

Rhetorical Moves in Medical Research Articles and their Online Popularizations

Alexandra Csongor and Anikó Hambuch

Abstract: Students, scholars and researchers extensively use Web sources in their works. The online news media commonly translates the content of scientific articles while also influencing the decision-making process of the lay audience. Linguistic studies mostly concentrate on scientific discourse. There have been few studies that compare the language use of research papers and their popularizations. The focus of the study is to investigate and compare the rhetorical structure of research and popular articles by means of move analysis. The analysis is based on an electronic corpus of 60 articles divided into two sub-corpora: 30 Medical Research Articles (MRAs) about prenatal vitamins and nutrition, and 30 corresponding Popular Science Articles (PSAs). The texts in the two sub-corpora were analysed and divided into moves, which mark the content of the particular discourse unit. As a second step, based on the move-analysis of all texts in the corpus, a characteristic move structure for both genres was identified. The results indicate that PSAs have an identifiable pattern. The writers are likely to take over some of the rhetorical moves that are present in MRAs. However, significant structural differences exist between the two text types. The results of these analyses can be useful in assisting non-native and even native professionals in the interpretation and production of both scientific and popular science articles.

Key words: rhetorical move, medical research article, popular science article

Abstrakt: Im Fokus der vorliegenden Studie stehen die Untersuchung und vergleichende Analyse der rhetorischen Struktur von wissenschaftlichen und populärwissenschaftlichen Artikeln. Die Texte wurden auf ihr "move structure" hin analysiert. Die "Move-Analyse" basierte auf einen elektronischen Korpus von 60 Artikeln. Der Korpus wurde in zwei Subkorpora unterteilt: der erste Subkorpus umfasst 30 medizinisch-wissenschaftliche Artikel (MRAs) in den Themen "Pränatale Vitamine" bzw. "Ernährung". Der zweite Subkorpus beinhaltet 30 populärwissenschaftliche Artikel (PSAs), die aufgrund der wissenschaftlichen Artikel des ersten Subkorpus verfasst wurden. Die Identifizierung der Abfolge von "moves" erfolgte in beiden Genres, und zeigte ein erkennbares Muster in den PSAs. Die Verfasser der populärwissenschaftlichen Artikel scheinen einige der rhetorischen "moves" der wissenschaftlichen Artikel (MRAs) in ihren Aufsätzen zu übernehmen.

Abstrakt: Tato studie se zaměřuje na prozkoumání a srovnání rétorické struktury vědeckých a populárních článků prostřednictvím tzv. move analysis, tj. analýzy struktury textu pomocí funkčních kroků. Tato analýza vychází z elektronického korpusu 60 článků, rozděleného do dvou sub-korpusů: 30 článků z lékařského výzkumu (MRAs – Medical Research Articles) o prenatálních vitamínech a výživě a 30 odpovídajících populárně-vědeckých článků (PSAs – Popular Science Articles). Texty v obou sub-korpusech byly analyzovány a rozděleny do tzv. moves (funkčních kroků), které označují obsah konkrétního diskuzního celku. Dalším krokem vycházejícím z analýzy všech textů v korpusu byla identifikace charakteristické struktury funkčních kroků pro oba žánry. Výsledky naznačují, že populárně-vědecké články mají identifikovatelné schéma. Autoři pravděpodobně přebírají některé z rétorických funkčních postupů přítom-

ných v článcích z lékařského výzkumu. Mezi těmito dvěma typy textu však existují významné strukturální rozdíly. Výsledky těchto analýz mohou pomáhat nejen nerodilým, ale i rodilým odborníkům při interpretaci a tvorbě jak vědeckých, tak populárně-vědeckých článků.

1 Introduction

Since the 1990s, as a result of the technological revolution, the world wide web has become a global platform of information flow. The online news media commonly translates the content of scientific articles while also influencing the decision-making process of the audience, both specialist and non-specialist (Entwistle, 1995). Nowadays, it is increasingly accepted, that the results of science are important for everyone. The interaction between science and the news is called *science popularization* (Myers, 2003, Scherer, 2010). This interaction helps the work of researchers to build a bridge between experts and lay people by adding lay perspectives and experience to research, as well as by enhancing lay-professional relationships.

Linguistic studies mostly concentrate on scientific discourse. There have been few studies that focus on popular science articles in the field of medicine or compare the language use of medical research papers and corresponding popularizations.

Two levels of written Medical English are examined in the present study; academic writing and writing about the field of medicine for lay people. The focus of the present study is to investigate and compare the rhetorical structure of research and popular articles by means of move analysis.

1.1 Discourse Structure of Medical Research Articles

Swales (1981) proposed a four-move schema for the introductions of articles. Nwogu (1997) using Swales' (1981) genre-analysis model attempted to identify the structure of information in the Introduction, Methods, Results and Discussion sections. He established an eleven-move schema for the discourse organization in the genre of medical research articles. The structural moves analysis approach was adopted by Fryer (2007, 2012). He identified ten rhetorical moves in this genre. The summary of his model can be seen below. Moves and steps (indicated by numbers and letters, respectively) identified in the corpus of Fryer:

Introduction – to present the study in relation to previous research

1. *Presentation of study background*
 - a) established knowledge
2. *Identification of gap(s) in existing research*
 - a) lack of data (or questionable data) in specific area related to established field; b) reason for need to fill gap
3. *Statement of research purpose*
 - a) hypothesis/objective; b) brief description of material/methodology

*Methods – to describe the selection of study material
and to recount procedure and techniques used to analyze material*

4. *Description of material/participants*
 - a) size of study sample; b) study period; c) selection criteria; d) type of data collection; e) frequency of data collection; f) study approval/informed consent
5. *Description of experimental procedure*
 - a) measurements taken; b) definition of terms; c) sample categorization; d) endpoints/outcomes
6. *Description of data analysis procedure*
 - a) statistical test techniques; b) software

Results – to report data obtained in relation to methodology

7. *Report of observations*
 - a) reference to non-verbal material; b) main findings; c) associations/correlations (and/or lack thereof); d) adjustments to analysis

Discussion – to interpret results in relation to previous research, to discuss implications of study, and to propose areas for further research

8. *Discussion of main findings*
 - a) findings in relation to hypothesis/objective; b) comparison with literature; c) possible mechanisms/causes, implications
9. *Study limitations*
 - a) strengths/weaknesses
10. *Conclusion*
 - a) main findings; b) implications; c) recommendations/suggestions for future research

(Fryer, 2012, 9)

1.2 *Discourse Structure of Science Popularization*

The discourse structure of science popularization was examined by Nwogu (1991). In his study he characterized the generic structure of medical texts using Swales' (1981) move analysis approach. Nwogu expanded this theory to the whole texts of science popular articles. His results suggest that the Journalistic Reported Version of research articles have an identifiable schema. Based on his analysis the texts are made up of nine moves.

MOVE 1: Presenting Background Information

- by reference to established knowledge in the field
- by reference to main research problem
- by stressing the local angle
- by explaining principles and concepts.

MOVE 2: Highlighting Overall Research Outcome

- by reference to main research results.

- MOVE 3:** Reviewing Related Research
 - by reference to previous research
 - by reference to limitations of previous research.
- MOVE 4:** Presenting New Research
 - by reference to authors
 - by reference to research purpose.
- MOVE 5:** Indicating Consistent Observations
 - by stating important results
 - by reference to specific observations.
- MOVE 6:** Describing Data Collection Procedure
 - by reference to authors
 - by reference to source of data
 - by reference to data size.
- MOVE 7:** Describing Experimental Procedure
 - by recounting main experimental processes.
- MOVE 8:** Explaining Research Outcome
 - by stating a specific outcome
 - by explaining principles and concepts
 - by indicating comments and views
 - by indicating significance of main research outcome
 - by contrasting present and previous outcomes.
- MOVE 9:** Stating Research Conclusions
 - by indicating implications of the research
 - by promoting further research
 - by stressing the local angle.

(Nwogu, 1991:115–116)

Stejskalova (2012) studied a corpus of 35 popular science articles in the field of medicine. This study modified the structure of Nwogu based on the analysis of online articles. The texts were collected from similar sources to this work such as The New York Times, Science Daily, and Science News etc. The following moves were identified in the analysis of Stejskalova:

MOVE 1: Presents the background of the research

MOVE 2: Announces a recent finding of the research

- MOVE 3:** a) Larger context:
provides general knowledge about the studied issue or fills the gaps in knowledge
b) Limitation of ongoing or previous research:
informs about the limitations of the ongoing research or previous studies
c) Previous study:
provides information about the related previous studies
- MOVE 4:** Presents new research and explains the purpose of the research
- MOVE 5:** Indicates research results in detail
- MOVE 6:** Describes data collection procedures
- MOVE 7:** Indicates the main research outcomes and provides their description and explanation
- MOVE 8:** Provides research conclusions and future implications of the research results

(Stejskalova, 2012, 16)

2 Materials and Methods

The basis of the present study is a corpus of medical research articles (MRAs) and corresponding online popular science articles (PSAs). The present study includes two sub-corpora: 30 medical research articles from prestigious medical journals and 30 online popularized versions of the research articles. They all provide information about recent scientific findings on maternal vitamins and prenatal nutrition. Findings related to medication and vitamins are often presented in prestigious journals and are also often rewritten for the lay public. Most of the MRAs present findings of the latest research about prenatal care as they were written between 2004 and 2013. The popular open access articles were found in the health or science sections of online magazines, such as *The New York Times* and Reuters.

First, the study attempts to characterize the discourse structure of the two genres. The texts in the two sub-corpora were analysed and divided into moves, which signal the content of the particular discourse unit. The moves were identified by recognizing the function and the specific purpose of each text unit with the help of context and linguistic clues. Moves were determined based on the methodologies of Nwogu (1991, 1997), Stejskalova (2012) and Fryer (2012). As a second step, based on the move-analysis of all texts in the corpus, a characteristic move structure for both genres was identified.

3 Results

3.1 Structural Move Analysis of MRAs

The articles in the first study corpus were governed by the IMRAD structure; only three texts were not divided into the traditional format. The analysis of MRAs iden-

tified 11 moves that make up the texts in the corpus. The moves and their discourse function identified within the analysis are summarized in Table 1.

Tab. 1: *Moves and their discourse function in the corpus of MRAs*

Move	Discourse function
M1	Presenting Background Information
M2	Identifying Gaps in Existing Research
M3	Stating Research Purpose
M4	Describing Material/Participants and Data-collection
M5	Describing Experimental Procedure
M6	Describing Data Analysis
M7	Reporting Observations
M8	Discussing Main Findings
M9	Explaining Specific Research Outcomes
M10	Discussing Study Limitations, Strengths and Weaknesses
M11	Stating Research Conclusions

Based on the analysis of 30 texts the most typical is a schema of ten moves. The articles consisted of an average of 9.6 moves, and 15 articles out of 30 are composed of 10 moves. The move explaining specific research outcomes (M9) occurred only eight times in the corpus, all the other moves occurred more than 20 times therefore M9 was considered as a non-typical element of MRAs. The ten moves occurred with varying degrees of frequency in the texts examined.

The articles in the corpus most commonly start with the background information, which is followed by the questionable – or lack of – data in established knowledge. The authors always clearly formulate the objective of the study, which is usually one sentence at the end of the Introduction section. The Methods section follows a rigid format, starting with describing materials/participants, afterwards describing methods of investigation in details and ends with providing the statistical tests performed. The Results section encompasses one move only. The Discussion section compares the obtained results to the literature in that field and to the objectives of the study. This section may contain a move that emphasizes specific, unexpected outcomes or results of great importance. There is an optional move to mention the strengths and weaknesses of the research. The Conclusion section may contain the element of study limitations as well. The articles end with the last move of concluding the results and suggesting future implications.

3.2 *Structural Move Analysis of PSAs*

The analysis of texts in the second sub-corpus reveals that a typical popular science article embodies the following types of information:

Tab. 2: *Moves and their discourse function in the corpus of PSAs*

Move	Discourse function
M0*	Headline-Summarizing the Most Important Information
M1	Announcement of Recent Research Findings
M2	Presenting Background Information
M3	Reviewing Previous Related Research
M4	Presenting New Research
M5	Presenting Research Results in Detail
M6	Describing Data Collection and Procedures
M7	Indicating Main Outcomes and Explaining Them
M8	Stating Research Conclusions
M9	Indicating the Original Source Article

* This is labelled M0 as headlines are not usually considered part of the text in move analysis.

Two of the moves (M0, M1) occurred in all the 30 texts of the corpus. Move 8 occurred in all but one article, Move 2 in 25 texts, Move 5 and 6 in more than 20 popular articles. These moves are classified as required elements of PSAs. Move 3, 4, 7 and 9 occurred less frequently (<20) in the corpus. These can be classified as optional moves. The typical PSA consists of eight moves, as 16 articles comprise eight moves and the average number of moves is 7.8.

Based on the observations in a typical PSA the headline is followed by announcing the main finding of the research being popularized. This is usually a brief statement of one or two sentences. It is the initiation move in most PSAs and precedes the move of background information. The next move is M2 which functions to provide explanation and established knowledge to the topic. M3 – the review of related research – was found to occur only in 12 texts so it can be considered as an optional element of popular articles. The next move is presenting the purpose of the new research, in several cases alluding to the researchers and in some cases to the original medical paper. Move 4 is usually followed by Move 6, which is concerned with the discussion of data identification, collection and procedure of experimentation. This move partly corresponds with the information found in the first two moves of the methods of a research article. The details are omitted but the most important information is contained in this move and it is a highly frequent element of PSAs. It suggests that authors of these articles presume the methods as important information for lay audiences. Move 5 reports the research result in details. Move 7 was found to occur in 63% of the corpus and its place is not stable in the order of moves. It indicates and also explains the main outcomes. Move 8 is a major move in PSAs; it provides the conclusion of the research. The writers usually interpret the results and also add comments and views of the researchers of the study or other researchers as well. This move may also contain information about implications and future directions in that field. The last element is the indication of original source article, which also directs

the reader to the actual text by means of hyperlink. However it is not a typical move, it was found to occur in 19 texts. This relatively high frequency may be the result of search methods in the present study. Consequently, it is not possible to conclude that PSAs usually contain a hyperlink that enables the reader to find the original source article that was popularized.

In conclusion, the results show that a typical MRA contains 10 moves in the corpus, and a typical PSA is built up of 8 moves. Most of the rhetorical moves that are present in MRAs are found to occur in the corresponding popularizations. While, the first move of the MRA is concerned with providing background information, the PSA starts with the announcement of recent research findings and provide background information in the next move. The moves depicting data collection methods and procedures are present in both genres but the details are not important in popularization. The moves about discussing main findings and conclusion are found in both corpora and the stability of these moves is fixed.

4 Discussion

As it is widely known, medical research articles follow a distinct rhetorical structure. Text analysis of the constituting MRAs of the corpus revealed that the MRAs are governed by the IMRAD format, and the sections are subdivided into ten rhetorical moves. The order of moves appears to be relatively fixed in the corpus. Similar findings were reported previously by Nwogu (1997) and Fryer (2012). Fryer described ten rhetorical moves based on a corpus of 16 medical research articles. The results of this dissertation are consistent with the ICMJE recommendations for writing up medical research (ICMJE, 2013).

The results also indicate that PSAs have an identifiable pattern and a typical popular article contains eight moves. The writers of PSAs are likely to take over some of the rhetorical moves that are present in MRAs. However, significant structural differences exist between the two text types. The MRA starts with the *background information*, while the PSA typically opens with the *announcement of the main outcome*.

This deductive pattern is possibly used to capture the attention of the reader. The *review of previous research* and *identification of gaps in established knowledge* is a more stable move of MRAs than PSAs. The moves depicting *data collection methods and procedures of experimentations* are present in both genres, but it is more detailed in research papers. The information about *statistical methods* is only provided in MRAs. *Study limitations* are not typically present in popularizations, while it is present in most of the MRAs included in the present study.

The move of *conclusion* is a major element in both corpora and the location of this move within the typical move structure is fixed.

The findings in the present study deviate to some extent from the earlier studies of *Nwogu* (1991) and *Stejskalova* (2012) of science popularization. The most prominent difference is that the initiation move is *the announcement of new research* in 83% of the PSA corpus. Consequently, the articles start with highlighting the research outcome without providing any background information. This deductive pattern is identifiable in the whole discourse structure of texts. The order of moves is not as fixed as it is in MRAs; the corresponding popularizations are also more variable in their thematic pattern. However, there is also a tendency of these elements to occur in a set order. For example, the initial moves are typically Move 2 (*Announcement of Recent Research Findings*) and Move 1 (*Presenting Background Information*). Move 8 (*Stating Research Conclusions*) tends to occur as a final move. Between the initial moves and the conclusion, the moves of presenting new research and describing methods are commonly found.

The findings related to the two sub-corpora indicate that changes take place in the discourse structure when medical research is rewritten for lay audiences. The research article and the popular science article are considered as two different genres with different communicative purposes and different target audiences. The MRA is written for a professional audience and the information is presented in a fixed discourse structure. As Montgomery puts it, the Research Article is 'the master narrative of our time' (Montgomery 1996, in Hyland 2010). The corresponding popular articles are written for non-specialist readers. The way the information is presented is considerably changed in the popularization process. The focus is on the outcome of the research and on the relevance it may have for the readers. Popular texts centre upon the interpretation of the research results and the source of the information referring to the scientists, even by occasionally mentioning their names. Although the means of obtaining the results are not detailed, the most important elements of methods are summarized in the popular articles. This may serve the purpose of making the message more convincing.

Novelty is a key element of both genres but in different approaches. In scientific writing researchers need to share their novel findings with their peers, the authors follow a conventional structure and present facts precisely. Popular articles, on the other hand, report about newsworthy scientific findings or breakthroughs. The arrangement of information within the genre is closer to journalistic discourse, which typically opens up with the main outcome often presented as a sudden discovery.

5 Conclusion

The aim was to provide a detailed rhetorical analysis of MRAs and PSAs. As genres are dynamic in nature, it is necessary to examine the conventions of established genres over and over again. It is even more important to map and describe the specific features of new and emerging genres, such as online scientific reports. The findings

support the contemporary view of science popularization, which assumes that popularization is not about simplifying and distorting scientific information, but rather interpreting the discoveries of science for different audiences. Research comparing academic and popular science discourse is motivated by the needs of those experts or readers, who interpret or produce these genres. Besides the IMRAD structure for research articles, the rhetorical moves identified in the present study can be used as guidelines when producing both popular and scientific articles.

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