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Rhetorical Moves and Hedging in Medical Research Articles and their Online Popularizations

PhD Dissertation

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LIST OF ABBREVIATIONS

BMJ	- The British Medical Journal
CARS	- Creating a Research Space
EMP	- English for Medical Purposes
ESP	- English for Specific Purposes
FTA	- Face Threatening Act
ICMJE	- International Committee of Medical Journal Editors
IMRAD	- Introduction, Methods, Results and Discussion
JAMA	- The Journal of the American Medical Association
KWIC	- Key Word in Context
MRA	- Medical Research Article
NEJM	- The New England Journal of Medicine
PSA	- Popular Science Article

PREFACE

Since the 1990-s, as a result of the technological revolution, the World Wide Web has become a global platform of information flow. A basic knowledge of the Internet becomes increasingly fundamental for professionals, and it is also an important source of health-related information. Students, scholars and researchers extensively use Web sources in their works. The Internet is an important source of information about medical advances in the field of health, not only for researchers but also for lay people. 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. There is a need to translate academic writing to the lay public, as people are getting more and more interested in recent findings of health-related research. 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. This work aims to broaden our knowledge about the popularization of science. The focus of the study is to investigate and compare the rhetorical structure of research and popular articles by means of move analysis; while also examining how the linguistic phenomena of hedging - expressing uncertainty and tentativeness - are used in the two text types.

First, the study attempts to investigate the generic structure of scientific and popular science articles. This structural analysis is extended by investigating selected lexico-grammatical features of hedging in each rhetorical section. The role of hedging, which is a central feature of medical discourse, has not been extensively studied yet in online scientific discourse. The results of these analyses can be appropriate to assist non-native and even native professionals in the interpretation and in the production of both scientific and popular science articles.

The method of investigation is corpus-based. 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 computerized, quantitative analysis is supplemented with manual analysis and qualitative methods.

Chapter 1 provides the theoretical framework for the study. This chapter places the study in the frontier of health sciences, and describes the study of specialized language use, namely English for Medical Purposes (EMP). The most important issues of netlinguistics - as a new sphere of study within applied linguistics - are discussed. This chapter also presents some aspects of genre analysis and how this concept applies to the web. The chapter introduces move analysis and describes the discourse structure of scientific popularization and medical research papers. Previous research on politeness strategies and hedging in medical research papers and scientific popularizations is discussed. Finally, the principles of the corpus-based approach are summarized. The hypotheses of the present study are provided at the end of this chapter.

Chapter 2 contains the description of the materials and methods used in the study. This chapter presents the data-collection procedures and the research corpus. This chapter also describes the methods of investigations and statistical test techniques used in the study.

In Chapter 3 the main observations of the study are presented. In this chapter the generic structure of the texts, in terms of moves is demonstrated in both corpora. Next, both qualitative and quantitative information will be presented concerning the incidence and grammatical classes of hedging categorized according to rhetorical sections.

In Chapter 4 the main differences investigated in the two genres are summarized. The evaluation of the hypotheses is performed in the discussion section. The purpose of Chapter 4 is to discuss the main findings and the strengths and weaknesses of the study. Finally, the conclusions to be drawn from the study are provided and implications for further research are proposed. The Appendix contains the titles and the sources of the MRAs and PSAs found in the corpus.

1. INTRODUCTION

2.1. *English for Medical Purposes*

Over recent years researchers have been interested in texts written for specific purposes. This paper is concerned with specialized language use, more precisely English for Specific Purposes (ESP) texts. The specific purpose is professional, namely English for Medical Purposes (EMP). Kurtán collects various definitions of language for specific purposes in linguistics (Kurtán, 2003). The present analysis interprets the term Specialized Language based on the definition suggested by Warta:

- 'It is a special discourse used by a given discourse community sharing common purposes.
- It is a special discourse specific to that discourse community so the language code systems of different discourse communities usually show discrepancies.
- The specialized language is different from the so called general language regarding lexical, semantic, grammatical, stylistic, textual, sociolinguistic and pragmatic attributes. Special vocabulary is only part of the language and linguistic repertoire needed for achieving special communication purposes' (Warta, 2005: 28).

Medical language is traditionally regarded as the language used by specialists when communicating with each other (Keresztes, 2010). Two levels of written Medical English are examined in the present study; academic writing and writing about the field of medicine for lay people. Within text analysis the approach of genre analysis is usually applied for the study of ESP texts (Kurtán, 2003). In the framework of genre analysis a detailed investigation of specific features of language, such as hedging, is carried out.

1.2. *The Concept of Genre and Genres on the Web*

The notion of genre has been a matter of discussion in linguistics and it has changed considerably during the last 30 years. The concept of genre has been studied by different disciplines, such as sociology, psychology, cognitive psychology and linguistics. The linguistic approach goes back to Aristotle, who used categories to classify different types of communication with similar form, topic or purpose (in Rosso, 2005).

Systemic functional linguists used genre to complement the notion of register that comes from Halliday. In his description a register is *'a variety of language, corresponding to a variety of situation'* (Halliday, 1985:89). The concept appeared in Martin's genre model as an alternative for the term register (Martin, 1992). There are three major traditions of genre studies: (a) English for Specific Purposes (ESP), (b) North American/New Rhetorical Studies, and (c) Australian Systemic Functional Linguistics (Hyon, 1996, Hyland, 2002). Genre analysis within applied linguistics became significant with the analysis of ESP texts, Bhatia and Swales represent the ESP tradition. The model focusing on the research article by Swales had an enormous influence on the study of genres (Swales, 1981, 1990, 2004).

From the point of view of the present study the most extensive definition of genre is that of Swales:

> 'A genre comprises a class of communicative events, the members of which share some set of communicative purposes. These purposes are recognized by the expert members of the parent discourse community and thereby constitute the rationale for the genre. This rationale shapes the schematic structure of the discourse and influences and constrains choice of content and style' (Swales, 1990: 58).

In his model Swales suggests that genres are purposive, the communicative purpose is realized by a move structure that is realized by rhetorical strategies.

Bhatia (1993) developed the genre model further, suggesting a framework for the analysis of ESP texts (Bhatia, 1993, 2004).

The genre of Medical Research Articles has been extensively studied by linguists. Scientific articles have a standardized structure known as the IMRAD format. The obligatory subsections of the IMRAD structure are the Introduction, Methods, Results and Discussion. As mentioned earlier, one of the most significant models of MRAs was proposed by Swales (Swales, 1990). He focused on the Introduction section of the research paper and developed the so called CARS model (Creating a Research Space). In his analysis each rhetorical move is expressed by Steps, and this Move and Step model had a huge influence on studying ESP texts. The various approaches are interested in how the Moves and Steps are realized and expressed in the different genres or subgenres. In Move Analysis the texts are segmented into series of moves, which are functional units in a text (Swales, 1990).

1.2.1. Genres on the Web

The analysis of digital genres first appeared in the work of Yates and Orlikowski (Yates, Orlikowski, 1992). Linguists dealing with web genres build on the following definition of genre:

> '... a distinctive type of communicative action, characterized by a socially recognized communicative purpose and common aspects of form' (Orlikowski, Yates, 1992: 543).

As the use of web communication gained ground, the need for studying genres of the digital media emerged. Haas and Grams developed a system for the categorization of websites and links (Haas, Grams, 1998). Crowston and Williams constituted a genre repertoire of websites based on the definitions of the Oxford English Dictionary (Crowston, Williams, 2000).

Roussinov *et al*. completed this website typology with genres suggested by Internet users (Roussinov *et al*., 2001). Shepherd and Watters introduced the term cybergenre, and proposed taxonomy of these cybergenres. They described the evolution of the news genre in the Internet context (Shepherd, Watters, 1998). According to their classification novel cybergenres have no equivalent in the print world, while extant genres are reproduced or replicated genres coming from the traditional media (Shepherd, Watters, 1998). Santini refines the genre typologies on the web:

- reproduced/replicated genres,
- adapted/variant genres,
- emergent/novel genres,
- spontaneous genres,
- unclassified web pages (Santini, 2007).

Nowadays, the researches mostly study the genre of web pages to facilitate genre based navigation in the World Wide Web (Roussinov *et al.*, 2001 Crowston, Williams, 2000, Rosso, 2005, Santini, 2007).

The notion of genre is complex and needs to be extended. First, genres may form a hierarchy; for example a popular article on prenatal vitamins is a subcategory or subgenre of a more general popular science paper. Second, as Orlikowski and Yates suggested, genres form a genre system, in which genres are linked to or embedded in each other making a complex pattern (in Crowston, Williams, 2000). Orlikowski and Yates introduced the concept of genre repertoire; the set of common genres used by a community (in Crowston, Williams, 2000). Finally, according to Santini (2007) genres, especially web mediated genres are dynamic concepts, the genre attributes change rapidly and the new genres do not have a name before they become standardized. Moreover, in one website or web document more than one genre can be merged to make a hybrid form or multiple genres (Santini, 2007).

In the cybergenre model Shepherd and Watters introduce the term functionality, which refers to the capabilities offered by the new communication medium. According to the model cybergenres can be characterized by their content, form and functionality (Shepherd, Watters, 1998). In replicated genres the content and form is the same as in the source media and there is no added new functionality. In virtue of this model, the online articles of the corpus can be regarded as a variant genre of an existing genre. The form and content may be different to some extent from a standard printed article, and they exploit the capabilities of the communication medium. It means that all of the documents in the corpus contain images or videos or other multimedia elements. They also contain a number of hyperlinks that provide links to other documents or advertisements. Moreover, these functions, such the advertisements, menus, navigational buttons and links represent different communicative purposes (Santini, 2007). However, the study of web specific attributes is not within the scope of this paper, as the aim is to analyze and compare the generic structure and target lexical items in research papers and scientific popularizations. On the other hand, the above functions, such as hyperlinking, interactivity and multi-functionality could be further investigated in future studies as they may affect the textuality of the web documents.

1.3. *Applied Linguistics and the Internet Era*

The aim of this section is to introduce a relatively new field of research within applied linguistics. The Internet has had a significant impact on language use. The research area that deals with these novelties of language resulted in the emergence of netlinguistics. The term Internet Linguistics was first introduced by David Crystal (Crystal, 2001). Later, based on the work of Posteguillo the term netlinguistics became prevalent (Posteguillo, 2002).

The studies that aim at exploring linguistic characteristics of this special language use are becoming more and more common in Hungary as well. Judit Háhn in her dissertation also argues for accepting netlinguistics as a new discipline (Háhn, 2010).

David Crystal was the first to analyze the linguistic effects of the Internet in his book entitled *Language and the Internet* in 2001 (Crystal, 2001). According to his definition Internet Linguistics is concerned with the synchronic and diachronic analysis of language in all areas of computer mediated communication (Crystal, 2005). He even speaks about a linguistic revolution in connection with the new communication possibilities, and refers to the World Wide Web as a revolutionary development. The changes resulted in the emergence of a new communication medium, which is more dynamic and creative than traditional writing (Crystal, 2003). Posteguillo in his study outlines the scope of netlinguistics. It is a new field of study within applied linguistics, which analyzes digital communication in functional, stylistic, pragmatic and sociolinguistic analytical framework (Posteguillo, 2002). This new research direction is based on the theories of discourse and genre-analysis, functional grammar and sociolinguistics. Netlinguistics may overlap with other fields of study, such as sociolinguistics or computational linguistics.

Within the field of netlinguistics the following investigations are the most common:

- Analysis of the technological layer, which is relevant for IT experts.
- Analysis of new e-terms and terminology emerging as a result of digital communication.
- Analysis of Internet discourse: studying interpersonal relations of Internet users such as chat forums, e-mail and other interactive genres. The study of relations between the Internet and the users, such as the analysis of websites, data bases, search engines. First the investigations in connection with e-mail discourse appeared e.g.: research of Gimenez, Lan and Yonyang (Gimenez, 2000; Lan, 2000; Yongyang, 2000).

- Genre analysis: the study of the dynamic nature of genres is a central topic of netlinguistics. The cybergenre theory, which aims at classifying Internet genres, is a key concept of this area (Shepherd, Watters, 1998).
- Pragmatic questions based on Halliday's systemic-functional grammar: the study of new realizations of tenor and mode characterized by a tendency toward informal discourse. A new specific feature of digital mode is the hypertextuality.
- Sociolinguistic aspect, which includes the study of digital identity and discourse communities of Internet users. This area also deals with the role of English language as the lingua franca in the net (Posteguillo, 2002).

The present study is concerned with the discursive layer and genre theory of Internet communication. It also touches upon the sociolinguistic perspective when discussing the discourse community of the medical research articles and the popularized online articles of the corpus.

The scope of netlinguistics is becoming wider as the changes are rapid in this area. There are communication theories, language philosophy and sociolinguistic approaches emerging in connection with the studies of digital communication.

The era of the new information society is also called the post-Gutenberg galaxy. As Balázs points out, the world of the Web and digitalization has an effect on our way of thinking and the changes going on have a tremendous effect on communication and language use (Balázs, 2001).

The methodological and empirical researches are mostly focusing on new forms of communication and the nature of language use. The most prominent feature of the special language use of the Internet is that traditional written and spoken genres adopt new profiles and new genres emerge. According to Bódi these new genres can be classified as public and personal, as well as interactive and non-interactive genres (Bódi, 2004). Internet genres are the homepages, websites, correspondence, Internet chats, discussion forums and the e-mail (Bódi, 2004).

However, the above categories are constantly expanding and are supplemented by other genres. The appearance of weblogs or social networking services adds new perspectives to the study of information society, and the language use of this society.

First, linguists were concerned with researches exploring the language use of the e-mail communication. The study of homepages and websites from a linguistic point of view is a new area, which only started to develop during the last fifteen years. The analysis of websites came into focus with the spread of genre theories in netlinguistics. Roberts investigated the homepage from a linguistic perspective in 1998 (Roberts, 1998). Medina *et al*. set up a corpus of corporate websites and described some linguistic, semiotic and pragmatic properties. The corpus was analyzed from three main aspects: images, linguistic markers focusing on colloquialism, and hypertextuality (Medina *et al.*, 2005). There have been only a few studies about websites and homepages among Hungarian linguists. Háhn describes three promotional genres in her doctoral thesis (Háhn, 2010).

Studies concerning health-related websites are mostly concerned with the accessibility, readability and quality of information and are published in medical journals such as the JAMA, The Journal of American Medical Association. (http://jama.ama-assn.org)

Askehave and Nielsen defined and characterized the homepage as a new web genre. They emphasized the dynamic nature of the genre model, and the multimedia and hypertext elements of online texts. They offered a two-dimensional genre-model, in which the reading process is non-linear. The users of web documents constantly shift between reading and navigating modes:

- ‘In the reading mode, the text must be characterized in terms of its communicative purpose, moves, and rhetorical strategies.
- In the navigating mode, the medium must be characterized in terms of its communicative purpose, links, and rhetorical strategies’ (Askehave, Nielsen, 2004: 17-18).

To sum up, the genres of computer-mediated communication are complex, the genres overlap, and they are evolving from one another. The most prominent features of websites are the presence of multimedia elements, as images and sound become part of the text. Hypertextuality characterizes the documents, and the texts are connected with hyperlinks. The reading strategies are often non-linear and adapting to these characteristics the readers scan the texts for information. The readers often pick up some key words or structures rather than reading through the websites.

The main directions in the linguistic research of web pages are the following:

- analysis of thematic orientation, applicability studies,
- study of hypertext reading and non-linear structure of web documents,
- analysis of textuality and application of textuality standards,
- study of multimedia elements, hyperlinks and hypertextuality,
- genre analysis: description and categorization of cybergenres, analysis of linguistic and rhetorical specialties of the genre, move-step analysis, studies facilitating genre-based navigation,
- investigations in connection with reading, writing and translating web documents (Háhn, 2008).

The present study is concerned with the genre analysis of online articles, focusing on special linguistic features of science popularization and comparing these to the specialties of the academic paper. This study is limited to the analysis of texts only in the reading mode, as the main interest is to compare some aspects of language use of medical academic writing with the language use of popularization. However, it would be interesting to examine the two-dimensional model of health-related websites in future research.

1.4. *The Concepts of Discourse Community and Digital Community*

Genres are recognized and used by a particular discourse community. The term *discourse community* was introduced by Swales (1990). Posteguillo interprets Swale's definition of discourse community as follows:

> 'According to him, a speech community uses a spoken communication mode, it is determined by sociolinguistic characteristic, and it is centripetal (i.e. it tends to absorb people). On the contrary, a discourse community tends to use a written communication mode (in various forms), it is determined by functional and sociorhetorical characteristics (all members share a common purpose and use similar rhetorical devices to attain it) and it is centrifugal (i.e. its members struggle to be separated from those who do not belong to the community by means of a specific lexis and specific genres in order to obtain a discourse identity). Consequently, one may distinguish between the discourse communities of medical researcher, physicists, linguists, literary critics etc.' (Posteguillo, 2002: 31).

The term *discourse community* can be applied to research papers on medicine. However, the Web is a more complex setting for studying this concept. There are numerous communities using the World Wide Web for diverse purposes. The audience of the online popular articles is mostly unpredictable. Many communities may use the Web to publish information about the latest developments in science for different motives and the readers of these articles can be members of different discourse communities. It can be concluded that different speech and discourse communities overlap when examining Internet communication. Posteguillo suggests the term *netcommunity*.

> ‘A netcommunity, then, is a networked community of practice made up of Internet users who share the use of one - or a few - cybergenres for a certain set of common purposes. Net users in a netcommunity may belong to different speech communities of either native or non-native speakers of English’ (Posteguillo, 2002:32).

MRAs are written by experts; the authors belong to the discourse community of medical researchers. They have suitable qualifications and they share a set of common goals. They acquire and utilize the specific terminology and rhetorical devices of this genre. The communicative purpose of this discourse community is to publish the latest results of research and also to gain the acceptance of these results by peers. The readers of these articles belong to the same discourse community of medical researchers. This discourse community may involve a broader community of scientists.

It is doubtful whether we can talk about one discourse community in the context of online articles. The popularized versions of the medical articles may be written by specialists. In this case, they belong to the discourse community of medical researchers, and within this community they belong to a group, which writes popular articles on science for lay people. In most cases the popularizations are written by non-specialist science journalists, who belong to a different discourse community. The audience of these online articles is unpredictable. The readers may come from different speech and discourse communities, who use the Internet for health-related information.

1.5. *Science Popularization*

The aim of science popularization is to popularize scientific discourse for non-specialist readers (Myers, 2003:265). Popularization is a social activity that inter-relates science and society and it has resulted in the emergence of genres, such as science news in the printed media or online scientific articles. These articles use a fairly similar structure and linguistic choices (Myers, 2003).

The main purpose of scientific popularization is to inform laypeople of the recent results and advances of science. There had been a negative attitude toward the popularization of science earlier; however Whitley argues that the status of scientific popularization has improved considerably. According to him, it acts as a useful means of communication between scientists and the lay audience. As Hyland puts it:

> 'Popular science does not just report scientific facts to a less specialist audience but represents phenomena in different ways to achieve different purposes' (Hyland, 2010:119).

Moreover, as science becomes more and more specialized, even the scientists themselves can benefit significantly from popularized articles (Whitely, 1985). It appears that popularization has an effect on the scientific audience as well, as it enhances the information flow of the scientific literature. This information enhancement is even more justified in the new era of the World Wide Web. According to a study published in the *New England Medical Journal*, researchers were more likely to cite papers that appeared in the popular media, such as the *Times* (Philips *et al*., 1991).

Popularization has various levels and forms. It can appear in different communication media. The levels of science popularization can be categorized based on the background knowledge of the audience. The highest level is for experts, such as the articles in journals like the *Scientific American.* The audience and also the authors of these articles are usually professionals. There are texts for pedagogic purposes, such as course books, manuals, and encyclopaedic texts etc., mostly written by specialists of that particular field. Most often articles are popularized for the lay audience.

These texts can have various forms and can be written by professionals or non-specialists as well. Depending on the communicative medium, popularizations can appear on television, in the radio, or in the printed media such as textbooks, journals, magazines etc. (Varttala, 2001). Nowadays, these popularized articles are mostly transmitted via the Internet. The special communicative context of the Internet has an effect on the form and the language use of these texts.

Linguistic studies mostly concentrated on the language use of specialist-to-specialist discourse. There have been fewer studies that focus on popular articles in the field of medicine (Dubois, 1986, Varantola, 1987, Varttala 1999, Hyland 2010). Hyland (2010) examined a corpus of research papers and popular science articles. He investigated several aspects which distinguish the two genres, for example the differences in structure. He suggests that popular articles typically start with the background information and the main findings of research, whereas the main outcome is preceded by background information and methodological steps and procedures in medical research articles (Hyland, 2010).

1.6. *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. Swales (1981) proposed a four-move schema for the introductions of articles. Nwogu expanded this theory to the whole texts of science popular articles. He defined 'move' as follows:

> 'By the term 'move' is meant a text segment made up of a bundle of linguistic features (lexical meanings, propositional meanings, illocutionary forces, etc.) which gave the segment a uniform orientation and signal the content of discourse in it ' (Nwogu, 1991:114).

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)

1.7. *Discourse Structure of Medical Research Articles*

Most research articles use the standard IMRAD format, however only a few studies focus on the detailed investigation of the schematic structure of MRAs. Nwogu (1997) using Swales' (1990) 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 this genre. Table 1 shows moves and their discourse function suggested by Nwogu (1997).

Move	Discourse function	Section
M1	Presenting Background Information	Introduction
M2	Reviewing Related Research	Introduction
M3	Presenting New Research	Introduction
M4	Describing Data Collection Procedure	Methods
M5	Describing Experimental Procedure	Methods
M6	Describing Data-Analysis Procedure	Methods
M7	Indicating Consistent Observations	Results
M8	Indicating Non-Consistent Observations	Results
M9	Highlighting Overall Research Outcome	Discussion
M10	Explaining Specific Research Outcomes	Discussion
M11	Stating Research Conclusions	Discussion

Table 1. Moves and their discourse function in the corpus of Nwogu (Nwogu, 1997, 125)

The structural moves analysis approach was adopted by Fryer (2007, 2012). Fryer provided a methodology, in which he combined a detailed rhetorical and lexico-grammatical analysis of medical research articles. He identified ten rhetorical moves. 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)

1.8. *Politeness Strategies and Hedging in Academic and Popular Scientific Discourse*

1.8.1. Politeness Strategies

According to Brown and Levinson (1987) politeness is a systematic feature in linguistic interaction. In their model based on Goffman's concept of *Face* (1967) they distinguish between *Negative Face* and *Positive Face*. *Negative Face* is the person's need to be unimpeded; *Positive Face* is the want to be approved of and accepted by others (Goffman, 1967). Based on this we can differentiate between positive and negative politeness strategies carried out to maintain either integrity or self-image. The theory suggests that linguistic interaction may threaten the person's *Face*. These face-threatening acts or FTAs ought to be mitigated or redressed with politeness strategies (Brown, Levinson, 1987).

The researchers in academic papers usually make claims and deny claims of other researchers so they need devices to make their utterances more polite. Positive politeness strategies emphasise solidarity and the common goal of the writer and the reader. The use of first person pronouns *'I'* and '*we'* are used to express solidarity. The use of adjectives or adverbs that express surprise (e.g.: *unexpectedly*) or dilute claims in the scientific community (e.g.*: happily*) and joking in scientific writing are also considered to be positive politeness devices (Myers, 1989).

Negative politeness devices are efforts of social distancing, restraint and formality. In scientific writing hedging, impersonal constructions, pessimism and modesty are interpreted as negative politeness techniques (Myers, 1989).

> 'Hedging is a politeness strategy when it marks a claim, or any other statement, as being provisional, pending acceptance in the literature, acceptance by the community - in other words, acceptance by the readers' (Myers, 1989:12).

1.8.2. The Concept of Hedging

There are two main directions within genre analysis, one of them deals with the concept of discourse community, and the other is concerned with the analysis of specific features of language, such as hedging used in a particular genre (Dudley-Evans, 2000). According to Lakoff hedges are 'words whose meaning implicitly involves fuzziness – words whose job is to make things fuzzier or less fuzzy' (in Varttala, 2001:5). This definition is used as a starting point in investigating hedging as a linguistic phenomenon. The concept of hedging was developed further by other linguists, such as Brown and Levinson (1987), Dubois (1987), Myers (1989), Swales (1990) and Salager-Meyer (1994).

Hedging is usually associated with linguistic politeness. Brown and Levinson in their model considered hedges as devices that minimize the threat to face (1987). Hedging devices are primarily used in negative face work, as hedge utterances leave room for the opinion of the audience. By the use of hedging the sender protects his negative face against critical comments. Being tentative is a means of self-protection against the criticism of the audience. Myers studied politeness in written academic discourse. He discusses hedges as positive or negative politeness strategies (Myers, 1989). Hedging may also be used to have a positive politeness dimension. The interpretation of hedging can be ambiguous in certain communication situations. According to Swales hedges are rhetorical devices to protect one's reputation as a scientist (Swales, 1990). Salager-Meyer considers hedges 'as a resource to express scientific uncertainty, scepticism and doubt' (Salager-Meyer, 1994, 151). To sum up, hedging can be regarded as a politeness phenomenon and may have a number of purposes.

The following categories of hedges are postulated by Salager-Meyer:

1. 'shields: i.e. modal verbs expressing possibility, semi-auxiliaries like *to appear, to seem*; adverbs of probability like *probably, likely*, and adjectives derived from them; epistemic verbs, i.e. verbs referring to the probability of the truth of a proposition or hypothesis such as *to suggest.*

2. approximators: i.e. adaptors or rounders of quantity, degree, frequency and time like *approximately, roughly, occasionally, quite, often* etc.

3. author's personal remarks which express the author's personal doubt and direct involvement, e.g.: *I believe, to our knowledge* etc.

4. emotionally charged intensifiers e.g. : *extremely difficult, surprisingly, unexpectedly* etc.

5. compound hedges i.e. several hedges juxtaposed e.g.: *it may suggest that..., it would seem likely that* ...etc. ' (Salager-Meyer, 1994).

In the earlier work of Prince *et al.* (1982) shields are divided into two subcategories. Plausibility shields express uncertainty on part of the speaker, whereas attribution shields attribute uncertainty toward the proposition to someone else than the speaker e.g. according to him etc. (Prince *et al.,* 1982).

Considering the linguistic realization of hedges the main categories are auxiliaries, semi-auxiliaries, full verbs, various adjectives and adverbs, indefinite nouns and pronouns, passive voice and use of questions and tense (Varttala, 2001, Hyland, 1994). Hedging has typically been linked to modality, mostly to epistemic type of modality. Epistemic modality can be expressed in a number of ways. Lyons (1977) defined epistemic modality as 'any utterance in which the speaker explicitly qualifies his commitment to the truth of the proposition expressed by the sentence he utters, whether this qualification is made explicit in the verbal component ... or in the prosodic or paralinguistic component' (Lyons,1977, 797).

According to earlier studies, hedges expressing tentativeness and possibility are central elements of scientific communication, especially of MRAs (Myers, 1989, Hyland, 1998, Rébék-Nagy, 1999). Salager-Meyer investigated the number of hedges in the different subgenres and sections of the research article (Salager-Meyer, 1994).

By using hedges the authors indicate their attitude toward their utterances. Hedging is used to express that the information presented may not be certain or precise. Researchers primarily use hedging to express caution in all sections of the research article. For example, they present their own contribution or research modestly; they indicate the possible limitations, inaccuracies and weaknesses of the research or draw conclusions and generalizations by expressing caution. Based on the politeness theory hedging in academic writing is mostly considered to act as a *shield* to defend the authors against the criticism of the readers. Such hedging can be viewed as a *negative politeness* feature as leaving room for the opinions of the audience and at the same time fending off criticisms. The link between negative politeness and hedging was established by Myers (Myers, 1989). Hedging as an interpersonal negative politeness phenomenon has been widely investigated in medical discourse. Hedges are thought to be a feature of written communication in specialist-to-specialist writing and it is a typical strategy in research articles.

There are a number of studies investigating the use of hedging between disciplines as well (Fahnestock, 1986, Myers, 1989). However, there are conflicting ideas about hedging in popularizations (Varantola, 1987). The dominant view claims that the tentative tone of the scientific papers is changed, and only definite assertions are used in popular articles (Smith, 1987, Myers, 1989). As a result, hedging is not required and it is rarely, or not used in popularized texts. Myers (1989) and others have suggested that mitigation devices, such as hedging are not necessary in popular science articles as the author and the audience do not have the same technical knowledge. This implies that there is no need to protect the face of the author. On the other hand, according to Crystal the notion of hedging is common in popularizations as well (Crystal, 1988). Varantola argues that hedging is also typical of scientific popularizations (Varantola, 1987). In popular articles the results are not presented as precisely as in research articles. Consequently, approximative devices or lexical items indicating indefinite degree or frequency, are used commonly (Varantola, 2001).

Varttala suggests that hedging may be interpreted as a positive politeness device in scientific popularization. He argues that the authors of the articles in his corpus do not wish to violate the readers' positive face. A number of hedging devices imply common ground between sender (specialist) and addressee (non-specialist); thus expressing positive politeness (Varttala, 2001).

1.9. *Principles of Corpus Linguistic Analysis*

For textual research it is essential to have a corpus of materials for testing hypotheses about the language use. Corpus linguistics enables the expert to carry out linguistic investigations. According to the definition of Biber a 'corpus is a large, principled collection of naturally occurring texts …'(Biber, 1998:12). It implies that the corpus is always planned and it is made for linguistic research. Sinclair claims that a corpus is used for the study of language (Sinclair, 2005). His definition of a corpus:

> 'A corpus is a collection of pieces of language text in electronic form, selected according to external criteria to represent, as far as possible, a language or language variety as a source of data for linguistic research' (Sinclair, 2005:16).

A specialized corpus usually contains texts, which are representatives a particular text type, and the corpus is created to answer one or more research questions. The authentic texts are collected based on a principle and are stored electronically.

A corpus-based approach usually utilizes a concordancing programme for quantitative analysis. KWIC (Key Word in Context) concordances allow systemic investigations of collocations. Sinclair defined collocations as 'the occurrence of two or more words within a short space of each other in a text' (Sinclair, 1991, 170). There are other possibilities provided by text analyzer softwares. The *Word List* tool lists all the words or word-clusters in a text, set out in alphabetical or frequency order. It also provides a statistical overview of the texts. With *Key Words* tool you can find the key words in a text.

The principles of the corpus approach are the following:

- It is empirical, analyzing the actual patterns of language use in natural texts.
- It utilizes a large and principled collection of natural texts as the basis for analysis.
- It makes extensive use of computers for analysis.
- It depends on both quantitative and qualitative analytical techniques (Biber et al. 1998,4).

1.10. *Hypotheses*

This dissertation aims to address the following research questions:

- Hypothesis 1 - A typical discourse structure of PSAs cannot be described by means of move-analysis.
- Hypothesis 2 -The rhetorical structure of the PSA differs from that of the underlying MRA.
- Hypothesis 3 - Hedging is not applied in online popular science articles.

2. MATERIALS AND METHODS

2.1. *Data Collection and the Research Corpus*

The principles of the present corpus were:

- to create two sub-corpora to answer the hypotheses,
- the two sub-corpora are made up of written ESP texts in the field of medicine,
- one sub-corpus contains Medical Research Articles, the other sub-corpus consists of corresponding online scientific popularizations,
- the discourse structure and selected lexico-grammatical items are in the focus of investigation,
- the size of the present corpus was determined by earlier studies on ESP texts.

The basis of the present study is a corpus of medical research articles and corresponding online popular science articles. The present study includes two sub-corpora: medical research articles from prestigious medical journals and online popularized versions of the research articles. They all provide information about recent scientific findings on maternal vitamins and prenatal nutrition. The topic of prenatal care was chosen as I assumed it to be a newsworthy subject. It is presumably relevant for the online reader who is interested in health issues. Findings related to medication and vitamins are often presented in prestigious journals and are also often rewritten for the lay public. The popular open access articles were found in the health or science sections of online magazines, such as *The New York Times* and *Reuters*.

The articles were selected randomly with the help of different internet search engines. As a first step, online articles were searched that are concerned with prenatal vitamins. The simple search methods did not yield the amount of articles expected, so advanced search techniques and other tools for managing health information were used including *WebMD*, *OmniMedicalSearch*, *Pubmed* and *HealthMash*. In order to produce an up-to-date and representative corpus the criteria of selecting were:

- to cover a wide variety of topics within prenatal care,
- all online popular articles have a corresponding medical research article,
- the medical research articles are published in prestigious journals and present recent findings about the subject.

The online popular articles were downloaded from the Web, and they were saved in an electronic format. The original texts were used in order to ensure authenticity. However, it is important that electronic discourse contains both textual and multimedia elements. This means that the texts on the Web are connected to other texts by hyperlinks and the use of images and multimedia elements is also a typical feature of web documents. The present research is concerned exclusively with the texts of the websites without analyzing the added functionality provided by the special communication medium. The study of web specific characteristics is outside the scope of this research; however it might be interesting for future studies. As dynamic nature is also a characteristic feature of websites, it was important both to save the texts and to record the exact date of downloading. Collecting the corresponding MRAs was a time-consuming process. Some of the articles were available online via the Internet, however most of the texts were ordered from other libraries. The titles and the sources of the research articles and the popular articles of the corpus can be seen in the Appendix.

A wide variety of issues is covered by the articles; such as the connection between vitamins and premature birth or other birth complications; c-sections; preeclampsia; foetal development; cleft palate; lung function of the child; asthma; language problems; autism; heart defects; childhood obesity; diabetes risk; neuro-cognitive development and multiple sclerosis. The corpus can be considered representative in terms of content as it contains a variety of medical problems in connection with prenatal care. Most of the MRAs present findings of the latest research about prenatal care as they were written between 2004 and 2013. Concerning the sources of online popular articles 20 different websites were used in the process of random selection. *Science Daily* is the most common in the corpus as it occurred 6 times as a source of popular articles. *Natural News* occurred 3 times, *WebMD*, *The New York Times* and *Reuters* are quoted two times in the collection of 30 articles. Although these websites may be read by a variety of readers, these magazines are aimed at a wider audience than medical research papers.

2.2. *The Size of the Corpus*

The size of the corpus was determined by several factors, such as the scope and the purpose of the research. The scope of the research is to compare two particular genres; the medical research article and the online popular science article. The corpus is an English for Medical Purposes (EMP) corpus, which factor also influences the size of the corpus (Williams, 2002). Sinclair also notes that a smaller corpus is needed for typical studies than for studies applied in the case of general corpora (Sinclair, 2005). Moreover, the search methods resulted in the same articles after a certain number of texts were collected. The online popular articles were depicting the same issues already present in the corpus and were based on the same medical research papers. However, it is possible to enlarge the corpus later in case new findings appear in the media about the subject.

As mentioned earlier in this chapter, a wide range of topics, authors, sources and types of research are included in the corpus. The present corpus can be regarded as a representative sample of specific medical English and the popularization of medical research. As the focus of my research is to compare certain linguistic aspects of scientific and popular writing, the size of the corpus had to be kept within a manageable range in order to be able to perform both qualitative and quantitative analysis. The characteristic features of the two sub-corpora are summarized in Table 2 and Table 3. The tables include the file size in bytes, the number of running words in the texts (tokens), the number of different words (types), the type/token ratio and the number of sentences.

Text	File size (byte)	Tokens	Types	Type/Token ratio (%)	Nr. of sentences
overall	**827057**	**119783**	**7289**	**33.52**	**4797**
mean	**27575**	**3993.5**	**885**	**34**	**161**
mode	**29995**	**_***	**780**	**33.28**	**205**
median	**26299**	**3834**	**841**	**33.42**	**152**
min	**18004**	**2608**	**636**	**25.9**	**105**
max	**49206**	**7253**	**1368**	**39.28**	**281**
1.	26442	3864	845	33.28	205
2.	29916	4056	1018	39.28	133
3.	25770	3783	810	32.45	135
4.	49206	7253	1368	33.25	281
5.	28163	4063	1016	36.08	170
6.	26778	4178	904	33.90	211
7.	24752	3651	898	33.03	149
8.	21490	3238	780	33.07	111
9.	26155	3728	752	30.52	154
10.	24686	3401	754	31.90	138

Text	File size (byte)	Tokens	Types	Type/Token ratio (%)	Nr. of sentences
11.	26780	3680	925	36.10	155
12.	20021	2871	836	37.37	125
13.	32044	4614	988	35.65	197
14.	22469	3165	792	34.97	116
15.	29995	4592	685	25.98	153
16.	29995	4571	681	25.90	152
17.	20163	2817	636	30.40	105
18.	21380	3152	780	33.10	131
19.	35631	4988	989	32.52	186
20.	18004	2608	772	36.65	115
21.	33662	4620	922	31.84	205
22.	25965	3841	982	35.28	178
23.	38873	5491	1177	36.70	243
24.	24227	3332	739	33.57	133
25.	25256	3637	1002	37.83	169
26.	31593	4736	1113	37.92	125
27.	25027	3826	783	31.60	144
28.	23218	3171	789	34.80	110
29.	32687	4858	988	33.56	239
30.	26912	4019	822	33.28	151

Table 2. The characteristics of the corpus of MRAs

*The mode is the number that is repeated most often, but all the numbers in this column appear only once, so there is no mode.

Text	File size (byte)	Tokens	Types	Type/Token ratio (%)	Nr. of sentences
overall	**100425**	**15570**	**2558**	**39.75**	**739**
mean	**3348**	**520**	**239**	**47.13**	**25**
mode	**_***	**402**	**338**	**_***	**16**
median	**3044**	**472**	**217**	**46.36**	**23.5**
min	**1603**	**261**	**140**	**37.23**	**10**
max	**5533**	**851**	**358**	**59.06**	**49**
1.	2587	402	196	48.76	17
2.	5533	851	358	42.07	49
3.	3803	547	217	39.67	24
4.	2599	402	197	49.00	16
5.	2908	453	210	46.36	19
6.	2141	330	140	42.42	14
7.	2085	307	166	54.07	14
8.	2904	452	204	45.13	26
9.	2200	354	203	57.34	18
10.	3948	614	265	43.16	35
11.	4246	629	286	45.47	27
12.	3005	474	233	49.16	22
13.	2665	422	216	51.18	20
14.	3083	486	214	44.03	23
15.	2298	363	188	51.79	19
16.	4381	683	319	46.71	33
17.	4570	764	322	42.15	28
18.	5464	850	335	39.53	34
19.	2034	325	183	56.31	13

Text	File size (byte)	Tokens	Types	Type/Token ratio (%)	Nr. of sentences
20.	1603	261	150	59.06	10
21.	4868	754	338	44.83	48
22.	3788	617	308	49.92	24
23.	4953	750	338	45.07	39
24.	2780	383	177	46.21	16
25.	2634	390	205	52.56	16
26.	3281	470	241	51.28	25
27.	1860	300	144	48.00	13
28.	4396	674	256	37.98	34
29.	3853	622	303	49.51	28
30.	3955	658	245	37.23	35

Table 3. The characteristics of the corpus of PSAs

*The mode is the number that is repeated most often, but all the numbers in this column appear only once, so there is no mode.

It can be seen in Table 2 that the total number of sentences is 4794 in the corpus of medical research articles. The length of the individual texts in the corpus ranges between 110-281 sentences with an average of 161 sentences. The size of the first sub-corpus is 827057 bytes, containing 119783 tokens and 7289 types. The abstract, information about the authors, tables and figures, acknowledgement and references were not included in the analysis due to the purposes of the present study. The corpus of MRAs containing only the Introduction, Methods, Results, Discussion and Conclusion sections comprises a total of 107266 running words. As comparison, the total number of running words is 15570 in the corpus of the corresponding popular science articles. The length of texts falls between 10-49 sentences. The average length of the popular articles is 25 sentences in the corpus. The size of the second sub-corpus is 100425 bytes, 739 sentences, 15570 tokens and 2558 types.

2.3. *The Method of Investigation*

The method of investigation involves studying the discourse structure and lexico-grammatical features of texts belonging to the genre of medical research article and the popular science article. The purpose is to adopt a novel approach to genre analysis, in which a detailed rhetorical move and lexico-grammatical analysis of the corpus is provided.

First, the study attempts to characterize the discourse structure of the two genres. The investigation is based on Swales's (1990) approach to the analysis of genres and Nwogu's (1991, 1997) move analysis model of medical research papers and popularized medical texts. The texts in the two sub-corpora were analyzed 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.

The next step of the investigation is a linguistic analysis of moves, focusing on the use of hedging, which is a typical element of medical discourse. The study focuses on the incidence of selected lexical hedging devices in the two genres. The present study is limited to the selection of lexical items, non-lexical hedging phenomena, such as the use of voice and tense is not examined here. Typical lexical items commonly regarded as hedges were selected, however, other expressions that relate to tentativeness and uncertainty were identified. For the purposes of comparison hedging devices were categorized into the following distinct grammatical classes: modal verbs, semi-auxiliaries, lexical verbs, adverbs, adjectives and nouns. Prototypical forms of hedging were investigated and classified in each move.

The distribution of hedges in the different discourse units was provided. Finally, a comparison of hedging phenomena in the popular and research articles was carried out.

2.4. *Data-Analysis*

First, the texts were coded into rhetorical moves and the software *WordSmith Tools Version 6.0* (Scott, M., 2012, WordSmith Tools version 6, Liverpool: Lexical Analysis Software) was used to identify and classify the various hedge words in the different moves of the two sub corpora. The lexical items were analyzed in context with the help of the concordances. It was followed by statistical tests to compare the total number of hedging devices in the two genres and also to compare the grammatical classes of hedging devices. Significance testing for correlations, sign test, two independent samples test for proportions and test for homogeneity of proportions were used with the help of *Excel, IBM SPSS Statistics 19* and *Stata 11.1*.

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. These three texts are concerned with nutrition in the prenatal or breastfeeding period. The analysis of MRAs identified 11 moves that make up the texts in the corpus. The moves and their discourse function identified within the analysis are summarized in Table 4.

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

Table 4. Moves and their discourse function in the corpus of MRAs

Based on the analysis of 30 texts the most typical is a schema of 10 moves. The articles consisted of an average of 9.6 moves, and 15 articles out of 30 are composed of 10 moves. Based on the frequencies the most typical order is the following:

- M1: Providing general and/or specific background information to the subject matter of the research
- M2: Identifying lack of data or gaps in existing research which justifies the study
- M3: Describing the main objective(s) and hypothesis of the study
- M4: Describing the size of the materials, selection criteria and data-collection in details

- M5: Describing the measurements, procedures and categorizations performed
- M6: Describing statistical tests and software used in the study
- M7: Reporting the main results of the analysis
- M8: Explaining the results in relation to the literature and to the objective of the study
- M10: Discussing the significance and limitations of the study
- M11: Providing a conclusion and indicating implications for future research

The move explaining specific research outcomes (M9) occurred only 8 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 10 moves occurred with varying degrees of frequency in the texts examined.

The frequencies and order stabilities of moves are shown in Table 5.

Move	Frequency of move (%)	Order stability of move (%)
M1	100	97
M2	90	67
M3	97	67
M4	90	86
M5	93	93
M6	90	89
M7	93	89
M8	100	86
M10	77	63
M11	100	65

Table 5. Frequency and order stability of moves in the 30 articles

Frequency of move is the number of move occurrences per number of articles x100.

As can be seen, three of the moves occurred in all texts: M1-Presenting Background Information, M8-Discussing Main Findings, and M11-Stating Research Conclusion. These are considered as obligatory moves. All the other moves occurred with high frequency from 77-97%.

These can be classified as required moves. Move 10-Discussing study limitations is the least frequent, however it occurred in 77% of the articles. The order stabilities ranged from 63-97%.

As mentioned earlier, 3 articles were not clearly characterized by the IMRAD structure so it was reasonable to analyze the structural pattern of the corpus of 27 MRAs. The frequencies and order stability of moves in the adjusted corpus can be seen in Table 6.

Move	Frequency of move (%)	Order stability of move (%)
M1	100	96
M2	96	74
M3	100	74
M4	100	93
M5	100	93
M6	100	93
M7	100	93
M8	100	89
M10	85	63
M11	100	65

Table 6. Frequency and order stability of moves in the 27 articles

As shown in Table 6 the frequencies are more stable in the adjusted corpus. There are 8 moves with 100% frequency, which means that these moves occurred in all 27 articles. It suggests that these are obligatory moves in medical research articles. Only one article did not contain the second move-that is identifying gaps in existing research. Move 2 can also be considered as an obligatory element. Four articles did not involve the study limitations. Move 10 is classified as an optional move. Move 9 was considered as a non-typical move.

The order stability of the 10 moves ranges from 63-96 %, which suggests that the order of moves is relatively fixed in MRAs.

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 end 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. There was no significant correlation found between the number of moves and the number of sentences in the texts of the study corpus.

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:

- A headline statement which functions to capture the attention of the reader and to convey the significance of the research.
- A brief statement which provides some background to the subject matter of the research. This information is not contained in all texts.
- An announcement of the positive results of the research either with or without reference to source of data.
- An indication of previous research in the subject matter. This information is contained in few texts.
- An introduction of the new research indicating the researchers who conducted the study, the purpose of the research, and in several cases alluding to the source scientific article.
- An indication of some of the data collection methods and procedures used in the study.
- An indication of the main outcomes of the research and their significance.
- A discussion of main conclusions of the research and its relation to other research, and indication of implications and comments and views.
- An indication of the original scientific article usually by means of a hyperlink.

The moves and their discourse function identified in the corpus of popular articles are summarized in Table 7.

Move	Discourse function
M0*	Headline-Summarizing the Most Important Information
M1	Presenting Background Information
M2	Announcement of Recent Research Findings
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

Table 7. Moves and their discourse function in the corpus of PSAs

* It is signalled as M0 as headlines are not usually considered part of the text in Move Analysis.

The first element functions to attract the interest of the reader. The headline is read and interpreted first and it helps the audience decide to read the whole article or not. The second move answers the question what the audience knows about the subject matter in advance. The third move is concerned with the most relevant information of the research for the expected audience. The fourth move assists the readers to capture the information in its scientific context. The fifth move summarizes the results of the study and makes it more concrete. The sixth move provides information about data collection and procedures performed in the research. It corresponds to the Method section or move 4 and 5 of the research article. It promotes the credibility of results and helps lay audiences to understand the experiments. M7 is concerned with the explanation of the main results. M8 indicates and summarizes the significance of the main observations and draws conclusions adding comments and views. The last move is a reference to the original article, which enables the reader to get more information about the original study.

The nine moves occurred with varying degrees of frequency in the corpus. Table 8 shows the distribution of moves per popular article.

Text	Move 0	Move 1	Move 2	Move 3	Move 4	Move 5	Move 6	Move 7	Move 8	Move 9	Total
1	+	+	+	+	-	-	+	+	+	+	8
2	+	+	+	-	-	+	+	+	+	-	7
3	+	+	+	-	+	-	+	+	+	+	8
4	+	+	+	+	+	-	+	+	+	+	9
5	+	+	+	-	+	-	+	+	+	+	8
6	+	+	+	-	+	+	+	-	+	+	8
7	+	+	+	+	-	+	-	+	+	-	7
8	+	-	+	-	-	+	+	+	+	+	7
9	+	+	+	-	+	+	+	+	+	+	9
10	+	+	+	+	-	+	+	-	+	+	8
11	+	+	+	-	-	+	+	+	+	+	8
12	+	+	+	+	-	+	+	-	+	+	8
13	+	+	+	-	+	-	+	+	+	+	8
14	+	+	+	-	-	+	+	-	+	+	7
15	+	+	+	-	+	+	-	-	+	-	6
16	+	+	+	-	+	+	-	-	-	+	6
17	+	-	+	+	-	-	-	-	+	-	4
18	+	-	+	+	+	+	+	+	+	+	9
19	+	-	+	+	+	-	+	+	+	-	7
20	+	+	+	-	+	-	+	+	+	-	7
21	+	+	+	+	+	+	+	+	+	+	10
22	+	+	+	-	-	+	+	+	+	-	7
23	+	+	+	-	-	+	+	-	+	-	6
24	+	+	+	-	+	+	+	-	+	-	7
25	+	+	+	-	-	+	+	+	+	-	7
26	+	+	+	+	+	-	-	+	+	+	8
27	+	-	+	-	-	+	-	-	+	+	5
28	+	+	+	-	-	+	+	+	+	+	8
29	+	+	+	+	-	+	+	-	+	+	8
30	+	+	+	+	-	+	+	+	+	-	8
Total	30	25	30	12	14	21	24	19	29	19	

Table 8. The distribution of moves per PSA

As can be seen in Table 8, two of the moves (M0, M2) occurred in all the 30 texts of the corpus. Move 8 occurred in all but one article, move 1 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 8 moves, as 16 articles comprise 8 moves and the average number of moves is 7.8. The frequencies and order stabilities of moves are shown in Table 9.

Move	Frequency of move (%)	Order stability of move (%)
M0	100	100
M2	100	83
M1	80	50
M4	47	33
M6	80	48
M5	70	34
M7	63	26
M8	97	59

Table 9. Frequency and order stability of moves in the 30 PSAs

The first column presents the most typical order of moves based on frequencies in the corpus. The second column shows the occurrence of the move in percentage in the corpus of 30 PSAs. The order stabilities of the moves are reported in the third column.

Five moves occurred with high frequency (80-100%), two moves were essential elements (M5-70%, M7 -63%), and M4 appeared with a frequency of 47%. As shown in Table 9 the order stabilities of the 8 moves ranged from 26-100 %. It suggests that - as opposed to MRAs - the information is not presented in a fixed order in PSAs.

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 M1 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. Move 9 was not a normally required element in the present study either. There was no significant correlation found between the number of moves and the number of sentences in the texts of the second study corpus.

3.3. *Summary of Structural Move Analyses*

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. If the articles are arranged in pairs, the MRA significantly contains more moves than the corresponding popularization (sign test, $z = -3.83$, $p = 0.0001$).

The scientific research articles are more homogeneous in terms of rhetorical structure than popularizations, which is best shown in the frequencies and order stabilities of moves in the two texts.

Most of the rhetorical moves that are present in MRAs are found to occur in the corresponding popularizations. However, significant structural differences exist between the two genres. 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.

3.4. *Hedging in the Corpus of Medical Research Articles*

3.4.1. Hedging categories in the corpus of MRAs

The aim of the author is to extend the structural analysis of the study corpus with the analysis of selected lexico-grammatical features. As a next step, the articles were examined in terms of interpersonal meaning, more specifically in relation to the use of hedging. Hedging is a fundamental characteristic of science as writers of academic texts inevitably indicate their attitude in their articles. Hedging phenomena is expected to occur quite frequently in the corpus of MRAs. The different moves of MRAs are summarized in terms of selected lexico-grammatical features used as hedges.

The grammatical classes of hedges will be illustrated and the observations will be supplemented by selected examples from the study corpus. A quantitative summary of lexical items is supplemented by a qualitative analysis of hedging phenomena.

Figure 1 shows the number of hedging devices in the different moves of the MRAs.

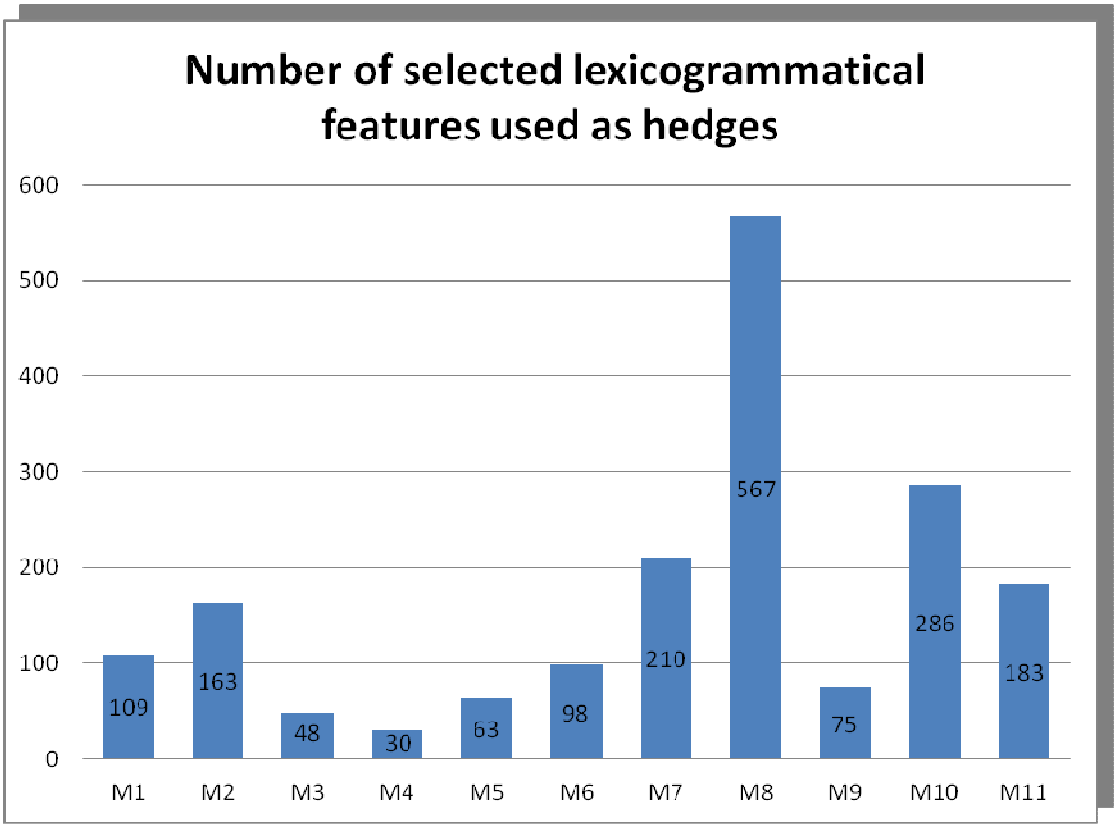

Figure 1. The number of selected lexical hedges in the different moves of the corpus of MRAs

M=Move

As Figure 1 indicates M8 (Discussing Main Findings) is the most heavily hedged move in the corpus. M10 (Discussing Study Limitations) and M7 (Reporting Observations) also used hedging devices frequently. However, the number of hedges in these moves is about half of the devices found in M8. The results also show that the moves M2 (Identifying gaps in existing research) and M11 (Stating Research Conclusions) and M1 (Presenting Background Information) exhibit a number of hedges.

By contrast, the moves M3 (Stating Research Purpose), M4 (Describing Material/Participants and Data-collection), and M5 (Describing Experimental Procedure) exhibit the lowest number of hedges. In the Methods section M6 (Describing Data Analysis) is the most heavily hedged move.

The total number of lexical hedging found in the corpus was 1832 items. The categories of lexical hedges in the corpus of MRAs are shown in Figure 2.

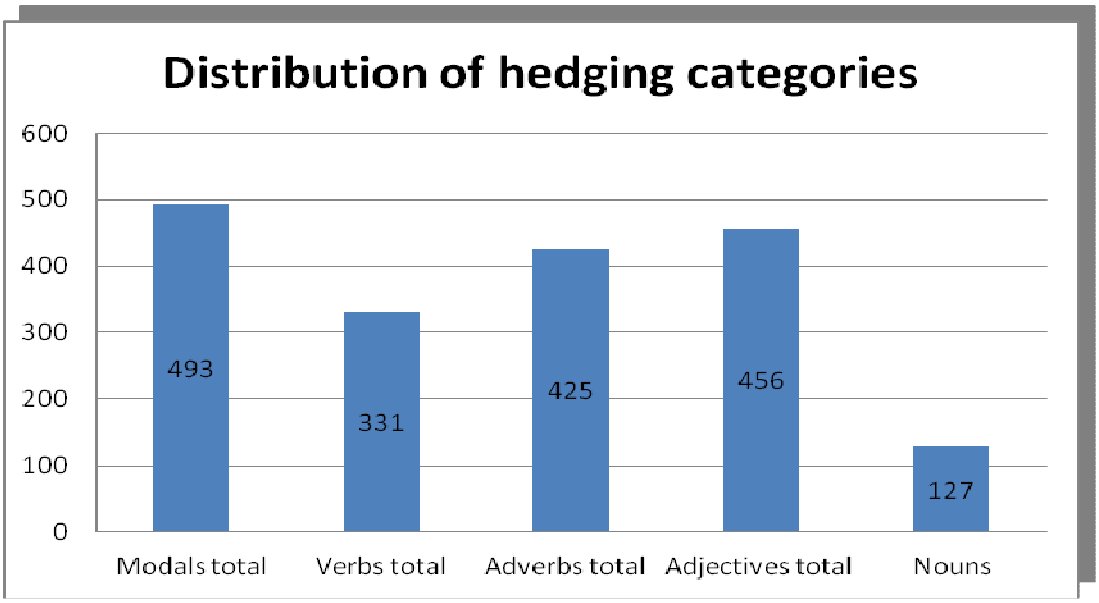

Figure 2. Distribution of different categories of hedges in the corpus of MRAs

As Figure 2 indicates the most common form of hedging is the use of modals or semi-auxiliaries. The results also show that the number of adverbs and adjectives used as hedging is also high in the corpus. The number of lexical verbs interpreted as hedges is 331, which means that this category is the fourth most common. Nouns interpreted as hedges are the least frequent in the corpus. The relative incidences of the different grammatical classes used as hedges can be seen in Table 10.

Table 10 shows that the relative incidence of lexical hedges is 17.08 per 1000 words in the study corpus.

Hedging categories	Incidences	Frequency per 1000 words
Modals+ Semi-auxiliaries	493	4.59/1000
Verbs	331	3.08/1000
Adverbs	425	3.96/1000
Adjectives	456	4.25/1000
Nouns	127	1.18/1000
total	1832	**17.08/1000**

Table 10. The relative incidences of the hedging categories in the corpus of MRAs

3.4.2. Modal Auxiliaries

Six different modal auxiliaries were found to occur in hedging interpretation, namely, *may, might, can, could, should* and *would*. The incidences of these modal auxiliaries can be seen in Figure 3.

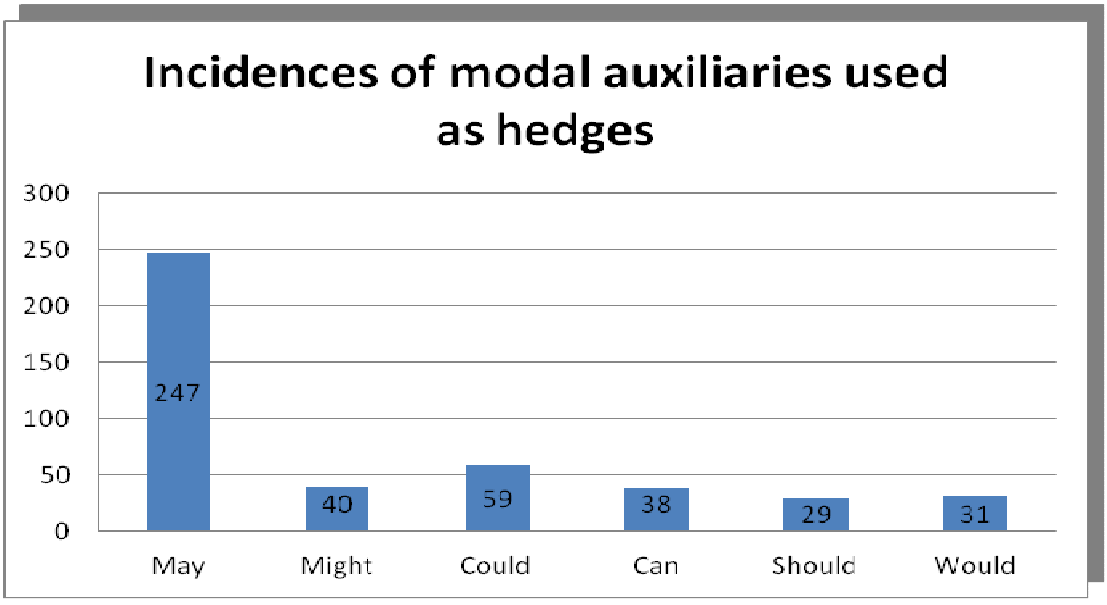

Figure 3. Incidences of modal auxiliaries used as hedges in the corpus of MRAs

In the texts examined, *may* was the most common modal auxiliary used as a hedge with a total number of 247 occurrences amounting to more than half of the modal auxiliary hedges. The results are not unexpected as *may* is the most typical modal auxiliary to express epistemic meaning. *Could* was the second most common modal auxiliary in hedging use, *migh*t and *can* occurred with about the same number of incidences. The most common function of these auxiliaries was to make the information uncertain or less than absolute. *Should* and *would* were also used to convey an epistemic meaning.

The following are typical examples of *may* used as hedging in the corpus of MRAs:

(1) Consequently, children with ASDs born to women who used folic acid *may* have had a higher probability of being diagnosed at an early age.(MRA30 [Move 7])

(2) The biological activities of n-3 fatty acids have led some to believe that maternal levels of n-3 fatty acids *may* significantly affect pregnancy outcomes and fetal development (MRA26 [Move 8])

(3) Because vitamin D is critically important for the maintenance of calcium homeostasis, it is possible that vitamin D deficiency, which causes a slight lowering of the serum calcium, is related to both skeletal muscle and smooth muscle strength and *may* play a role in initiation of early labor. (MRA20[Move 8])

(4) Our results confirm previous findings that dietary supplements *may* be relevant for preeclampsia prevention, and they extend them to suggest that regular use of a multivitamin in the periconceptional period *may* reduce the risk of preeclampsia, particularly among lean women. (MRA11 [Move 11])

For some typical clusters (i.e. a group of words which follow each other in a text) of *may* see examples below:

may have been; may also be; may be associated with; may not be generalizable; may be important in; may reduce the risk; may be involved in; may be related to; may be relevant; may contribute to; may be linked to; may be helpful; may influence; may increase; may explain; may play a role; may provide; may disrupt; may be altered;

may have influenced; may occur; may not reflect; may result in; may have resulted from; may help; may have effects; may underpin; may confound.

The total number of semi-auxiliaries in hedging use was 49 in the study corpus and mostly took the form of epistemic words such as, *appear, seem, tend* e.g.:

(1) It *appeared* that there might be a threshold effect of vitamin D status on 6-y fat mass. (MRA27, [Move 7])

(2) Since HLA DRB1*15 status *seems* to be associated with MS season-of-birth effects, this needs to be added to the analyses. (MRA8, [Move 10])

(3) Follow-up studies suggest that, even when there is not an associated intellectual disability, impairment *tends* to persist into adulthood and is associated with poor literacy. (MRA3, [Move 10])

3.4.3. Full Verbs

Full verbs were commonly used in the corpus to mitigate the claims and avoid excessive assertiveness. The most typical epistemic full verbs in the study corpus were *suggest, consider, indicate, hypothesize, conclude, believe, implicate, propose, think* and *imply*. For the use of these verbs see some examples below.

(1) Our data also *suggest* that a circulating level of approximately75 nmol/L (30 ng/mL) of 25(OH)D is required to normalize calcium excretion into the urine. (MRA4, [Move 8])

(2) Some *consider* levels of 25(OH)D ≥50 nmol/L as sufficient, while others suggest that levels ≥75 nmol/L are needed. (MRA8, [Move 2])

(3) The primary analyses *indicated* a slightly inverse association with all ASDs and a suggestion that associations may differ by case subgroups. (MRA13, [Move 8])

Altogether 331 occurrences of verbs identified as hedges were found, the verb *suggest* was used most frequently with 136 incidences.

See some typical clusters of the verb *suggest:*

> *these findings suggest that; our data suggest that; study suggests that; which is suggested to; some studies have suggested; our results suggest that; the present study suggests that; others suggest that.*

Altogether 39 other non-factive reporting verbs or tenative cognition verbs were used as hedges in the corpus such as *anticipate, assume, postulate, estimate, expect, interpret, suspect* and *speculate*.

3.4.4. Adverbs and Adjectives

Hedging was also frequently expressed by adverbs, amounting to 425 incidences in the study corpus. As illustrated at the beginning of this chapter the grammatical class of adverbs was the third most frequently identified category of hedges. In the corpus 39 different adverbs were identified, *significantly* and *approximately* were found to occur the most commonly e.g.:

(1) Prevalence of autism spectrum disorders is *approximately* one in 110 children in the United States, and incidence appears to be rising. (MRA2, [Move 1])

(2) Prepregnancy overweight *significantly* modified the effect of periconceptional multivitamin use on the risk of preeclampsia (table 3). (MRA11, [Move 7])

Other probability adverbs were used, such as *potentially, possibly, probably, likely, perhaps, apparently, presumably, theoretically.* Adverbs expressing indefinite frequency or indefinite degree, and approximative adverbs were found in the study corpus. Such hedging appeared commonly, especially in the sections of move 7 and move 8. See the typical adverbs used as hedges below:

> *particularly, generally, often, typically, usually, relatively, slightly, substantially, approximately, about, highly, widely, mainly, commonly, frequently, rarely, sometimes, considerably, fairly, greatly, largely, moderately, mostly, partly, rather, somewhat, extremely, markedly, modestly, almost, nearly.*

Hedges, in the form of adjectives similarly to adverbs present information as not precise, or uncertain. Altogether 456 incidences of hedges were identified in the study corpus, which may be grouped as probability adjectives, adjectives of indefinite frequency or degree and approximative adjectives. *Potential* and *possible* were the most frequent adjectives expressing probability, and *some* was the third most common adjective to mitigate the precision of assertions. See examples below.

(1) A *potential* confounder, however, is sun exposure, which is suggested to have immunomodulatory effects apart from generating vitamin D. (MRA8, [Move 8])

(2) Spring births have been associated with a higher risk of MS, and vitamin D deficiency during winter pregnancies has been suggested as a *possible* explanation for this. (MRA8, [Move 2]

(3) Direct sources (i.e., ones that are not converted from n-3 fatty acids) of DHA are found in microalgae in the form of supplements, and in *some* prenatal vitamins. (MRA26, [Move 8]

The use of the following forms of adjectives as hedges appeared especially frequently in the moves 7, 8 and 10, in reporting the results, discussing the findings and study limitations:

common, likely, few, many, several, small, consistent with, most, certain, apparent, suggestive, little, rare, frequent, considerable, slight, numerous, usual, typical, remarkable.

3.4.5. Nouns and Compound Hedges

The incidence of nouns used as hedges was the lowest in the study corpus. The most common forms can be categorized as nouns of tentative likelihood. Altogether 127 occurrences were identified, *possibility* amounts to 29, *potential* to 24 incidences. See examples of use below.

(1) The present findings suggest the *possibility* that premature rise in plasma leptin levels is involved in fetal programming in these neonates and contributes to obesity and subsequent metabolic disorders after exposure to a high-calorie diet. (MRA29, [Move 8]

(2) Although, recall bias is not frequently present in case–control studies on congenital malformations [41], we have chosen for one investigation at a fixed moment shortly after pregnancy to reduce the *potential* for recall bias. (MRA25, [Move 10]

Further examples of tentative likelihood used in the corpus were *likelihood, trend, tendency* and *probability*. The other nominal hedges can be categorized as tentative cognition words such as *estimate*, *notion suggestion* and *concept.* Non-factive assertive nouns such as *interpretation* and to *our knowledge* were also frequently used. Nominal hedging was especially common in move 8 and 10, in the discussion of results and study's strengths and weaknesses.

Apart from the above elements the articles contained a number of compound hedges (i.e., the juxtaposition of several hedges). The following are some typical examples of these strings of hedging devices:

- *may increase the likelihood,*
- *may be more likely,*
- *it appeared there might be,*
- *it would appear,*
- *it would suggest,*
- *we do not think this would explain,*
- *we speculate that there may be,*
- *our results suggest there may be,*
- *significantly more likely to be,*
- *presumably reduces the possible influence,*
- *the present findings suggest the possibility,*
- *it is possible that calcitonin may be a contribution* etc.

3.4.6. Summary of selected lexico-grammatical features used as hedges

The lexical hedges identified in the different moves are summarized in Table 11.

Move	modals	semi-auxiliaries	verbs	adverbs	adjectives	nouns
1	*may, can, could, should*	*appear*	*suggest, hypothesize, believe, consider, implicate, propose, think, anticipate, estimate, indicate*	*significantly, particularly, probably, generally, often, usually, approximately, considerably, almost, nearly*	*potential, common, likely, few, many, several, most, certain, apparent, rare, consistent with*	*potential, likelihood, concept*
2	*may, might, can, could, should, would*	*appear*	*suggest, hypothesize, conclude, consider, propose, postulate, estimate, expect, indicate*	*significantly, particularly, probably, generally, often, usually, unlikely, potentially, typically, relatively, about, highly, theoretically, commonly*	*possible, some, many, potential, common, likely few, several, small, little, considerable, usual, typical*	*to our knowledge, possibility, potential, likelihood, notion*
3	*may, might, could, should, would*	*appear*	*hypothesize, consider, anticipate*	*possibly, particularly, often, relatively, somewhat*	*potential, common, few, most, certain*	*possibility, likelihood*
4	*may*		*suggest, consider, implicate, think, estimate*	*significantly, probably, often, usually, relatively, mainly, substantially, moderately*	*potential, likely, possible, small, suggestive, frequent, slight*	*potential, interpretation, concept*

5	*might, would*	*appear*	*suggest, consider, assume, expect*	*particularly, generally, often, relatively, slightly, approximately, about, highly, widely, mainly, commonly, sometimes, moderately, rather*	*potential, common, likely, few, many, several, small, some, certain, usual*	*estimate*
6	*may, might, could, would*	*appear*	*suggest, consider, assume, estimate*	*potentially, likely, often, typically, usually, approximately, highly, widely, commonly, frequently*	*potential, possible, common, likely, many, several, small, consistent with, most, some, rare, slight, numerous*	*possibility, potential, estimate*
7	*may, might, could, should, would*	*appear, seem, tend*	*suggest, consider, indicate, assume, interpret*	*significantly, likely, substantially, unlikely, potentially, probably, generally, often, typically, slightly, approximately, about, highly, widely, mainly, frequently, partly, somewhat, modestly*	*potential, common, likely, few, several, small, consistent with, most, some, apparent, little, numerous, typical*	potential, estimate, trend, likelihood, probability, tendency

8	*may, might, could, can, should, would*	*appear, seem, tend*	*suggest, hypothesize, conclude, consider, propose, postulate, estimate, expect, indicate, believe, implicate, interpret, suspect, speculate*	*significantly, likely, unlikely, particularly, perhaps, possibly, potentially, probably, generally, often, typically, usually, relatively, slightly, substantially, approximately, about, highly, mainly, presumably, commonly, sometimes, considerably, fairly, greatly, largely, mostly, partly, somewhat, extremely, markedly, modestly, almost, nearly*	*potential, possible, common, likely, few, many, several, small, consistent with, some, certain, apparent, little, rare, frequent, slight, numerous, typical, remarkable*	*possibility, potential, estimate, interpretation, trend, likelihood, to our knowledge, notion, suggestion*
9	*may, might, could, would*	*appear, seem, tend*	*suggest, consider, implicate, imply*	*significantly, unlikely, perhaps, possibly, potentially, probably, typically, usually, slightly, largely, moderately*	*possible, many, likely several, small, consistent with, most, some, certain, little, typical*	possibility, potential, likelihood, notion, suggestion

10	*may, might, could, can, should, would*	*seem, tend*	*suggest, consider, indicate, implicate, propose, think, imply, assume, estimate, expect, interpret, suspect*	*significantly, likely, unlikely, particularly , perhaps, possibly, probably, generally, often, typically, usually, slightly, relatively, substantially, approximately, highly, frequently, rarely, considerably, greatly, largely, moderately, rather, somewhat*	*potential, possible, likely, common, few, many, several, consistent with, most, some, certain, apparent, suggestive, numerous, typical*	possibility, potential, estimate, interpretation, trend, likelihood, to our knowledge, probability, tendency
11	*may, might, could, can, should, would*	*appear, seem, tend*	*suggest, hypothesize, conclude, believe, consider, indicate, propose, interpret, speculate*	*significantly, likely, unlikely, particularly, potentially, probably, generally, often, relatively, substantially, approximately, highly, mainly, apparently, commonly, mostly*	*potential, possible, likely, common, many, several, small, consistent with, some, certain, apparent, suggestive*	possibility, potential, interpretation, trend, likelihood, notion, concept

Table 11. Summary of selected lexico-grammatical features used as hedges in the corpus of MRAs

3.5. *Hedging in the Corpus of Popular Science Articles*

3.5.1. Hedging categories in the corpus of PSAs

The different moves of PSAs were analyzed in terms of selected lexico-grammatical features that are most typically interpreted as hedges, similarly to the research articles. The distribution of hedges in the previously determined moves can be seen in Figure 4.

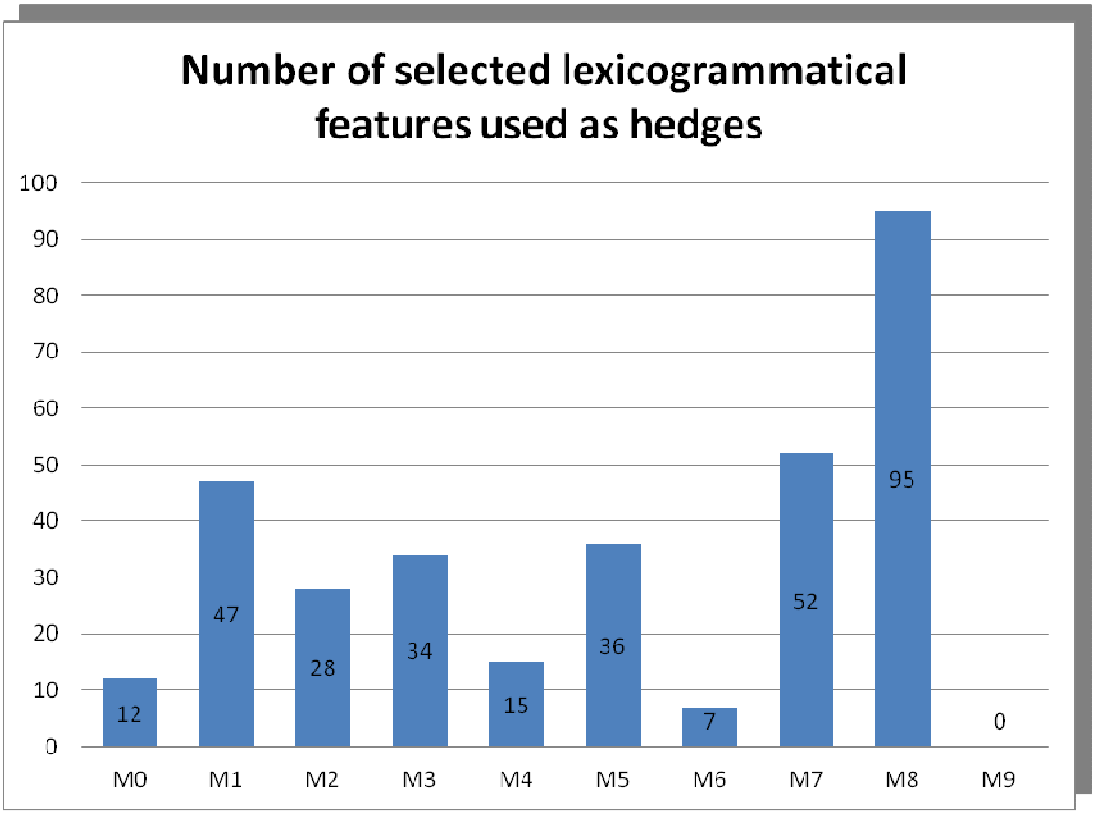

Figure 4. The number of selected lexical hedges in the different moves of the corpus of PSAs
M=Move

Figure 4 demonstrates that M8 (Stating Research Conclusions) is the move that contains the most lexical hedgings. M1 (Presenting Background Information) and M7 (Indicating and Explaining Main Outcomes) contained about the same number of hedges. However, the incidence of hedges in these two moves is about the half of the incidences in M8.

In M2 (Announcement of Recent Research Findings), M3 (Reviewing Previous Related Research) and M5 (Presenting Research Results in Details) hedgings were found to occur in about 30 cases. Lexical hedges were less frequent in M0 (Headline), M4 (Presenting New Research) and M6 (Describing Data Collection and Procedures).

The total number of lexical hedging found in the corpus of PSAs was 326 items. The categories of lexical hedges in this sub-corpus are shown in Figure 5.

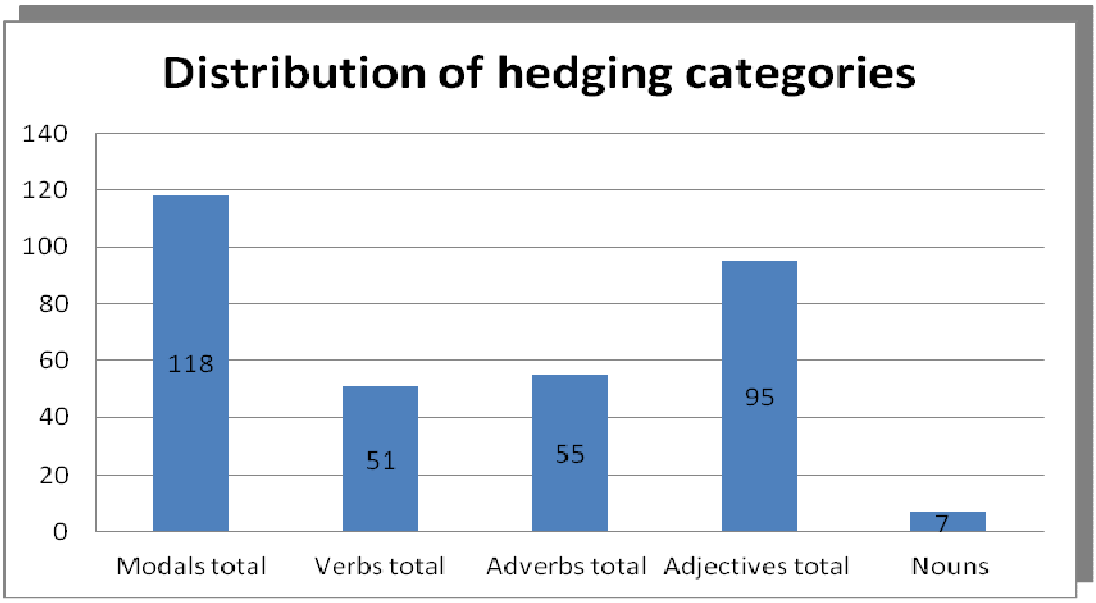

Figure 5. Distribution of different categories of hedges in the corpus of PSAs

Figure 5 demonstrates that similarly to MRAs, hedging was most commonly realized by means of modal- and semi-auxiliaries. The adjectives were the second and the adverbs the third most common hedge types. Full verbs were found to occur in about the same cases as adverbs. Nouns, similarly to the first sub-corpus occupy the last place considering incidences of use as hedges.

The relative incidences of the different grammatical classes used as hedges in the popular articles can be seen in Table 12.

Hedging categories	Incidences	Frequency per 1000 words
Modals +Semi auxiliaries	118	7.57/1000
Verbs	51	3.27/1000
Adverbs	55	3.53/1000
Adjectives	95	6.10/1000
Nouns	7	0.45/1000
Total	326	**20.94 /1000**

Table 12. The relative incidences of the hedging categories in the corpus of PSAs.

Table 12 shows that the relative incidence of lexical hedges is 20.94 per 1000 words – as compared to the 17.08 per 1000 words in MRAs in this study corpus.

3.5.2. Modal Auxiliaries

Six different modal auxiliaries were identified in hedging interpretation. *May, might, can and could* were found to occur most frequently, and only five incidences of *should* and *would* were identified. The incidences of the four most common modal auxiliaries can be seen in Figure 6.

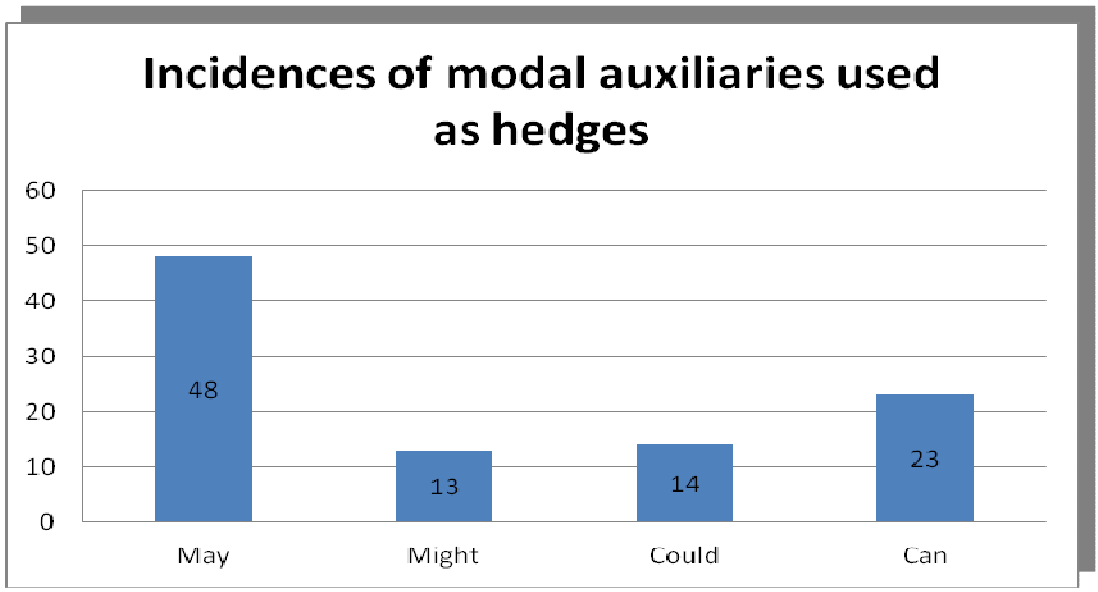

Figure 6. Incidences of modal auxiliaries used as hedges in the corpus of PSAs

May was the most common modal auxiliary used as a hedge with a total number of 48 occurrences amounting to more than half of the modal auxiliary hedges. *Can* was the second most common modal auxiliary in hedging use, *might* and *could* occurred with about the same number of incidences.

The following are typical examples found in the corpus:

(1) Some studies have suggested that folic acid *may* also play a role in preventing autism and related conditions, which together are called autism spectrum disorders (ASDs). (PSA30 [Move 3])

(2) Pregnant women who do not get enough vitamin E *may* give birth to children who are at higher risk of developing asthma, a new study finds. (PSA19 [Move 2])

(3) Vitamin D in Pregnancy *May* Help Prevent Childhood Obesity. (PSA17 [Move 0])

For some typical clusters (i.e. a group of words which follow each other in a text) of *may* see examples below:

may help people; may help doctors; may not be adequate; it may cause; appears there may be; women may be; conception may be; may be necessary; may be a link; may be a recipe; may be a simple strategy; may be an early window; may cut risk of; may lower risk of; may reduce the risk of; may also play; may also contribute to; may be associated with; in pregnancy may protect.

The total number of epistemic words, such as *appear, seem* and *tend* was 15 e.g.:

(1) Women who take a multivitamin every day around the time of conception *appear* to have a reduced risk for delivering low-birth-weight babies, a new study shows. (PSA10, [Move 2])

(2) Having sufficient amounts of folic acid and vitamin B12 before getting pregnant is important, because these nutrients *seem* to be most vital in an embryo's first few days and weeks. (PSA18, [Move 7])

(3) For example, women who take supplements *tend* to be more health-conscious in general, and this might have played a role. (PSA30, [Move 7])

3.5.3. Full Verbs

Altogether 11 different full verbs categorized as non-factive reporting verbs or tentative cognition verbs were used as hedges in the corpus of popular articles. The relative frequency of such hedging is similar to the corpus of MRAs. The most typical epistemic full verbs in the study corpus were *suggest, believe, conclude* and *think.* For the use of these verbs see some examples below.

(1) They *concluded* that their findings *suggest* vitamin B12 fortification may help cut the rate of neural tube defects more than folic acid fortification alone. (PSA18, [Move 8])

(2) Vitamin C, an antioxidant nutrient found in fruits and vegetables, plays an important role in the production and repair of connective tissues throughout the body and is *believed* to be critical to the maintenance of the fetal sac membranes. (PSA12, [Move 3])

(3) Pre-eclampsia is *thought* to be linked to a deficiency in L-arginine, an amino acid that helps to maintain a healthy blood flow during pregnancy. (PSA5, [Move 1])

The other verbs in the corpus interpreted as hedges were *propose, consider, estimate, expect, hope, suspect,* and *speculate* e.g.:

(1) The authors *propose* several possible reasons for this finding. (PSA28, [Move 3])

(2) Foods such as tempeh, miso and sea vegetables are sometimes said to have vitamin B12, although they are not *considered* reliable sources of it. (PSA18, [Move 8])

(3) After factoring in other things that might affect the risk of autism, the researchers *estimated* that children whose mothers took folic acid were nearly 40 percent less likely to develop this disorder. (PSA30, [Move 5])

3.5.4. Adverbs and Adjectives

Altogether, lexical items belonging to the categories of adverbs and adjectives occurred 150 times as hedges in the popular articles. The corpus of popular articles included 25 different adverbs in hedging position.

The adverbs interpreted in hedging use were probability adverbs such as *likely* and *probably*; adverbs of indefinite frequency such as *often, rarely, sometimes, typically, usually, commonly, generally;* adverbs of indefinite degree such as *significantly, greatly, largely, routinely, slightly, markedly, extremely, particularly, surprisingly* and *substantially;* and approximative adverbs such as *nearly, about, everywhere, almost, approximately* and *around.* Hedging of this type was the most common in M1 (Presenting Background Information) and M8 *(*Stating Research Conclusions). See the typical adverbs used as hedges below.

(1) Although karyotyping provides the same kind of information, CMA will *likely* provide more information on other potential disorders that might not otherwise be picked up such as intellectual disability or autism. (PSA23, [Move 8])

(2) In the United States alone, *nearly* 15 percent of preterm deliveries are a result of preeclampsia. (PSA11, [Move 1])

(3) This means that women in the L-arginine plus vitamin group were *significantly* les*s* likely to develop pre-eclampsia compared with the placebo group. (PSA5, [Move 8])

(4) “The increased risk of giving birth to an SGA infant observed among women treated with antipsychotics during pregnancy is *probably* an effect of confounding factors, such as smoking," the authors comment. (PSA24, [Move 8])

(5) Autism is a complex condition that *usually* has no well-defined cause. (PSA30, [Move 8])

The popular science articles contained 18 different adjectives interpreted as hedging devices. Adjectives of probability, indefinite degree or indefinite frequency and approximative adjectives were identified in the corpus.

The most commonly used hedges in this group were *certain, likely, some, many, most and potential.*

The other adjectives used as hedges were *apparent, possible, little, consistent with, few, several, numerous, typical, uncommon, remarkable, small* and *some kind of.* The adjectives are commonly linked to quantifications. See examples below.

(1) In a related study, the American Dietetic Association and Dietitians of Canada affirmed that appropriately planned vegetarian diets are healthful, nutritionally adequate and provide benefits in the prevention and treatment of *certain* diseases. (PSA26, [Move 3])

(2) While *most* people have low levels or are deficient in vitamin D, insufficient amounts of the vitamin can be especially harmful for new moms and their infants. (PSA1, [Move 1])

(3) *Some* experts also think that antioxidant vitamins can help protect against the condition. (PSA5, [Move 1])

3.5.5. Nouns and Compound Hedges

This grammatical class was the least frequent in hedging position. Only 7 incidences of hedges were identified in this subgroup. The lexical items used were *potential, notion, likelihood* and *to our knowledge.*

(1) ”The results of this study are consistent with the *notion* that early life nutrient intake, both in utero and in the early postpartum period, modifies the risk of developing childhood asthma," says the study, in The American Journal of Respiratory and Critical Care Medicine. (PSA19, [Move 2])

(2) Vitamin D deficiency may increase the *likelihood* of having a Caesarean section, a new study has found. (PSA20, [Move 2])

(3) *To our knowledge*, none of the trials have followed up their sample to investigate whether these supplements have effects on neurodevelopment that are only manifest after birth," the authors write. (PSA3, [Move 1])

The articles contained a number of compound hedges. The following are some typical examples of these:

- *may be more likely,*
- *results suggests that CMA may,*
- *may increase the likelihood,*
- *suggesting some congenital heart defects,*
- *it appears there may be,*
- *in some cases may be helpful,*
- *less likely she would have,*
- *might be expected,*
- *significantly less likely,*
- *it can only show there may be a link,*
- *it would suggest,*
- *sometimes said to have,*
- *the study suggests that folic acid might play a role etc.*

3.5.6. Summary of selected lexico-grammatical features used as hedges

The lexical hedges identified in the different moves are summarized in Table 13.

Move	modals	semi-auxiliaries	verbs	adverbs	adjectives	nouns
0	*may, could, can*		*suggest*		*likely*	
1	*may, can, might, could*	*seem*	*think, suggest*	*about, nearly, probably, commonly, generally, rarely, routinely, greatly, largely, typically, around*	*some, likely, many, most, certain, numerous, typical, uncommon*	*to our knowledge*
2	*may, can, should*	*appear*	*suggest*	*nearly, significantly, everywhere*	*some, likely, many, potential, remarkable*	*likelihood*
3	*may, might, can, would*	*appear, tend*	*suggest, believe, propose*	*often, largely, approximately, particularly, surprisingly*	*some, likely, most, certain, potential, little, several, remarkable, small*	
4	*may, can, could*		*suggest*	*about*	*some, likely, consistent with*	*notion*

5	*may, might, can, could*	*tend*	*suggest, estimate*	*about, nearly, significantly, markedly*	*most, likely, certain, apparent, little, few, remarkable, small*	*potential*
6	*could*			*about, almost, around*	*more or less likely, uncommon*	
7	*may, might, could, can, would*	*appear, seem, tend*	*suggest, believe, think, expect, speculate*	*about, typically, usually, significantly, substantially, almost*	*some, likely, many, most, certain, several*	
8	*may, might, could, can, should*	*appear, tend*	*suggest, conclude, believe, think, consider, hope, suspect*	*likely, probably, commonly, rarely, sometimes, usually, slightly, approximately, extremely, particularly*	*some, many, most, certain, potential, possible, few, numerous, typical, small, some kind of*	*potential*

Table 13. Summary of selected lexico-grammatical features used as hedges in the corpus of PSAs

3.6. *Hedging in Medical Research Articles vs. Popular Science Articles*

	Hedges in PSAs	Proportion of Hedges to Total Words in PSAs	Hedges in MRAs	Proportion of Hedges to Total Words in MRAs	Significance level
Modals total	118	0.76	493	0.46	0.000
Verbs total	51	0.33	331	0.31	0.691
Adverbs total	55	0.35	425	0.40	0.422
Adjectives total	95	0.61	456	0.43	0.001
Nouns	7	0.04	127	0.12	0.010
Total	**326**	**2.09**	**1832**	**1.71**	**0.001**

Table 14. Proportion of hedges in the two genres

Table 14 demonstrates the statistical test of two independent samples for proportions. It compares the proportion of hedges in the two genres. It shows that there is no significant difference in the proportion of verbs and adverbs ($p>0.05$) in the two samples. It means that there is no statistical difference concerning the percentage of verbs and adverbs used as hedges in MRAs and PSAs. Nominal hedges are more frequently used in MRAs, whereas modal auxiliaries and adjectives are found to occur as hedges more commonly in popular articles. As shown in Table 14 the total number of hedges is significantly higher ($p<0.05$) in the corpus PSAs.

Table 15 reports the result of the test of homogeneity for the proportions of different hedges in the two samples.

	Proportion of hedges to total 326 popular hedges	Proportion of hedges to total 1832 medical hedges
Modals total	36.2	26.9
Verbs total	15.6	18.1
Adverbs total	16.9	23.2
Adjectives total	29.1	24.9
Nouns	2.1	6.9
Total	100	100

Table 15. The proportion of grammatical classes of hedges to the total number of hedges

The null hypothesis is that there is no difference in group proportions. The proportions of grammatical classes of hedges to the total number of hedges in each genre are compared to examine whether the two distributions are homogeneous or significantly different. The test shows that there is no significant difference between the distributions of the proportions of grammatical classes used as hedges in the two genres (test of homogeneity, $p = 0.251$).

MOVE	Number of hedges in PSAs	Number of hedges in MRAs	Popular (%)	Medical(%)
M0	12	0	3.7	0
M1	47	109	14.4	5.9
M2	28	163	8.6	8.9
M3	34	48	10.4	2.6
M4	15	30	4.6	1.6
M5	36	63	11.0	3.4
M6	7	98	2.1	5.3
M7	52	210	16.0	11.5
M8	95	567	**29.1**	**30.9**
M9	_*	75	_*	4.1
M10	_*	286	_*	15.6
M11	_*	183	_*	10.0
Total	326	1832	100.0	100.0

Table 16. The number and proportion of hedges in the different moves

Table 16 compares the number and proportion of hedges in the identified moves of popular and research articles. It shows that the mostly hedged section of both genres is Move 8 amounting to 29.1 and 30.9 %. However, the function of the two moves is different in the two study corpus. Move 8 in MRAs is for discussing main findings, whereas move 8 functions as stating conclusions in PSAs. There are no values in the columns of popular articles for M9, M10 and M11, as these articles consist of 8 moves.

4. DISCUSSION

4.1. *Textual Analysis of the Study Corpus*

Since the target audience of the PSA is the lay public, it was assumed that the text is not constructed by the same or similar moves as the underlying MRA. Hypothesis 1 of the present study was that a typical discourse structure of popularized medical texts cannot be described by means of move analysis. To confirm the hypothesis the first step was to determine a generic structure of MRAs and PSAs of the study corpus.

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 10 rhetorical moves (cf. Results 3.1.). The order of moves appears to be relatively fixed in the corpus (cf. Results 3.1.). Similar findings were reported previously by Nwogu (1997) and Fryer (2012). Fryer described 10 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 8 moves (cf. Results 3.2.). To sum up, the results contradict hypothesis 1, that the discourse structure of popular science articles cannot be described by rhetorical moves, since the analysis of the study corpus suggests a typical pattern of science popularization. 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 results support hypothesis 2, that the rhetorical structure of the PSA differs from that of the underlying MRA. 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. To sum up, as presumed in hypothesis 2, the structure of the MSAs and PSAs is one of the most striking differences between the two genres.

4.2. *The Use of Hedging in the Study Corpus*

Hypothesis 3 of the present study was that hedging is not applied in online popular science articles. The findings in the present study do not justify this hypothesis, as hedging was found to occur commonly in the PSAs of the study corpus. Moreover, the results concerning the total number of selected hedges show that hedging is more frequent in popular science articles (20.94 /1000 words), than in medical research articles (17.08/1000 words).

The present study aimed at investigating the use of hedging as a means of expressing tentativeness in both medical research papers and corresponding online popularizations. In the present analysis the linguistic phenomenon of tentativeness was examined by the selection of typical lexical items interpreted as hedges.

The purpose was to compare the lexical elements of hedging in the MRAs and their corresponding PSAs and to examine whether hedging is applied in less specialized ESP texts. The lexical items were categorized into five grammatical classes; modal- and semi-auxiliaries, full verbs, adverbs, adjectives and nouns. Both qualitative and quantitative information was presented concerning the incidence and grammatical classes of hedging in the two genres.

The results show that modals and semi-auxiliaries are most frequently used as hedges in both corpora. The modal auxiliary *may* expressing epistemic modality is the most commonly used lexical item in both research and popular articles. Regarding the grammatical category of verbs, *suggest* occurs the most frequently in both text types, and the proportion of verbs used as hedges to the total number of words is similar in the two sub-corpora. However, the selection of other verbs suggests that more cognition verbs are used in popularizations, such as *believe, think, consider, hope* and *suspect.* There is no statistically significant difference in the use of adverbs as hedges, whereas adjectives are more commonly used as hedges in popularizations. Adverbs that can be linked to epistemic modality such as *probably, possibly, potentially* are more commonly used in research articles. The adjectives in both corpora are probability adjectives or act as quantifiers. Nominal hedges are more frequent in MRAs. This is not unexpected as nominalization is a central feature of MRAs. The following nouns and noun phrases are the only examples identified as hedges in the popular articles: *likelihood, notion, potential,* and *to our knowledge*.

The results in chapters 3.5.1 and 3.6.1 demonstrate that the frequency of lexical hedging varies in the different rhetorical moves in both genres. As seen in Figure 1, MRAs are divided into 10 rhetorical sections and Move 8 (Discussing Main Findings) is the most heavily hedged part of the texts. The hedges identified in Move 8, amount to 30.9% of all hedges. Move 3 (Stating Research Purpose) in the Introduction section, and Moves 4 and 5 (Describing materials, data-collection and experimental procedures) in the Methods section contain the lowest percentage of hedges.

These results are consistent with the earlier findings of Salager-Meyer (1994), who analyzed a corpus of 15 medical research articles and pointed out that the Discussion was the most hedged section, and Methods contained the least hedging devices. Salager-Meyer concluded that the use of hedges was influenced by the general structure of discourse (Salager-Meyer, 1994). It was also suggested by other researchers that hedges are most common in Discussions and are least represented in Methods (Hyland, 1994). In the corpus of PSAs the move of stating research conclusions is the most heavily hedged section. The moves presenting background information and explaining main outcomes, namely M1 and M7, also frequently used lexical items that can be interpreted as hedges.

The results of the present study show that numerical hedging, approximative adverbs, adjectives and items indicating imprecision can be found in both corpora, however, adjectives are more frequent in PSAs. In MRAs this cautious strategy is used as a protective communication tool. On the other hand, in popular articles imprecision is used as the precise information is unnecessary for the lay reader.

Nevertheless, the most common forms of hedging are the epistemic modal auxiliary *may* and the tentative verb *suggest* in the corpus of popularizations, similarly to the MRAs. As the authors address lay audiences the motivation of hedging is different than in scientific communication. A possible explanation is that the author of the popular article adopts the tentative tone of the original science article. Hedging may be used when the author of the popular article intends to convince the lay audience that the article is the translation of real science. To sum up, it is a stylistic feature to convey the meaning that it is written like science. It can also be viewed as a defence tool by the authors of these articles. They hedge their statement to create fuzziness and provide inaccurate information this way reducing responsibility. The present study also revealed that the authors of popular articles frequently use linguistic techniques that can be interpreted as hedgings, as their aim is to limit the responsibility of the writer toward the information of the articles.

Expressions like the *study has found*, *researchers have determined that, the authors of the new report say, says the study* or *scientists revealed* may be interpreted as defence tools against the criticism of the audience, and also convey the meaning that the researchers are responsible for the truth of the information and not the writer of the article. In this sense, they may act like *attribution shields*, which attribute the claim to someone else than the writer (Csongor et al., 2013).

4.3. *Contemporary Approach of Science Popularization*

In accordance with the genre definition of Swales (Swales, 1990), MRAs and PSAs are two distinct genres with different target audiences and communicative purposes. The popular articles in the corpus were found on the Internet and belong to the genre of science popularization. The popularized articles are written for the general lay public and the authors may be either specialists or non-specialist journalists. The most important communicative function of the popular articles in the corpus is to capture the attention of the reader and convince the audience of the positive effects of the prenatal vitamin. The communicative purpose of the MRA is to gain the acceptance of results by other researchers. Based on the web genre typology the popular articles of the present corpus can be considered as a replicated genre of the printed version of popular articles on science. Popular scientific articles existed in the traditional printed media, and these migrated to the computer environment. However, it is difficult to identify digital genres as they are complex and they integrate different attributes. The genre of a research paper is well-defined and it is rather conventionalized.

Although MRAs and PSAs are acknowledged as two distinct genres, the contemporary view of popularization argues that the popularization is not the simplified version of the research article. According to the traditional view the scientific information is translated using simple terms for a lay audience. This implies that the information is distorted and the non-specialist audience does not play an active part in the decision making process of science (Myers, 2003).

In the contemporary view popularization is considered as a social activity, in which non-specialist readers get informed about scientific findings and in this cycle popularization interrelates science and society (Myers, 2003). Online newspaper articles represent a stable genre within scientific popularization and they act as a useful means of communication between scientists and lay people.

4.4. *Limitations*

There are a number of limitations to the present study. Although, the study sample was restricted to articles about prenatal vitamins, this criterion was helpful when searching for corresponding popularizations. As a specific area of medicine was selected, a comparison with a wider range of medical topics would be relevant. However, the findings from this corpus may be representative of other medical research articles as well. Moreover, the limited content of the articles made the move-analysis process and identification of hedges easier. In a possible future study each move could be further divided into constituent elements called *steps,* which would give a more sophisticated picture of the discourse structure of articles.

Another limitation is the issue of subjectivity in identifying moves and lexical hedges in the study. It is discussed by others (Fryer, 2007) that subjectivity is unavoidable and it is more apparent if the content can be misunderstood. It is possible that the findings are not absolutely accurate, but they definitely indicate certain tendencies. It is also indicated by other authors (Varttala, 2001) that studying the linguistic phenomenon of hedging can never be thorough and exhaustive. First of all, hedging is defined in broad terms in linguistic literature. Secondly, hedging may take variety of forms besides lexical items, such as the use of passive voice, tense or personal pronouns. Therefore the present study concentrated on lexical devices that are typically interpreted as hedges to be able to compare some aspects of this linguistic phenomenon in the two genres.

It is also important to note that the popular articles in the corpus may represent varying degrees of popularization. The texts found on the website of *Science Daily,* for example, are for audiences with some degree of background knowledge in the field, while other texts are written for the layperson with no specific information about prenatal vitamins at all. However, the articles are similar regarding content, length and the communicative medium. They all represent the genre of online newspaper articles and have a corresponding science article. Their purpose is to inform non-specialists or even scientists of recent discoveries in the field of prenatal vitamins.

The analysis of PSAs was restricted to the texts disregarding intertextuality, such as the use of hyperlinks and non-verbal elements of web documents. Similarly, the non-IMRAD sections, such as the abstracts, reference lists, acknowledgements and non-verbal elements, such as figures and tables were not selected for the analysis of MRAs. The study of these features may yield interesting results in future research.

4.5. *Conclusions*

The aim was to provide a detailed rhetorical and lexico-grammatical 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.

To sum up, the discourse structure of popularizations is quite different from the medical research papers. The genre of popular science article has its typical structure made up of 8 moves. The 30 medical research articles can be described in terms of 10 rhetorical moves. The two genres are organized differently. The generic structure of the popular articles is closer to journalism than science. The details are omitted, which is reflected in the length of the texts. In popular articles a deductive pattern is used, the emphasis is on the outcome of the research, rather than the background information and methodological steps of investigation.

Popular articles, however, seem to take over the tentative tone of scientific communication. Lexical hedges, which typically occur in MRAs, are extensively used in popularizations of the study corpus. Lexical hedging is used frequently in professional medical articles, and in the present corpus hedging was also typical in the corresponding popularizations, as a manifestation of scientific style. Unexpectedly, the results suggest that lexical hedging is even more commonly used in the sample of popularizations than research articles.

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. Scientists need to share their knowledge with lay people who are interested in their research findings. Consequently, popularization has a positive effect and a significant role in communicating the discoveries and latest results of science. This process is important from the point of view of lay people and scientists as well. The wider scientific community may also be informed of recent discoveries by means of scientific popularization, enabling interdisciplinary projects to resolve specific problems. Popular media can also help scientists gain resources and funding for a particular research project. Researchers should have information about the public understanding of science. The study of popular science articles can be an important means to achieve this goal.

4.6. *Innovations of the Study*

An innovation of the present study is that the corpus presents new findings in the field of prenatal vitamins and nutrition, and the medical articles are matched up with popularized articles of the same research. Therefore, to the best of the author's knowledge, it is the first attempt to create a corpus of medical research articles and corresponding online popularizations. The author of this dissertation used international medical journals, such as *The British Medical Journal, The Journal of the American Medical Association* and *The New England Journal of Medicine* as sources to collect articles about recent findings related to prenatal vitamins.

The present study may be one of the first corpus-based investigations to compare the discourse structure and the use of hedging phenomena in MRAs and corresponding online popular science articles. The present analysis examines the generic discourse features of the two genres, and then describes the lexical hedges used in the different rhetorical moves. The comparison of lexical hedges in the two genres was complemented by statistical tests as well.

Science popularization is not a common topic of discourse analysis and the process of interpreting medical research for the layman in the new communication medium of the Internet has not been extensively studied yet.

4.7. *Implications*

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. The move analysis and lexico-grammatical study of this corpus can be used to analyze other corpora of research or popular articles. Future studies could be conducted to use the methodology and explore the discourse structure and the use of hedging in other settings. The typical forms of lexical hedges can be valuable to transmit the conventions of both genres in the teaching of English for Medical Purposes.

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LIST OF TABLES

LIST OF FIGURES

APPENDIX

Appendix 1. The titles and sources of the articles in the corpus

	Title of MRA	Source of MRA	Title of PSA	Source of PSA
1.	Maternal Vitamin D Status Determines Bone Variables in the Newborn	Journal of Clinical Endocrinology and Metabolism, 2010	New Vitamin D Recommendation for Pregnant Women	Emax Health
2.	Prenatal vitamins, one-carbon metabolism gene variants, and risk for autism	Epidemiology, 2011	Autism and Prenatal Vitamins	Science Based Medicine
3.	Folic Acid Supplements in Pregnancy and Severe Language Delay in Children	Jama, 2011	Folic Acid in Early Pregnancy Associated With Reduced Risk of Severe Language Delay in Children	Science Daily
4.	Vitamin D Supplementation During Pregnancy:Double-Blind, Randomized Clinical Trial of Safety and Effectiveness	Journal of Bone and Mineral Research, 2011	Vitamin D Supplements Found to Be Safe for Healthy Pregnant Women	Science Daily
5.	Effect of supplementation during pregnancy with L-arginine and antioxidant vitamins in medical food on pre-eclampsia in high risk population: randomised controlled trial	BMJ, 2011	Dietary Supplement Can Protect Against Pre-Eclampsia, New Study Suggests	Science Daily
6.	Postnatal Vitamin D Supplementation Following Maternal Dietary Vitamin D Deficiency Does Not Affect Bone Mass in Weaning Guinea Pigs	The Journal of Nutrition, 2010	Maternal Vitamin D Improves Bone Health in Offspring	Complementary Prescriptions
7.	Maternal Vitamin A Supplementation and Lung Function in Offspring	New England Medical Journal, 2010	Benefits of prenatal vitamin A last a decade: study	Reuters

	Title of MRA	Source of MRA	Title of PSA	Source of PSA
8.	Vitamin D as a protective factor in multiple sclerosis	Neurology, 2012	High Vitamin D Levels in Pregnancy May Protect Mother More Than Baby Against Multiple Sclerosis	Science Daily
9.	Periconceptional multivitamin use and risk of preterm or small-for-gestational-age births in the Danish National Birth Cohort	American Journal of Clinical Nutrition, 2011	Women who take vitamins have fewer preemies: study	Reuters
10.	Association of Periconceptional Multivitamin Use With Reduced Risk of Preeclampsia Among Normal-Weight Women in the Danish National Birth Cohort	American Journal of Epidemiology, 2009	Vitamins May Lower Risk of Birth Complication	Medicine Net
11.	Periconceptional Multivitamin Use Reduces the Risk of Preeclampsia	American Journal of Epidemiology, 2006	Periconceptional multivitamin use reduces the risk of preeclampsia	Medicine News
12.	Vitamin C supplementation to prevent premature rupture of the chorioamniotic membranes: a randomized trial	The American Journal of Clinical Nutrition, 2004	Vitamin C Can Prevent Pregnancy Complication	Women's Issues
13.	Maternal Smoking during Pregnancy and the Prevalence of Autism Spectrum Disorders, Using Data from the Autism and Developmental Disabilities Monitoring Network	Environmental Health Perspectives, 2012	Study explores links between smoking during pregnancy and autism	UWM.EDU
14.	Maternal Serum Vitamin D Levels During Pregnancy and Offspring Neurocognitive Development	Pediatrics 2012	Low Vitamin D in Pregnancy Linked to Language Problems in Children	WebMD

	Title of MRA	Source of MRA	Title of PSA	Source of PSA
15.	Maternal Vitamin D Status:Effect on Milk Vitamin D Content and Vitamin D Status of Breastfeeding Infants	Advances in Nutrition, 2012	Breastfeeding Moms Found to Have Vitamin D Deficiency, Study Finds	Women's Enews
16.	Nutrient requirements and fetal development	The Journal of Family Practice, 2007	Vitamins to Help Pregnancy	Livestrong
17.	Risk of Oral Clefts in Relation to Prepregnancy Weight Change and Interpregnancy Interval	American Journal of Epidemiology, 2008	Health News: Maternal Vitamin A Intake & Cleft Palate	Nourished Kitchen
18.	Maternal Vitamin B12 Status and Risk of Neural Tube Defects in a Population With High Neural Tube Defect Prevalence and No Folic Acid Fortification	Pediatrics, 2009	Vitamin B12 Deficiency in Pregnant Women Linked to Birth Defect	Natural News
19.	Low Maternal Vitamin E Intake during Pregnancy Is Associated with Asthma in 5-Year-Old Children	American Journal of Respiratory and Critical Care Medicine, 2006	Prenatal Vitamins and Asthma in Children	The New York Times
20.	Association between Vitamin D Deficiency and Primary Caesarean Section	The Journal of Clinical Endocrinology and Metabolism, 2009	Having a Baby: Vitamin D Deficiency Is Tied to C-Sections	The New York Times
21.	Effects of interventions in pregnancy on maternal weight and obstetric outcomes: meta-analysis of randomised evidence	BMJ, 2012	Weight in Pregnancy Best Controlled by Diet, Study Suggests	Science Daily
22.	Gestational high fat diet programs hepatic phosphoenolpyruvate c arboxykinase gene expression and histone modification in neonatal offspring rats	Journal of Physiology, 2011	High-Fat Diet During Pregnancy Programs Child for Future Diabetes, Study Suggests	Science Daily

	Title of MRA	Source of MRA	Title of PSA	Source of PSA
23.	Prenatal chromosomal microarray analysis in a diagnostic laboratory; experience with >1000 cases and review of the literature	Prenatal Diagnosis, 2012	New prenatal genetic test is much more powerful at detecting fetal abnormalities	Psychology and Sociology
24.	Antipsychotics During Pregnancy Relation to Fetal and Maternal Metabolic Effects	Jama Psychiatry (formerly Archives of General Psychiatry) 2012	Antipsychotic Drugs During Pregnancy Up Gestational Diabetes Risk	MedIndia
25.	Dietary intake of B-vitamins in mothers born a child with a congenital heart defect	European Journal of Nutrition 2006	Vitamin B12 deficiency linked to heart defects in newborns	Natural News
26.	Nutritional Counselling for Vegetarians During Pregnancy and Lactation	Journal of Midwifery and Women's Health 2008	Nutritional Counselling for Pregnant Vegetarians	Natural Standard
27.	Maternal vitamin D status in pregnancy is associated with adiposity in the offspring: findings from the Southampton Women's Survey	The American Journal of Clinical Nutrition 2012	Vitamin D in Pregnancy May Help Prevent Childhood Obesity	Natural News
28.	Maternal Serum Vitamin D Levels During Pregnancy and Offspring Neurocognitive Development	Pediatrics 2012	Taking Vitamin D During Pregnancy	Cureguide
29.	Role of premature leptin surge in obesity resulting from intrauterine under nutrition	Cell Metabolism 2005	Study shows why poor prenatal nutrition leads to obesity	New Scientist Health
30.	Association Between Maternal Use of Folic Acid Supplements and Risk of Autism Spectrum Disorders in Children	JAMA 2013	Could folic acid help prevent autism?	WebMD

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