causal relationship and allied ones three points of view were formed:

- no-one from the types of relationships can be regarded as invariant;
- conditioning is a genus in relation to the particular categories of purpose, reason, condition, consequence, concession and motivation;
- causal relationships occupy the central position in the system of conditioning relationships with others acting as their modifications [1, c. 252].

The author is of the third opinion, as far as other types of conditioning suppose the presence of cause-and-effect link; particularly it underlies the conditional implications. The reason depends on the condition, but they are not identical. The counter-condition can abolish the consequence but can't change its character.

Meanwhile conditional implications have some peculiarities in technical research papers. It is common practice to deal with both fulfillment of condition and the alternative variant. Moreover, the conditional implication can take the form of assumption as it is shown below.

*Assuming that the dc flow roughly represents the glottal neutral area, then we may say that voice offset and onset are achieved at different laryngeal configurations. [10, c.1363]*

The sentence can be paraphrased as follows.

*If the dc flow roughly represents the glottal neutral area, then we may say that voice offset and onset are achieved at different laryngeal configurations.*

A relationship of concession reflects unfulfilled causation. It means that the action hasn't fulfilled in spite of the presence of reason and causal link.

Analyzing different kinds of statements with the meaning of conditioning one should take into account their modality. Corresponding to objective and subjective kinds of modality, the events conditioned have physical or mental nature respectively [4, c.49]. The types of relationships mentioned above belong to the first group if the reason, consequence or condition describes real events or facts.

The second group, for example, includes the special case of causal relationship when the consequence is the conclusion drawn by the speaker.

Besides, the second group contains the relationships of purpose, since there is an association between causation and purposefulness. In that case the purpose is the desirable result of certain action. Thus the fact of purpose existence can be regarded as subjective reason and the need for the action to be fulfilled as a consequence.

*To reduce the effects of background noise, some speech enhancement algorithms originally developed for normal hearing ... persons have been applied to CI speech processing. [11, c.1001]*

The sentence can also be transformed not changing the meaning.

*Some speech enhancement algorithms originally developed for normal hearing ... persons have been applied to CI speech processing because it was necessary to reduce the effects of background noise.*

Therefore, scientific argumentation relies on not only on causal association but on other types of conditioning relationship excluding the relationship of concession. However the latter is able to increase the effect of argumentation.

**The features of causativity category in scientific papers.** The expression plane of causativity category is shown by language means at such levels as lexical, syntactic and textual.

At lexical level causal semantics is expressed by the words naming causal concepts and actions. These are such nouns as *cause; reason; motive, account, consequence, conclusion* and verbs *to lead to, to result in, to result from, to cause etc.*

At the level of sentence that category is shown by adverbial modifier of cause, purpose, result and condition. That's true both for simple and complex sentences with subordinate clauses of corresponding types. It was noted, that language constructions aren't in congruence with logic operations but only partially correlate with them [4, c.44]. Therefore causal association can also be expressed by adverbial modifier of time since the reason is always followed by the result.

At textual level the sentences interrelated semantically and syntactically create super-phrasal unities. [7]. The latter serve as semantico-syntactic interpretation of utterances, which also enter into relationships between each other. The presence of casuality is implicated in super-phrasal unities with the relationships of argumentation, explanation, introduction, specification and time.

It should be noted that casual semantics is marked in the structures of different layers by the same means. A semantico-equivalent transformation is able to modify a simple sentence into a complex one, which, in turn, can be modified into a super-phrasal unity. It means that syntactic structures can be "rolled" and "unrolled" not changing its meaning. So, such structures have the property of isofunctionalism i.e. they demonstrate the same semantico-syntactic function at several layers of syntax. [9, c.6-7].

In the examples given below the conjunction *thus* serves as a sign of causal situation both in complex sentence and in super-phrasal unity.

*Female airways are smaller in cross-sectional area, and **thus** the pressure losses for viscosity are larger. [10, c.1367]*

*Finally, in those cases where the formants were visible ..., F1 and F2 generally showed little movement between the vowels. **Thus**, we are confident that variability in supraglottal postures as functions of stress and loudness was fairly minor in the modeled data. [10, c.1366]*

The meaning of the sentences doesn't change if they are paraphrased as follows.

*Female airways are smaller in cross-sectional area. **Thus** the pressure losses for viscosity are larger.*

*Finally, in those cases where the formants were visible ..., F1 and F2 generally showed little movement between the vowels, and **thus**, we are confident that variability in supraglottal postures as functions of stress and loudness was fairly minor in the modeled data.*

The example shows that the complex sentence is converted into super-phrasal unit and vice versa as a result of transformation.

**Scientific explanation as special case of argumentation.** The causal association lies at the heart of such type of argumentation as argumentation due to explanation [2, c.253]. Generally argumentation and explanation are the forms of scientific discourse cognitive component that mostly take place in technical research papers. [6].

An explanation makes natural phenomena, mathematical equations, physical theory etc. Since explanation must be convincing and feasible it can act the part of argumentation [3, c. 111-113].

According to the model of scientific explanation, it consists of, explanandum and explanans. Meanwhile explanandum is a sentence describing the phenomenon explained [5, c.91-92]. Explanans is defined as a class of sentences presented to explain it. In addition to, explanans is composed of sentences characterizing описуют antecedent conditions  $C_1, C_2, \dots, C_n$ , and sentences that refer to general laws  $L_1, L_2, \dots, L_k$ . Besides, explanandum must be logic result of explanans.

In light of the Toulmin Model of Argumentation, it includes such components as evidence, claim, warrant, backing, rebuttal and qualifier [8, c.274-277]. The first three of them are compulsory. On matching those models the some of their components congruence becomes evident.

## Argumentation

## Explanantion

Evidence

Explanandum

Claim

antecedent conditions of explanans

$C_1, C_2, \dots, C_n$

Warrant

General laws of explanans

$L_1, L_2, \dots, L_k$

Analogy serves as one of convincing methods. According to Lloyd, it is defined as any way of reasoning, in which an object or complex of objects compares to another one basing on their similarities. Besides, we know more about one of those objects i.e. analogy is a connection between more to less known thing [3, c.113].

Furthermore, analogy is a multidimensional phenomenon. There are the following types:

– a relation of a part of to another part of the same whole when one of them is known. In this case argumentation is inductive and comes down to giving examples;

– an associative analogy as correlation of things independent on the character of link between them. Naturally this type of analogy isn't used in scientific papers;

– an interrelation of things due to causal link between them. It is the sort of analogy that is used in scientific explanation [3, c.113-114].

The example given below shows the analogy between mails and femails since the difference between masculine and feminine organisms is unessential. To reproduce female voice the scientists used the model configuration of male larynx.

*To simulate female voices, McGowan ... used the same male configuration of the model, as they were mainly interested in reproducing the gross dc airflow. [10, c.1367)*

The next example demonstrates scientific explanation of experiments results, in which the cochlear implants users recognized speech in presence of different kind underground noise. In one of cases the results were better than in others

(explanandum). That fact is explained with the more sensitivity of those people to one of noises (explanans). The antecedent condition in those experiments is the fact that the object is the deaf people using cochlear implants. The evidence of more sensitivity was determined in the previous research and relied on the laws of medicine and biology. The analogy results from the correlation of such concepts as “to be sensitive”, “to hear” and “to recognize”. The people listened to a certain text together with background noise. The ability to hear is the result of sensitivity. Thus, in one of cases they heard the noise better than in others. It means that the speech was less audible. So, it affected their ability to recognize sounds.

*Figure 1 shows word-in-sentence recognition in the presence of speech-shaped noise. ... For all subjects... performance was better with the speech enhancement algorithm. ... Figure 2 shows word-in-sentence recognition in the presence of interfering speech babble. ... The speech enhancement algorithm showed only an estimated noise spectrum from the noisy speech spectrum would undoubtedly cause the performance to decrease. ... because CI users are more susceptible to speech babble than steady noise. [11, c.1003-1004]*

The example illustrates causal semantics by the verb “to cause”. At the level of sentence it is expressed due to a complex sentence with subordinate cause of reason. As for textual level, the extract demonstrates super-phrasal unity with the relationships of explanation.

**Conclusions.** Thus causal association serves as a foundation for scientific argumentation including scientific explanation as a special case. The category of causativity as a argumentative relevant category is considered as a variant of the conditioning category. The former is expressed by the means at different levels of language. The feature of syntactic and textual levels is isofunctionalism.

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### **Н.Е. Доронкина. Особенности каузации в аргументации научных статей.**

В статье исследуются особенности категории каузативности в научно-технических статьях. Анализируются такие понятия, как обусловленность, причастность, причина, причинность, каузальность и каузативность, а также связанные с ними категории, при этом каузация рассматривается как частный случай обусловленности. Исследуется связь между

причинно-следственными отношениями и другими видами отношений обусловленности. Освещаются способы выражения и маркировки каузальной семантики на лексическом, семантическом и текстовом уровнях. Описана семантически эквивалентная трансформация, которая позволяет переходить из синтаксического уровня в текстовый и обратно. Кроме того в статье рассматриваются такие формы когнитивного компонента научного дискурса, как аргументация и объяснение. Проводится сравнение модели научного объяснения и модели аргументации. Статья проиллюстрирована примерами из научно-технических статей в области акустики.

**Ключевые слова:** обусловленность, причастность, причина, каузальность, каузативность, сложное синтаксическое целое, аналогия, модальность, трансформация.

### **Н.С. Доронкіна. Особливості каузації в аргументації наукових статей.**

У статті розглядаються особливості зображення категорії каузативності у науково-технічних статтях. Аналізуються такі поняття, як причетність, обумовленість, причина, причинність, каузальність та каузативність, а також пов'язані з ними категорії. Каузація вважається окремим випадком обумовленості. Досліджується зв'язок між причинно-наслідковими відношеннями та іншими видами відношень обумовленості, які поділено на дві групи відповідно до типу модальності. Висвітлюються способи вираження та маркування каузальної семантики на лексичному, синтаксичному та текстовому рівні. Розглянуто тематичний, ланцюговий та паралельний типи зв'язку всередині складного синтаксичного цілого в якості інструмента реалізації причинно-наслідкових відношень на текстовому рівні. Особлива увага приділяється складним синтаксичним цілим з відношенням аргументації та пояснення. Представлено перехід з синтаксичного рівня на текстовий та навпаки за допомогою семантично еквівалентної трансформації. У статті також показано схожість та різницю між такими формами когнитивного компоненту когнитивного дискурсу, як аргументація та пояснення. Проаналізовано аргументацію через пояснення як окремий випадок аргументації. Крім того, розглянуто модель наукового пояснення та проведено її порівняння з моделлю аргументації. Висвітлено роль аналогії як спеціального прийому переконання. Показано класифікація аналогії та виділено її типи, які використовуються у науковій аргументації. Наведено приклади з науково-технічних статей в області акустичних досліджень.

**Ключові слова:** обумовленість, причетність, причина, каузальність, каузативність, складне синтаксичне ціле, аналогія, модальність, трансформація.