UDC 811.111'42

ARGUMENTATIVE DISCOURSE OF TECHNICAL RESEARCH PAPERS IN THE CONTEXT OF RHETORICAL STRUCTURE THEORY

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The article deals with Rhetorical Structure Theory (RST). It is shown that the theory is a very helpful descriptive tool not only for microstructure but for macrostructure as well. The role of rhetorical relations in argumentative discourse in the sphere of science is described. The structure of Toulmin's argumentation model in the context of rhetorical relations is given. The relations taking place between the model components are analyzed. They are divided into four groups according to the type of causal link. All rhetorical relations are analyzed by means of decomposition into nucleus and satellite. The group of basic causal relations is parted in agreement with the degree of speaker participation. The group of Conditional relations is presented in full paradigm. In considering the group of purposeful relations such factors as cognitive states of readers and speakers are taken into account. Concessive relations are discussed from two points of view. Macrostructure of scientific papers argumentative discourse is outlined in the context of topical content. To describe macrostructure of discourse such multinuclear schemas as Joint are used. RST diagram for Introduction chapter is shown. The examples of all rhetorical relations taken from technical research papers are presented.

Keywords: rhetorical relations; clause; nucleus; satellite; microstructure; macrostructure; cognitive state.

Introduction. Being recognized as linguistically helpful tool to analyze texts, RST provides the same approach to macrostructure and microstructure discourse building. Since it was formulated a number of investigations have used RST to discuss a wide range of problems dealing with text and discourse studies.

The aim of the article is to describe the role of rhetorical relations in argumentative discourse in the sphere of science. The theory states that each discourse unit is linked with at least another one. It describes different texts structure in terms of rhetorical relations. The size of connected units doesn't matter. The minimal unit called "clause" is any word group with the verb, link or linking grammar element at the top. Any type of discourse is considered to be organized hierarchically with the same set of relations at each level. Two spans connected by such relations are named the Nucleus (N) and the Satellite (S) [8, p. 245].

Argumentation model in the context of rhetorical relations. The universal argumentation model is known to include such components as Grounds, Warrant, Conclusion, Backing, Rebuttal and Qualifier [2, p.274-277]. A more detailed inspection shows the model structure in terms of relations.

Basic components (Grounds, Warrant and Conclusion) and Qualifier create causal relation acting as a single block which is defined to make another casual relation with Backing and conditional relation with Rebuttal (See Fig.1).
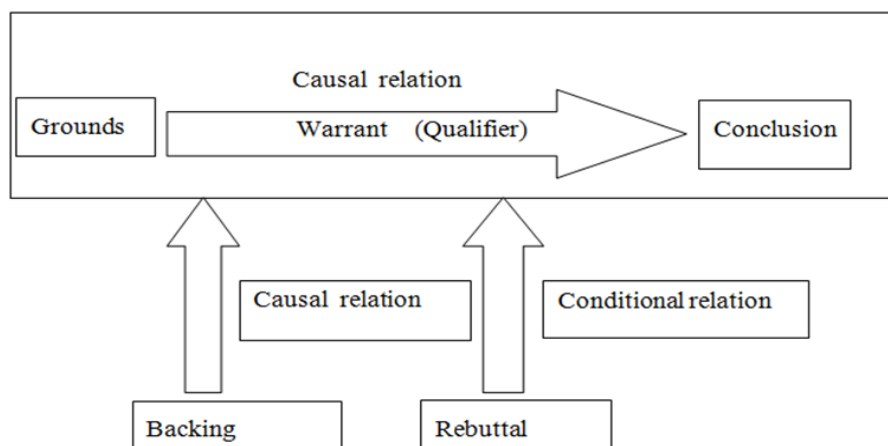

Figure 1. Argumentation model in terms of relations.

Both types of relations in the model are resulted from the mental conditioning category of conditioning uniting hierarchically dependent events. It was constituted in reliance on the concept of participation. There are such aspects of participation as purpose, condition, reason and others. Thus,

RST describes eighteen types of causal rhetorical relations divided into four classes: basic, conditional, purposeful and concessive [1].

Basic causal relations. The group consists of Non-volitional Cause, Non-volitional Result, Volitional Cause, Volitional Result, Evidence and Justify.

Furthermore, according to the degree of speaker participation, it is parted into non-volitational, volitational and half-volitational. The former implies the minimal participation because both the reason and the conclusion occur in the outer world. As a consequence of Non-volitional Cause readers find out that situation shown in S is a cause of the situation shown in N [8, p. 274-276].

The area differences across the MRI volumes are caused by the different resolutions. [10]

Conversely, Non-volitional Result enables readers to recognize the event presented in N could have resulted in the event presented in S.

Often only one image stack ... is used for vocal tract modeling. As a result, complementary information from other available stacks is not utilized. [10, 439]

The second subgroup is distinguished from the previous one bythe presence of the conscious participant whose cognitive state changes under the influence of the cause. The consequence is an intentional action or the result of it [1]. Similarly to the previous subgroup due to Volitional Cause readers understand that the situation described in S is a cause of the conscious action described in N.

We did not extract area functions from low-resolution coronal or axial stacks, since constrictions ... is not visible in those two stacks. [10, p.443]

Volitional Result informs that the reason expressed in N could lead to the consequence expressed in S.

The observed backscattering from the interfaces did not vary over such short time periods so the pings were ensemble averaged. [3, p. 33-34]

The third subgroup includes Evidence and Justify. They are called half-volatative because an event taking place in objective reality changes cognitive state of participants in causation described [8, p. 251-252]. The consequence in both cases is a conclusion or accompanying action.

The effect of an Evidence relation is to increase readers' belief of information presented in N. For example in technical research papers conclusions are drawn from experiment results. In the case of a Justify relation, the speaker explains why he has made such conclusion or performed such acts. Both relations are often used to build macrostructure of discourse.

Conditional relations. The group includes Condition, Unconditional, Unless, Otherwise and Means.

A Condition relation means that realization of actions contained in N depends on realization of condition presented in S. An Otherwise relation differs in that situation shown in N prevents actions shown in S [8, p. 276-277]. In technical research papers combinations of these relations creates complete induction in argumentative inference when a condition is fulfilled and in the contrary case.

The adaptive algorithm used here has been used in numerous experimental studies to measure frequency threshold tuning curves of AN-fiber ... At each frequency, the number of spikes occurring in the final 50ms of a 60-ms tone (with 5-ms rise/fall ramps) is compared to the number of spikes occurring in the final 50ms of the 60-ms window following the offset of the tone. If the difference is larger than a specified criterion (0 spikes here), then the sound level is decreased by one step 2 dB, otherwise the sound level is raised by two steps 4 dB. [4, p. 204]

Means is a relation between an action description and a tool making possible its fulfillment. The word "means" denotes not only a thing but also a method or algorithm. However, the fact of means existence doesn't imply that the action will be fulfilled. Besides, the role of that relation type in argumentation depends on context. The following example presents information is contained in the unit of Grounds i.e. it doesn't work as causation.

The acoustic backscatter measurements were obtained using multiple pairs of identical transducers mounted near the bottom of the tank. [3, p. 33]

Nevertheless, the whole paper is devoted to the development of methods when the conclusion of the paper is the algorithm presented can solve the problem. Thus, this type of relation can serve as Warrant in argumentation.

Unless is distinct from Condition in that realization the action presented in N depends on nonfulfillment the condition described in S.

… room-to-room crosstalk will occur <u>unless</u> the ceiling provides good sound transmission loss or barrier effects. [9]

An Unconditional relation takes place when there is no dependence between condition and consequence.

Purposeful relations. The group is composed of Purpose, Solutionhood, Background, Preparation, Enablement and Motivation.

A Purpose satellite characterizes unrealized situation i.e. purpose. A nuclear presents actions intended for achievement.

The goal of sparse wavenumber analysis is to accurately recover the wavenumber vectors vq at each frequency ωq. [7, p. 2]

A relation of Solutionhood takes place between S describing the problem and N that provides the way of its solution and thus serves as a particular case of purpose to achieve.

For complex-valued signals, the basis pursuit denoising problem <u>can be solved</u> using a second order cone optimization program. Second order cone programs <u>are typically solved</u> using interior points algorithms, which are computationally intensive due to the need <u>to solve</u> systems of linear equations in each iteration of the process. [7, p.2-3]

The example also illustrates Preparation that is included in the group of purposeful relations because its effect is aimed at a change of readers' epistemic state. The speaker lays out the situation in order to create readers' desire to find out the consequence. The author kindles readers' interest by means of the references chain i.e. the problem can be solved with the help of a certain program that can be realized by applying a certain algorithm etc. So, the reader must wait for the next reference or explanation.

A Background relation also works upon readers' epistemic state. Having learnt the information presented in S, readers understand N better. Specifically, some parts of scientific papers annotation are in a Background relation with corresponding parts of the text.

The optimal integration of information from independent Poisson sources (such as neurons) was analyzed in the context of a two-interval, forced-choice detection task.

…..

Understanding how observers integrate information over multiple observations is a classical problem in psychophysics …. In the subfield of psychoacoustics, integration is often considered in the context of combing information across time and/or frequency. …. In psychophysics, the benefit of integration is often estimated based on the assumption that information is normally distributed; the goal of the present report is to evaluate the accuracy of such estimates when the underlying distribution is Poisson rather than Gaussian. [5, p. 20]

Motivation and Enablement act at communicative level. Readers receive information provided in S increasing readers' desire to perform certain actions in case of Motivation. Technical research papers usually give a number of Motivation examples describing the construction of devices or experimental procedures to bring matters to readers' head.

If a reader understands information of an Enablement satellite his potential ability to perform action expressed by nuclear increases.

The square-root law has been used in psychoacoustic literature for analyzing a wide range of phenomena, including the independence of different detectors or frequency channels (see Green and Swets, 1966) [5, p. 20]

Concessive relations. Such type of relations implies disagreement between two propositions. The first of them is either condition or reason. The second one is the consequence. So, the feature of concessive relations is the integration of causal or conditional relations and opposition relations.

Semantically the structure of relations consists of three parts:

1. Reason or condition;
2. Implicitly predicted consequence;
3. Real consequence.

In TRS, the group of concessive relations contains only one relation type called Concession. It states that N and S exist at the same time in spite of their incompatibility.

Although this Poisson-based model does not capture all of the detailed stochastic properties of AN fiber activity, the main statistical properties that are most relevant to the present study are well represented by this model. [4, p. 204]

However, when the first element of structure is condition there is an Unconditional relation.

In all cases, even if the external noise is absent, all detectors still have internal, intrinsic noise. [5, p. 20]

Despite Concession implies unrealized causation, it is widely used in argumentation to increase argumentative effect.

Macrostructure of technical research papers discourse. Macrostructure of discourse is connected to its segmentation into a number of fragments. Each of them is characterized by topical and referential unity. Therefore, topics are considered to be the global meaning of a discourse. Macrostructure can be derived from microstructure with the help of operations called macrorules [6, p. 40-50]. Several level of macrostructure is possible because the procedure is recursive.

As for technical research papers, it is clear that macrostructure of each article is unique but due to the requirements of scientific journals all of them have the same global topic content according to the chapters.

In the context of argumentation each segment can be described in term of the Toulmin's model (see Fig.1). Each chapter contains one or more argumentation patterns. In particular, the first chapter called "Introduction" is dedicated to justification of the research conducted.

To outline the macrostructure of the chapter mentioned it is necessary to use another rhetorical multinuclear schema called Joint. It acts like logical operation of conjunction. Figure2 gives the RST diagram for typical Introduction chapter.
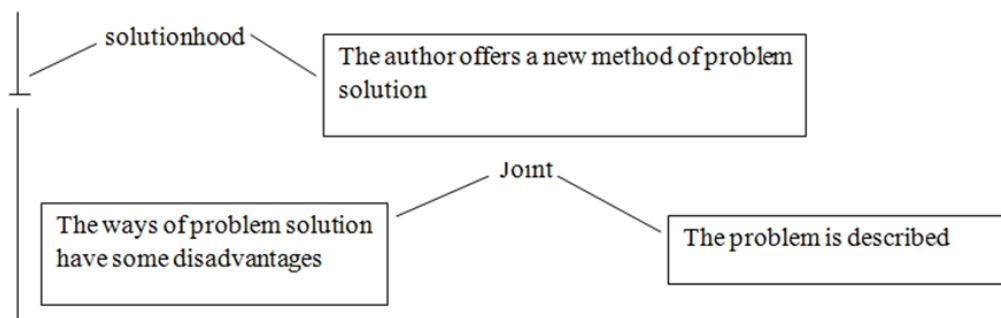

Figure 2. RST diagram for Introduction chapter.

At first, the author describes the problem to solve no matter practical or theoretical. Then he characterizes the present situation in the area of science. The ways of the solution either don't exist or have disadvantages. Therefore, the author offers a new improved method. As a result, readers should conclude that the research was desirable. The argumentation conclusion in this case is implicit.

Conclusions. The relations connected the argumentation model components belong to the causal group of RST. However, not all relations types can be used in this guise. In particular, conditional relations are applied to define Qualifier. For example, they often serve as a tool to provide full induction in argumentative inference. Besides, Concession is used to increase the argumentative effect. RST is effective to describe both macrostructure and microstructure of argumentative discourse in the sphere of science.

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Н. Є. Доронкіна. Аргументативний дискурс науково-технічних статей в контексті теорії риторичної структури. Відповідно до назви, стаття присвячена Теорії Риторичної Структури (ТРС). Показано, що теорія слугує в якості корисного описового інструменту не тільки для мікроструктури але і й також для макроструктури дискурсу. Описано роль риторичних відношень в аргументативному дискурсі в сфері науки. Представлено моделі аргументації Тулміна в контексті риторичних відношень. Досліджено відношення, які мають місце між компонентами моделі. Вони розділені на чотири групи відповідно до типу каузального зв'язку. Все риторичні відношення розглянуто за допомогою декомпозиції на ядро та сателіт. Групу базових каузальних відношень проаналізовано відповідно до ступені участі мовця. Групу умовних відношень представлено в об'ємі повної парадигми. У процесі аналізу групи цільових відношень враховано такі фактори, як когнітивний стан читача та мовця. Відношення поступки обговорюється з двох точок зору. Макроструктура аргументативному дискурсу наукових статей досліджено в контексті тематичного змісту. Для опису макроструктури дискурсу використано такі багатоядерні схеми, як Кон'юнкція. Наведено риторичний граф вступного розділу статей. Наведено приклади риторичних відносин з текстів науково-технічних статей.

Ключові слова: риторичні відношення; клауза; ядро; сателіт; мікроструктура; макроструктура; когнітивний стан.

Н. Е. Доронкина. Аргументативный дискурс научно-технических статей в контексте теории риторической структуры. Статья посвящена Теории Риторической Структуры (ТРС). Описана роль риторических отношений в аргументативном дискурсе в сфере науки. Представлена модель аргументации Тулмина в контексте риторических отношений. Каузальные отношения разделены на четыре группы в зависимости от типа каузальной связи. Группа базовых каузальных отношений проанализирована в соответствии со степенью участия говорящего. Группа условных отношений представлена в объеме полной парадигмы. В процессе анализа группы целевых отношений учтены такие факторы, как когнитивное состояние читателя и говорящего. Отношение уступки обсуждается с двух точек зрения. Макроструктура аргументативного дискурса научных статей исследована в контексте тематического содержания. Представлен риторический граф вступительного раздела статей. Приведены примеры риторических отношений из текстов научно-технических статей.

Ключевые слова: риторические отношения; клауза; ядро; сателлит; микроструктура; макроструктура; когнитивное состояние.