On Developing a Web Resource to Study Argumentation in Popular Science Discourse

Ilina Daria
Novosibirsk State University, Institute of Philology Siberian Branch, Russian Academy of Sciences, Novosibirsk, Russia
dviljina@gmail.com

Kononenko Irina
A.P. Ershov Institute of Informatics Systems, Siberian Branch, Russian Academy of Sciences, Novosibirsk, Russia
irina_k@cn.ru

Sidorova Elena
A.P. Ershov Institute of Informatics Systems, Siberian Branch, Russian Academy of Sciences, Novosibirsk, Russia
lsidorova@iis.nsk.su

Abstract

This paper discusses the experience of developing a web resource intended to study argumentation in popular science discourse. Such type of argumentation is, on the one hand, the main mean of achieving a communicative goal and, on the other hand, often not expressed in explicit form. The web resource is built around a corpus of 2256 articles, distributed over 13 subcorpora. The annotation model, which is based on the ontology of argumentation and D. Walton's argumentation schemes for presumptive reasoning, underlies the argument annotation of the corpus. The distinctive features of the argument annotation model are the introduction of weighting characteristics into text markup through assessing the persuasiveness of the argumentation, as well as highlighting argumentative indicators visually. The paper considers a scenario of argument annotation of texts, which allows constructing an argumentative graph based on the typical reasoning schemes. The scenario includes a number of procedures that enable the annotator to check the quality of the text markup and assess the persuasiveness of the argumentation. The authors have annotated 162 texts, using the developed web resource, and as a result, identified the most frequent schemes of argumentation (Example Inference, Cause to Effect Inference, Expert Opinion Inference), as well as described some specific indicators of frequent schemes. Based on the above-mentioned outcomes, the authors listed the indicators of the most frequent schemes of argumentation and made some recommendations for annotators about identifying the main thesis.

Keywords: popular science discourse; text corpus; argument annotation of text; argumentation indicator; annotation scenario

DOI: 10.28995/2075-7182-2021-20-318-327

О создании интернет-ресурса для исследования аргументации в научно-популярном дискурсе

Ильина Дарья
Новосибирский государственный университет, Институт филологии СО РАН, Новосибирск, Россия
dviljina@gmail.com

Кононенко Ирина
Институт систем информатики им. А.П. Ершова СО РАН, Новосибирск, Россия
irina_k@cn.ru

Сидорова Елена
Институт систем информатики им. А.П. Ершова СО РАН, Новосибирск, Россия
lsidorova@iis.nsk.su

Аннотация

В статье представлен опыт создания лингвистического интернет-ресурса, предназначенного для исследования аргументации в научно-популярном дискурсе, в котором аргументация, с одной стороны, является основным средством достижения коммуникативной цели, а с другой, — часто не выражена в явном виде. Создан корпус объемом 2256 статей, распределенных по 13 подкорпусам. В основу аргументативной разметки корпуса текстов положена модель аннотирования на базе онтологии аргументации и перечня типовых схем рассуждения теории Д. Уолтона. Отличительной особенностью рассматриваемой модели является введение

в разметку весовых характеристик для оценки убедительности аргументации, а также явное выделение индикаторов. Рассматривается сценарий аргументативной разметки текста, который обеспечивает построение графа аргументации с использованием знаний о типовых схемах аргументации. Сценарий включает ряд процедур, позволяющих аннотатору проверить качество разметки и оценить убедительность выявленной аргументации. В результате разметки 162 текстов выявлены наиболее частотные схемы аргументации, такие как «От примера», «От причины к следствию», «От эксперта», и описаны их специфические индикаторы. Опыт разметки текстов позволил создать список индикаторов наиболее частотных схем и сформулировать некоторые рекомендации для разметки аргументации, в частности, относительно выявления главного тезиса.

Ключевые слова: научно-популярный дискурс; корпус текстов; аргументативная разметка текста; индикатор аргументации; сценарий разметки

1 Introduction

Over the past two decades, the Internet serves as the main platform for sharing ideas, gathering knowledge, disputes, and debates. Justifying opinions or statements is a field of argumentation theory that studies the use of arguments in discourse from a philosophical, linguistic, cognitive, and computational perspective. The analysis of argumentation, in particular, includes the transformation of unstructured text into “chains” or graphs of related structured arguments, which allows not only to evaluate individual statements, but also identify the relations between them, taking into account the focus on supporting or refuting the main thesis discussed by the author of the publication. Modern theoretical studies of argumentation, in fact, are connected with the practice of argumentation, and in this case, the study of this practice on a mass scale should be a priority for this area [9]. Along with theoretical studies, in recent years, scholars actively work to automate the extraction of arguments from texts [15].

The proper development of these studies requires the creation of argumentation corpora, where text fragments are marked up with the components of argumentative structures and relations between them. At the moment, there exist several annotated corpora of argumentative texts, most of them are monologue texts in English. The most famous resource with argument annotation is AIFdb, the former Araucaria corpus [22], which contains news articles, records of parliamentary and political debates. Another resources in the German language are the corpus of the University of Darmstadt, which includes subcorpora of student persuasive essays [24], news texts, and scientific articles; the Potsdam Corpus, which contains a small collection of microtexts, later translated into English [19]. There are projects in some other languages – Italian, Greek, Chinese, but as far as is known, not in the Russian language.

In most projects, argument annotation includes text segmentation, highlighting units of argumentation, marking up roles (premise, conclusion) and relations (support / attack) without specifying the structure of arguments. The exceptions are corpora created using the OVA system (Online Visualization of Argument – the successor of Araucaria) [4], where the developers implemented an extended annotation of the argumentative structure related to specific argumentation schemes (based on the Argumentation Schemes by D. Walton) [25]. Argumentation schemes formalize certain reasoning patterns used for persuasion, that is why it is so important to study statistics and different contexts of using a particular scheme within the corpus. This is confirmed both by the rapid growth of the AIFdb corpus [6], which has already absorbed some argumentation markup systems [2–3], and by the increasing interest in the problems of automatic argument extraction, where annotated data is required. However, as noted in [16], existing annotated corpora that were used to automatically classify argument schemes have several shortages such as limited validation, restricted size, or poor representation of a broad range of scheme types.

The proposed work was carried out as part of a research project aimed at creating a corpus of Russian-language popular science texts with extended argument annotation. The texts were annotated manually based on the argumentation model developed by the project participants.

Section 2 defines features of popular science discourse in the aspect of argumentation and presents information about developing corpus accompanied with some statistics. The following sections provide an introduction to the argument annotation model (section 3) and also describe the scenario of effective work for the annotator (section 4). Section 5 presents the outcomes of preparing argument annotation for 162 texts, based on which the authors outline patterns and offer some recommendations for the annotator of argumentation.

2 Features of Popular Science Discourse

Popular science texts are mainly intended to present the results of research to the general audience and to prove their validity. They are of undoubted value for the theory of argumentation, since they represent two views on the world – the scientific and the naive ones. B.V. Kasevich described the main difference between the naive view that is always seeking continuity (usually imaginary) and the scientific view that is seeking completeness (fundamentally unattainable) [10].

The author may be a researcher, a bearer of a scientific view, or a journalist, a bearer of a naive view. Regardless, the main goal of the author is to break the continuity of the reader's naive worldview and replace it (a fragment of the worldview associated with the topic of the text) with a scientific or at least more scientific than it was before reading the text.

The audience of a popular science text is broad, non-specific, including people of different levels of education, with different knowledge about the subject of the text, but anyway, their viewpoint is naive, non-professional. Moreover, it is important to notice that popular science texts have optional, non-obligational nature because the audience may choose to read or not read them. This challenges the author to make the text interesting for the reader, to draw his attention to the subject being described.

Non-specificity of the reader and his optional assignment of the text content force the author to simplify or even mask the argumentation, in addition to the necessity of enhancing the attractiveness of the text. Too much explicit and formalized argumentation, being cumbersome and “boring”, didactic, will rather turn the reader away than be accepted by him.

Thus, the scholar who annotates popular science articles has to restore many implicit statements. The authors of this article have found out that about 10% of the annotated statements are implicit. Implicit content recovery is important for identifying not only separate arguments (schemes of argumentation consisting of premises and a conclusion), but also structures of argumentation, i.e. argumentation graphs, which support one main thesis, the main idea (for more details see [7]).

The process of selecting texts for developing annotated corpus in Russian language was operated automatically from open sources, such as “Science and Life” (nkj.ru), “STRF” (strf.ru), “Postnauka” (postnauka.ru), etc. The compilers have accompanied the articles with information about the author(s), date of publication, and subject (if it was indicated in the original source) and have grouped them into the source-based subcorpora. Using automated tools, the compilers collected about 2.3 thousand popular science articles, and arranged 13 subcorpora.

3 Argument Annotation Model

The argumentative structure explicates the processes of reasoning and persuasion that underlie the text, highlights the components of the argumentation field and the relations between them (controversial thesis, arguments for or against). To describe the arguments and argumentative structures the authors apply an extended version of the argumentation ontology – Description Logic ontology [21]. The distinctive features of this ontology [27] are a branched system of classes for representing typical schemes of reasoning and tools for modeling and analyzing the persuasiveness of argumentation. The descriptions are based on the AIF format [5], according to which arguments are represented in the form of a directed graph with two types of nodes: information nodes (statement vertices) and scheme nodes (argument vertices).

«Example_Inference»		
Statement role	**Statement type**	**Statement description**
TypicalObject_Premise	TypicalObject_Statement	***a*** is typical of things that have ***F*** and may or may not have ***G***
CaseProperty_Premise	CaseProperty_Statement	In this case, the individual ***a*** has property ***F*** and also property ***G***
Conclusion	GeneralProperty_Statement	Generally, if ***x*** has property ***F*** then (usually, probably, typically) ***x*** also has property ***G***

Figure 1: The Example Inference scheme of argumentation

Fig. 1 shows an example of an argumentation scheme. It combines the statements found in the text (two premises and a conclusion) into a single structure. The same statement can be included in different structures, thereby linking the "minimal" units of reasoning (arguments identified in the text) into a single chain and in the general into a graph of argumentation.

One of the key aspects of argumentation is a conflict between arguments. While typical arguments and their relations are aimed at supporting a certain statement-thesis, conflict – criticizing or disproving a thesis. In the argument annotation model conflict is represented by a scheme that defines a relation either between two statements or between a statement and an argument supporting a thesis.

The model of argument annotation of text, in accordance with the ontology, can be represented as the following system:

<T, S, Arg, C, R_e, Ind, W_S>, where *T* is a text, *S* – a set of annotated statements, *Arg* – a set of arguments that are instances of argumentation schemes, *C* – a set of conflicts, R_e – a set of relations between statements specifying "conditional" equivalence, *Ind* – a set of argumentation indicators, W_S – assessments of the author's belief in the truth of the statements. The argument in this model specifies an n-ary relation over statements with a special position assigned to the conclusion, and the conflict is a binary directional relation.

Fig. 2 shows an example of text annotation built in accordance with the proposed model.

Figure 2: Argument annotation of a text

Argumentation in a marked-up text is presented by (a) a set of annotated statements and indicators and (b) a graph representation of a set of arguments corresponding to relations between statements. The graph representation together with the textual one gives a complete overview of arguments and text fragments covered by them. In Fig. 2, statements (rectangular vertices) correspond to instances of type statement classes, and arguments (vertices with rounded edges) correspond to scheme instances.

Distinctive features of the proposed argument annotation model are introduction of weighting characteristics into the markup to assess the persuasiveness of the argumentation, and also the explicit identification of indicators that not only point out the presence of arguments and their types, but can also affect the general assessment of the persuasiveness of the argumentation.

4 Argument Annotation Scenario

The annotation scenario includes the main stage when the annotator selects statements and constructs the argumentation graph and the stage when the annotator analyzes the argumentation.

The main stage includes the following steps:

1. investigate argumentation indicators found automatically;
2. segment the text into argumentative discourse units (ADUs), i.e. sentences, clauses or minimal text spans that have propositional content including nominalized propositions and prepositional phrases with the meaning of cause, effect, concession, contrast;

3. select text fragments related to argumentation and create on their basis statement nodes for the argumentation graph (when forming the description of the statement node, the annotator can modify the initial text fragment to avoid ambiguities, resolve anaphora or restore ellipsis);
4. identify implicit statements related to argumentation and create graph nodes that correspond to no text fragment;
5. define the roles for each statement (conclusion or premise) and build argument nodes connecting statement nodes into a single graph structure; relations between statement and argument nodes are directed (from premise to argument or from argument to conclusion);
6. determine a scheme for an argument node using a multidimensional hierarchical classification of reasoning schemes; for any scheme, a semiformal description of each element of its structure is given (see Fig. 1);
7. detail the structure of each argument based on the corresponding argumentation scheme; at this stage, the fields in the structure of the arguments are filled with the appropriate statements;
8. identify "conditionally" equivalent statements, i.e. statements that have the same propositional content, but differ in the degree of detail (in dictum) or in modal component (influencing persuasiveness).

To proceed to the next stage – the analysis and validation of the annotation – the resulting graph must be carefully checked, since even a small change in its structure can lead to significant discrepancies in the final assessment. Automatic graph checking includes loop search and connectivity analysis. It is necessary to notice that the graph may contain cycles resulting from conflicts, but looping of supporting argumentation chains is not allowed.

There are several procedures of validation check that has to be performed by the annotator:

- analysis of argumentation indicators that might not be included in the markup,
- comparative analysis of typical annotation elements with their implementations in other annotated texts,
- comparative study of argumentative relations (specifically, analysis of correlation with rhetorical annotation [13, 17]),
- analysis of disconnected subgraphs and identification of causes.

Development of the methodology is aimed at building a training base of the argument mining parser for texts in Russian. To validate such corpus, a formal check is absolutely needed, including the analysis of the graph for coherence and absence of cycles, and content check, which may consist of assessing the inter-annotator agreement. Computing inter-annotator agreement on a manually annotated corpus is crucial to evaluating the reliability of annotation. One of the previous attempts to overcome the problem of low inter-annotator agreement arising from the complexity of the underlying argumentation ontology has been to pre-select from existing larger scheme typologies (see [18]). However, note that annotators can not reach absolute agreement. In contrast to artificial formal-logical methods of proving a thesis, argumentation in popular science discourse is often based on the so-called "starting point of arguments". They are "the preferable, comprising values, hierarchies, and lines of argument" that appear to be more convincing for groups of individuals" [14, 20]. It is fundamentally impossible to classify these preferences in such a way that classes do not overlap and do not include each other. At this moment no study in this direction has been performed due to the limited scope of the annotation trial.

The stage of argumentation analysis consists in assessing the degree of persuasiveness of the statements and annotating them with weight characteristics (ranging from 0 to 1, where 1 corresponds to the maximum persuasiveness, and 0 – to the minimum one). The weighted assessment depends on the specified audience: general, scientific, or adolescent. After setting the initial weights, the weights for the entire graph (all arguments and theses) can be calculated to assess the degree of persuasiveness of the argumentation for a particular audience [26]. Obtained result may be compared with the opinion of the annotator to make sure that the graph is built correctly and to identify inaccuracies in the markup at the structural level.

5 Features of Argument Annotation

When annotating the argumentation, the above stages of text annotation are implemented.

5.1 Argumentation Indicators

To draw the attention of annotators to arguments presented in texts explicitly and to assist with highlighting the boundaries of ADUs and choosing appropriate argumentation schemes, the corpus is provided with the system of preliminary text processing. This procedure simplifies detecting specific hints in the text, such as various kinds of verbal clichés. These clichés indicate the presence of an argument in the text [8].

The automatic search for indicators is operating based on the pattern constructions that describe the classes of language expressions with regard to possible lexico-semantic classes, grammatical forms, punctuation, and compatibility in multi-word strings [12]. The experts suggest indicator patterns according to the analysis of means of expression of argumentation. Patterns may be expanded taking into account the variants through the constructing samples with variables and iterative search methods [1].

At the moment, one marked-up text contains an average of 18 arguments, among which 0.5 are conflicting. Table 1 shows most frequent argumentation schemes and their indicators.

Schemes	**Count**	**Examples of indicators** (given informally)
Example	257	например ‘for example’; в частности ‘particularly’; привести <Verb, Pers=1>… пример ‘let’s give …example’; показывать<Verb, Tense=pres>… как/что ‘shows…how/that’; мочь _percep [видеть/ наблюдать], что ‘(can) see / observe… that’
Cause to Effect	249	поэтому/потому (что)/так как ‘because (of the fact that)’; дело в том, что ‘the fact is that’; привести <Verb, Tense= pres/past>…к ‘result in’; объясняться / объяснить…тем, что ‘account for the fact that’; связан…с тем, что ‘connected with the fact that’; это объяснимо ‘it is explainable’; причина этого ‘the reason is’
Expert Opinion	203	по мнению _expert [ученый/эксперт] <Noun, Case=gen> ‘according to _expert’; _expert <Noun, Case=nom>_speech [утверждать/писать] / _intel-act [доказать/обнаружить] / _eval [соглашаться]<Verb>…, что ‘scientists claim/consider/agree that’; согласно/по _speech-prod [слово]<Noun, Case=dat> / _mental-prod [представление/гипотеза]<Noun, Case=dat> _expert <Noun, Case=gen> ‘according to the ideas of _expert’; _speech-prod [работа/статья] …_expert … _intel-act [показать/продемонстрировать], что ‘the work(s) / paper(s) / article(s) …_expert… show that’; подробнее (об этом) см. ‘for more details see’
Logical Conflict	110	неверно, что ‘it is not true that’; несмотря на …, ‘in spite of’; с одной стороны… с другой (же)… ‘on the one hand…on the other’
Practical Reasoning	91	для … нужно / требуется / необходимо ‘to do/for …, it is required / needed’; <Verb, mood=imperative >
Analogy	54	похожий… на ‘is similar to’; похожая ситуация… наблюдаться/сложиться ‘a similar state of affairs…(developed / observed)’
Sign	47	означать, что ‘it means that’; указывать на то, что ‘it indicates that’
Position to Know	35	по/согласно _observ-data [наблюдение/данные] ‘according to the data’; подтверждать/подтверждаться… _observ-data <Noun, Case=nom, instr> ‘confirmed by observations’; результаты (эксперимента) показывают ‘the results (of the experiment) demonstrate that’

Table 1: Indicators of argumentation schemes

Among the most frequent schemes of argumentation, *Example Inference* and *Expert Opinion Inference* turned out to be well formalized.

Specific indicators of the *Example Inference* (see Fig. 1) are lexemes belonging to the family of words with the root "example". The place of the indicator regarding the text fragments of the argument helps identify the role of the corresponding statement in the structure of the argument (Conclusion, Premise):

(1) *<Conclusion> Пример: 'Example:' <CaseProperty_Premise>*
<Conclusion> Привед<у/ем>… пример<а,ы,ов> 'let's give<numeral/quantifier/article> example' <CaseProperty_Premise>
<Conclusion>. Например, 'For example,' <CaseProperty_Premise>

Another less specific (weak), but frequent indicators of the scheme:

(2) <Conclusion>. *Так, 'Thus' <CaseProperty_Premise>*

This indicator can also be a part of a complex subordinating conjunction *так, что* '*so that*' or *так, как* '*in a way that*' or an adverb followed by a comma that marks the segment boundary (see Fig. 3).

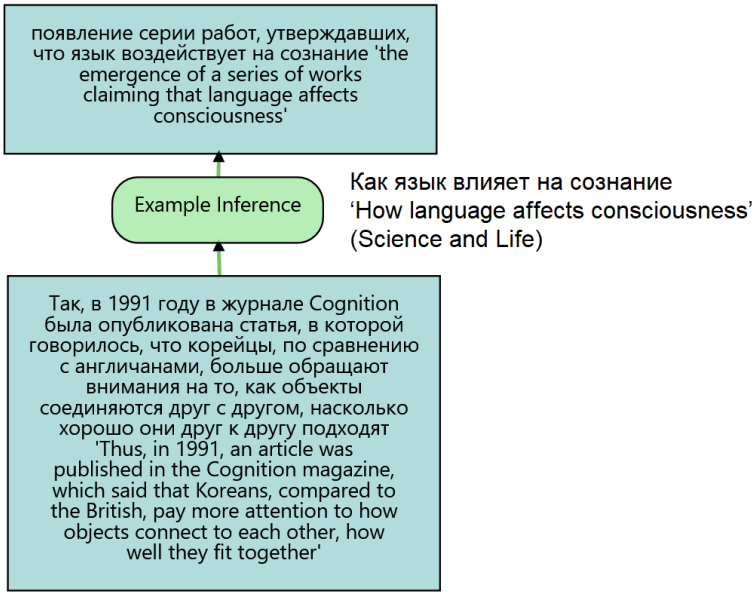

Figure 3: Example of the indicator of the Example_Inference

(3) *<Conclusion>: <CaseProperty_Premise>*
<Conclusion>. <CaseProperty_Premise>

The last two indicators are the weakest of the listed above: the colon can also express causal, explanatory, authorization and other relationships, and the full stop – any border between affirmative non-exclamatory sentences.

One more frequent scheme of argumentation with specific indicators is Expert Opinion Inference (see [11]).

To find out what proportion of argument schemes can be detected using indicators, an experiment was carried out with a system of 65 lexico-syntactic patterns that represent 4 classes of constructions of "expert opinion" indicators. The precision of the expertly created patterns reached 74.18% on the training collection and 65.73% on the test one. The precision measure on the training set demonstrates the frequency of an indicator constructions in argumentation (as opposed to non-argumentative narration). False positive results are caused by lexical, morphological and graphical homonymy and structural ambiguity.

5.2 Establish the Main Thesis

Annotated popular science articles contain one main idea (main thesis) or, less often, several ones. Accordingly, the annotation has one or several argumentative structures. The latter is observed mainly in texts where the authors do not limit themselves to a narrow topic, and do seek to tell about the entire field of research.[1]

In texts with one argumentative top, the statement of the main thesis, if it is explicit, is introduced either in the title, or in the lead (abstract under the heading), or in the first paragraph (most often in the first sentence or its dictum part), or in the last paragraph.

When extracting the main thesis from the title, it is necessary to take into account two features of this element of the text. Firstly, it is often a nominative sentence, i.e. to extract the main thesis, the annotator has to transform it into a verbal sentence (as a rule, representing a proposition of existence or functioning): for example, "Power of vowels" → "There is a power of vowels" → (eliminating figurative component) → "Vowels influence human actions". Secondly, the heading, being the most important means of drawing the reader's attention to the text, often reflects the main thesis not quite accurately, not specifically enough or too figuratively (see Table 2). This is due to the fact that the purpose of the author when composing the title is to point out an aspect of the topic that will be interesting or attractive to as many readers as possible (for example, a practical one), or to point out a more general topic.

Title	Main idea
Хочешь выиграть – подумай об этом на иностранном языке 'To win, think in a foreign language'	Думая на иностранном языке, люди принимают более взвешенные решения 'Thinking in foreign language helps people make rational decisions' (the 1st sentence)
Как язык влияет на сознание 'How language affects consciousness'	другой [иностранный] язык в буквальном смысле расширяет наше сознание и заставляет иначе взглянуть на мир 'a foreign language literally expands our consciousness and makes us look at the world differently' (the dictum part of the 1st sentence of the last paragraph)
Власть гласных 'The power of vowels'	Минимальные составляющие компоненты слов действительно способны изменять наше восприятие не только всего слова, но и объекта, который оно обозначает 'The minimal components of words are really capable of changing our perception of not only the whole word, but also the object that it stands for' (the dictum part of the last sentence)

Table 2: Examples of expressing the main idea in the title and in other parts of the text

Conclusion

To support the argument annotation of texts and the studies of argumentation, the project team (including the authors) has developed web platform (https://geos.iis.nsk.su/arg) [23] which provides the user with a set of specialized tools: text markup tools, graph editor, search services for finding arguments in annotated corpora, a linguistic module that performs preprocessing of texts and highlighting indicators, and a computational module that conducts an assessment of the persuasiveness of the argumentation depending on the initial weights of the statements specified by the annotator.

The presented above annotating technique covers the traditional division of both argument components into premises and conclusions as well as argumentative relations into support and attack. Moreover, being based on D. Walton's theory, the technique allows for a large subset of argumentation schemes (44 inference schemes and 23 conflict relations). Most prominent features of annotation procedure are as follows:

[1] E.g., Levontina I. Russkiy Natsionalnyy [The Russian National]. Elements.
URL: https://elementy.ru/nauchno-populyarnaya_biblioteka/432329/Russkiy_natsionalnyy (accessed 10.05.2021).

- reliance on the ontological model of argument annotation,
- consideration of argumentation indicators for the detection of arguments,
- comparative analysis and identification of correlations between argumentative and rhetorical structures [13],
- use of mathematical modeling methods to control the annotation process.

Based on the experience obtained during the process of text annotation, some recommendations for annotators have been prepared: rely on the list of indicators, identify the main thesis, differentiate argumentation and explanation. Outcomes of this research will underlie a detailed instruction on argument annotation. Since it is especially difficult to match arguments to reasoning schemes, the starting point for these instructions will be critical questions related to the main aspects of scheme classification.

Further attention is required to study stable combinations of argumentation schemes, examine the influence of various argumentative structures on the weights of propositions, and reveal linguistic indicators of these phenomena.

References

[1] Akhmadeeva I., Kononenko I., Salomatina N., Sidorova E. Indicator Patterns as Features for Argument Mining // International Multi-Conference on Engineering, Computer and Information Sciences (SIBIRCON). — Novosibirsk, Russia, 2019. — P. 0886-0891.

[2] Bex F, Lawrence J, Snaith M, Reed C. Implementing the argument web. — Int. J. of Communications of the ACM. — Vol. 56(10), 2013. — P. 66–73.

[3] Bex F, Reed C. Dialogue templates for automatic argument processing // Computational Models of Argument: Proc. of the 4th Int. Conf. COMMA (Vienna), IOS Press, 2012. — P. 366-377.

[4] Bex F., Snaith M., Lawrence J., Reed C. ArguBlogging: An application for the argument web. — Int. J. of Web Semantics: Science, Services and Agents on the World Wide Web, 2014. — Vol. 25. — P. 9-15.

[5] Chesñevar C.I., McGinnis J., Modgil S., Rahwan I., Reed C., Simari G., South M., Vreeswijk G., Willmott S. Towards an argument interchange format. — The knowledge engineering review, 21(4), 2006. — P. 293-316.

[6] Corpus AIFdb. Access mode: http://corpora.aifdb.org/.

[7] Eemeren F.H. van. The State of the Art in Argumentation Theory [Sovremennoe sostoyanie teorii argumentatsii], Crucial Concepts in Argumentation Theory [Vazhneishie kontseptsii teorii argumentatsii]. — St. Petersburg, Faculty of Philology of St. Petersburg State University, 2006. — P. 25-26.

[8] Eemeren F.H. van., Houtlosser P., Snoeck Henkemans F. Argumentative Indicators in Discourse: A Pragma-Dialectical Study, Argumentation Library. — Vol.12. Springer, Dordrecht, 2007. https://doi.org/10.1007/978-1-4020-6244-5

[9] Hinton M. Corpus Linguistics Methods in the Study of (Meta)Argumentation, Argumentation, 2020. https://doi.org/10.1007/s10503-020-09533-z

[10] Kasevich V.B. Buddhism. Worldview. Language [Buddizm. Kartina mira. Yazyk]. — Saint Petersburg, Saint Petersburg State University Publ., 2004.

[11] Kim I.E., Ilina D.V. Language expression of the argumentative framework “From popular opinion vs. from expert opinion” in the text of popular science article [Iazykovoe vyrazhenie argumentativnoi struktury «Ad populum» – «Ot eksperta» v tekste nauchno-populiarnoi stat`i]. — Vestnik NSU, Series: History and Philology, 2019. — Vol. 18. — N. 9. — P. 27–35.

[12] Kononenko I., Sidorova E. Development of the Lexicon of Argumentation Indicators // In: Kuznetsov S., Panov A. (eds) Artificial Intelligence. RCAI, Communications in Computer and Information Science. — Vol 1093, Springer, Cham., 2019. — P. 154-168.

[13] Kononenko I.S., Sidorova E.A., Akhmadeeva I.R. Comparative analysis of rhetorical and argumentative structures in the study of popular science discourse // Computational Linguistics and Intellectual Technologies: Proc. of the Int. Conf. “Dialogue”, 19(26), 2020. — P. 432-444.

[14] Kosarev A.V. On Ch. Perelman’s Rhetoric Theory of Argumentation [O ritoricheskoi` teorii argumentatcii KH. Perel`mana]. — Siberian Journal of Philosophy [Sibirskii` filosofskii` zhurnal], 2019. — Vol. 17(2). — P. 174–188.

[15] Lawrence J., Reed C. Argument mining: A survey. — Computational Linguistics, 45(4), 2019. — P. 765-818.

[16] Lawrence J., Visser J., Reed C. An Online Annotation Assistant for Argument Schemes // Proceedings of the 13th Linguistic Annotation Workshop eds. A. Friedrich, D. Zeyrek, and J. Hoek, Association for Computational Linguistics, 2019. — P. 100–107.

[17] Musi E., Alhindi T., Stede M., Kriese L., Muresan S., Rocci A. A Multi-layer Annotated Corpus of Argumentative Text: From Argument Schemes to Discourse Relations // Language Resources and Evaluation (LREC’2018): Proc. of the 11th Int. Conf. (Miyazaki, Japan), 2018. — P. 1629-1636.

[18] Musi E., Ghosh D., Muresan S. Towards feasible guidelines for the annotation of argument schemes // Proceedings of the third workshop on argument mining (ArgMining-2016), 2016. — P. 82-93.
[19] Peldszus A., Stede M. An annotated corpus of argumentative microtexts // Argumentation and Reasoned Action: Proceedings of the 1st European Conference on Argumentation. — London, College Publications, 2016. — Vol. 2. — P. 801–816.
[20] Perelman Ch., Olbrechts-Tyteca L. The New Rhetoric: A Treatise on Argumentation. — Transl. by J. Wilkinson, P. Weaver, 2019. — Notre Dame, IN, Uni. of Notre Dame Press, 1971, 576 p.
[21] Rahwan I, Banihashemi B, Reed C, Walton D, Abdallah S. Representing and classifying arguments on the semantic web. — The Knowledge Engineering Review, 26(4), 2011. — P. 487-511.
[22] Reed C., Rowe G. Araucaria: Software for argument analysis, diagramming and representation, International Journal on Artificial Intelligence Tools, 2004. — Vol. 13(4). — P. 961–979.
[23] Sidorova E.A., Akhmadeeva I.R., Zagorulko Yu.A., Sery A.S., Shestakov V.K. Platform for the study of argumentation in popular science discourse [Platforma dlia issledovaniia argumentatcii v nauchno-populiarnom diskurse]. — Ontology of designing, 2020. — Vol.10, 4(38). — P. 489-502. DOI: 10.18287/2223-9537-2020-10-4-489-502
[24] Stab C., Gurevych I. Identifying Argumentative Discourse Structures in Persuasive Essay // Conference on Empirical Methods in Natural Language Processing (EMNLP), Doha, Qatar, 2014. — P. 46–56.
[25] Walton D., Reed C., Macagno F. Argumentation schemes. — Cambridge University Press, 2008.
[26] Zagorulko Yu., Domanov O., Sery A., Sidorova E., Borovikova O. Analysis of the Persuasiveness of Argumentation in Popular Science Texts // S.O.Kuznetsov et al. (Eds.): RCAI 2020, LNAI 12412, 2020. — P.351-367. https://doi.org/10.1007/978-3-030-59535-7_26
[27] Zagorulko Yu.A., Garanina N.O., Borovikova O.I., Domanov O.A. Argumentation modeling in popular science discourse using ontologies [Modelirovanie argumentatcii v nauchno-populiarnom diskurse s ispol`zovaniem ontologii`]. — Ontology of designing, 9(4), 2019. — P. 496-509.