Identification of epistemic topoi in a corpus of biomedical publications

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

This dissertation reports on the results of a study into the characteristics of epistemic topoi and the methods of their identification in a corpus of biomedical publications. The study was conceived in response to the need for a systematized description of the organization of argumentative text and discourse. This need is well recognized in knowledge-intensive fields: information processing, storage, and retrieval; corpus analysis and natural language processing; data mining, knowledge management and translation; professional training and education.

The study followed the design of a situated study combined with a methodological inquiry. I used inductive methods to describe the features and functions of recurrent patterns of argumentative and linguistic organization. This part of the study consisted in close reading of a corpus of fifty-five NTG papers and rhetorical and linguistic annotation of seventeen clinical studies (45,599 words) selected from the corpus. The data was generated by means of rhetorical and linguistic analysis. Visual annotation played an essential role in the identification and description of the argumentative patterns, complementing the traditional methods of corpus analysis.

Forty-eight basic and nine composite epistemic topoi forming the superstructure of the papers were identified in the corpus. The topoi were found to be loosely associated with the IMRD structure and signalled with configurations of lexicogrammatical, semantic, deictic, and coreferential features. The topoi were classified according to the modes of reasoning and textual and discursive functions. The obtained results confirmed earlier insights into the links of linguistic patterning with text and discourse semantics. A significant outcome of the linguistic analysis is a catalogue of linguistic features that were found to have regular links with the topoi in the corpus.

The role of linguistic configurations as identifiers of argumentative meanings makes them a valuable medium of text and discourse analysis. By linking the argumentative meanings to the surface features of text and discourse, the analysis of linguistic configurations presents informatics practitioners with an alternative to the current methods of natural language processing and knowledge management. The catalogue of linguistic features and a detailed description of the study design make the presented findings amenable to secondary analysis, extrapolation, and generalization.

The auxiliary objectives of this study were a survey of argumentative practices represented in the corpus and a review of the state of epistemic research. The results of the survey and review suggest that agonistic reasoning practices and over-reliance on reductionist models have negative implications for research writing and communication. Specifically, they hamper analysis of argumentative organization of natural text and discourse. As an alternative to agonistic argumentation, I propose an argumentation model based on Aristotle's and Kneale's conceptions of situated knowledge and learning. The model of textual and discursive organization that accommodates situated knowledge and learning is political stasis. This model can be used as a heuristic and analytic tool. In this dissertation I use it as an explanatory conception and as a system of

reference points for identifying significant research trends both in argumentation studies and in clinical NTG research.

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I dedicate this work to the parents, teachers, and catchers in the rye of the earth's creatures, to those whose love is resourceful and kindness is not contingent on innocence, to those who work, learn, and share as long as they live.

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I gained numerous insights and a sense of direction that drove this study from three applied research projects: UW's *Crossing Borders: Sites of Discursive Negotiation in Healthcare Practice* and *HealthDoc*/*InkPot* and the Toronto-based *Using Simulation to Promote Team-Based Disclosure of Errors*. These projects have allowed me to better understand the relations between knowledge and praxis, and they have given me chances to learn from people working in various domains: rhetoricians (R. A. Harris and C. F. Schryer), computer scientists (C. DiMarco, D. Mulholland, S. Banks, R. Radulov, and M. Skala), linguists (E. Afros), policy researchers (L. Lingard), and healthcare specialists (S. Espin, L. Jeffs, M. Maione, and M. Spafford). I thank you for allowing me to witness your amazing work and draw inspiration from your perspectives. It was with a renewed appreciation of the potential of organized knowledge to solve problems on the ground and of the

importance of practical tasks for theory that I approached this project.

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Abbreviations

5-FU	5-fluorouracil
AIOP	Average intraocular pressure
ANOVA	Analysis of variance (models and method of statistical analysis)
APSA	Antiphosphatidylserine antibodies
AVP	Arteriovenous passage
BP	Blood pressure
BMC	BioMed Central
CARS	Create a Research Space model (Swales, 1990)
CMF	Circadian mean ocular perfusion pressure fluctuation
CDI	Colour Doppler imaging
EBM	Evidence-based medicine
HTG	High-tension glaucoma
IBM	International Business Machines
ICA	Intracranial carotid artery
IMRD	The textual structure including an introduction, methods, results, and discussion sections
IOP	Intraocular pressure
IR	Information retrieval
IT	Information technology
KM	Knowledge management
MEDLINE	Medical Literature Analysis and Retrieval System Online
MIOP	Maximum intraocular pressure
MMC	Mitomycin C
MOPP	Mean ocular perfusion pressure
NFL	Nerve fibre layer
NTG/NPG/LTG	Low/normal pressure/tension glaucoma
PA	Pulse amplitude
POAG	Primary open-angle glaucoma
POBF	Pulsatile ocular blood flow
PSHL	Progressive sensorineural hearing loss
PSV	Peak systolic velocity
R/D	The rim area/disc area ratio
RNFL	Retinal nerve fibre layer
TESOL	Teaching English to Speakers of Other Languages

Chapter 1: Introduction

If you can help it, do not write.

L. Tolstoy

Overview of the study design and findings

This dissertation presents the results of an inquiry into the generic features of argumentative organization in a corpus of clinical research publications. The need for a systematized description of argumentative text and discourse is well recognized in knowledge-intensive fields: information processing, storage, and retrieval; discourse and natural language processing; data mining, knowledge discovery, management, and translation; professional training and education.

The study followed the design of a situated study combined with a methodological investigation. I used inductive methods to describe the characteristics and functions of recurrent patterns of argumentative and linguistic organization. This part of the study consisted in close reading of a corpus of fifty-five normal-tension glaucoma (NTG)[1] papers and rhetorical and linguistic annotation of seventeen clinical studies (45,599 words) selected from this corpus. Visual annotation played an essential role in the identification and description of the argumentative patterns, complementing the traditional methods of corpus analysis. The observations were selected and interpreted with reference to two categories of situational parameters. On the one hand, I sought to produce results that would be of use in natural language processing, education, text and discourse analysis. On the other hand, I addressed the issues that I found to be underrepresented in the literature. From my literature review and environmental scan, I found that even though epistemic topoi are a familiar concept in language and communication studies, there is little information on the nature of these phenomena and on its realizations in discourse. There is also little agreement how the topoi can be identified in text and discourse.

I also discovered that theoretical, empirical, and applied investigations are typically viewed as distinct types of research. However, in the process of the empirical part of my study, I found it impossible to produce a conclusive set of findings by means of empiricist methods alone. The topoi proved to be complex semantic phenomena with no definite unit size. Moreover, the long list of topoi that my analysis produced turned out to lend itself to various classifications and interpretations. That is, argumentative meanings turned out to be real but hardly 'objective' elements of text and discourse organization.

Such indeterminacy of phenomena is no news in the rhetoric of science. Here, for example, is Harris's (2005a) commentary on the effects of the researchers' terministic screens on their observations:

> [A] Ptolemaist and a Copernican might look up, indicate the same point of light in the

[1] Also known as normal pressure glaucoma (NPG) and low tension (or pressure) glaucoma (LTG, LPG).

> night sky (say, the one we call *Venus*), utter an observation sentence, "lo, planet," and be making a true proposition within their different cosmologies. But the Ptolemaist could also indicate a different point (the moon) and, with precisely the same utterance, say something true in his system, false in the Copernican... Lo, incommensurability. (p. 41)

When I first ran into problems with the indeterminacy of the units of argumentative organization, incommensurability seemed a very distant threat. I was swamped with the sheer amount of patterns, sizes, and combinations of the linguistic manifestations of topoi, as well with the complexity of the links between them. To control this stream of reality, I had to make methodological decisions. The criteria for such decisions came from a survey of the state of the art and knowledge in information and argumentation studies.

This survey provided two important insights. I found that the preferred unit size for my findings would be the clause. The other insight invoked the spectre of incommensurability. I found that informatics overwhelmingly relies on empiricist (positivist and ethnomethodological) research. Thus the combination of primary and secondary induction that I used in my study called for methodological 'translation'. On the other hand, a review of relevant epistemic theory suggested that my reliance on induction went against the grain of this field, which is traditionally opposed to empiricism. I found that the three preferred models of argumentation in epistemic studies are persuasion, explanation, and pragma-dialectical argumentation. These models tend to foreground one facet of argumentation (the effectiveness, formal validity, or appropriateness of arguments) to the detriment of others. Thus each of the paradigms focuses on one type of situational parameters: interpersonal, conceptual, or phatic. Moreover, most argumentation models assume that communicators bring to their encounters well-formed standpoints and maintain them throughout. The outcomes of such argumentation are modelled as either the communicators' assent to the presented good reasons (provided that the parties are rational or virtuous) or stubborn resistance to the reasons.

What falls through the cracks of the disciplinary divisions is learning. There is very little knowledge of the ways that communicators learn and take account of their natural, conceptual, discursive, and social environments as they engage with one another and with their rhetorical situations. For me this grey area spelled two problems. On the one hand, I had trouble finding justification or as much as terminology to describe my study design. On the other hand, I had little theory to rely on in interpreting my findings. Another meta-theoretical problem that I ran into was that scholars across the disciplines typically profess to pursue one type of research: theoretical, empirical, or political. My own study was uncomfortably perched between models and modes of argumentation and threatened to become an abomination to all of my audiences. Eventually I came across Aristotle's and Kneale's conceptions of situated knowledge and learning that provided me with a ramified lexicon. At this point my project careened into a methodological inquiry. I started analysing my research methods and probing into my assumptions about language and discourse, as well as about the state of epistemic and linguistic research.

The outcomes of my meandering study that are presented in this dissertation include a catalogue of linguistic features realizing epistemic topoi and a taxonomy of topoi exemplifying these

features, as well as a description of the method for situated investigations of multidimensional communicative phenomena, which allowed me produce these results. The descriptions of the topoi and their linguistic features are cast in standard linguistic terminology; their classification uses the categories of rhetorical and activity theory.

The taxonomy describes and classifies epistemic topoi used by the community of clinical NTG researchers in pursuit of their research tasks. I identified fifty-seven recurrent topoi signalled with distinctive configurations of lexicogrammatical, semantic, deictic, and coreferential features. Specifically, I identified the epistemic topoi linked to three major argumentative activities:

- Problem solving (including study design and results topoi)
- Decision making (including state of the art, present study, and conclusions topoi)
- Interpersonal argumentation (including affective arguments, logical arguments, and commentary topoi).

My results confirmed earlier insights into the role of linguistic patterning in scientific reasoning and the relative stability of feature constellations in research genres. The role of linguistic configurations as unique identifiers of argumentative meanings makes them a valuable medium of text and discourse analysis. Their synchronic analysis can bring forth useful results for education and knowledge management. In this study it allowed me to describe the superstructure of clinical NTG research papers and to show how language creates possibilities for the development, articulation, and negotiation of epistemic practices and lexicons. Diachronic analysis of the topoi can offer helpful insights into research trends in communities of practice. In this study I used it for analysis of the dynamics of research in the domain through the prism of its argumentative strategies.

The methodological part of my study is presented in the form of a survey of the prevalent argumentation models and practices in informatics and knowledge management, in scholarly epistemic domains, and in clinical research. It is based on a combination of a literature review, environmental scan, analysis of secondary findings, and ethnomethodological analysis. An important outcome of this part of my research is a description of agonistic and integrated models and practices, along with their discursive manifestations and social substrata. I found that while agonistic argumentation is marked with over-reliance on rigid binary oppositions and agonistic reasoning strategies, integrated strategies call for complex and flexible patterning. The best known model of the latter type is the model of political deliberations, which includes issues related to the following elements of the argument:

- Phenomena or events (fact, cause/ effect, and value)
- Effective responses to them (action, its expediency and possibility)
- Appropriate methods for working out such responses (procedure and definitions)
- Situational motivations for choosing among the proposed methods and responses (appraisal and outcome).

Many authors have demonstrated that such stases are essential heuristic instruments used by expert researchers, practitioners, and communicators. It has also been argued that they can be useful in education. In my study I have used political stasis as an explanatory framework for assessing the

state of research discourse in epistemics and in ophthalmic clinical research.

Dissertation outline

With this dissertation I seek to contribute to the practical tasks of information science and education, as well as the analysis of natural language, text, and discourse. I also hope that my findings may be of interest to the methodologists and meta-theorists working in argumentation studies and clinical research. The dissertation is divided accordingly.

In the next chapter I present a motivation for my inquiry into the linguistic manifestations of epistemic topoi, as well as its major theoretical and methodological concepts. I start the second chapter with a survey of the issues and methods of informatics and knowledge management that pertain to my study. Next, I introduce the major theoretical concepts that informed my investigation. Finally, I present Aristotle's and Kneale's conceptions of situated knowledge and learning that underwrite my methodology.

The following two chapters assess the need for my methodological inquiry into the methods of situated learning. The third chapter reviews the existing models of linguistic and schematic organization of research publications and discusses the status of integrated argumentation models and practices in epistemic disciplines. The empirical part of this chapter is designed as an environmental scan based on the journal titles from my bibliography. Thus it offers an outlook on the current research trends and perceptions in the field of epistemic studies. The fourth chapter achieves three objectives. It surveys the meta-theory and disciplinary organization of epistemic disciplines, their major analytic methods and research types. It also looks into the limitations and implications of dichotomous argumentation models and practices. Finally, it analyses the models of integrated argumentation that have been proposed in the literature as alternatives to dichotomous argumentation. An important outcome of this analysis is a composite model of deliberative stasis for research argumentation.

The fifth chapter analyses my study design in terms of situated learning and explains how my analytic and theoretical framework emerged from the results of my pilot study. Specifically, it outlines my methodological decisions and demonstrates the application of analytic induction and visual annotation for analysis of epistemic topoi. This chapter also provides an overview of the NTG corpus and presents the catalogue of linguistic features that I developed for my investigation.

The sixth chapter starts with a survey of the theory and epistemic lexicon of NTG research followed with the results of my analysis of the NTG corpus. Next, it presents the results of my analysis of the argumentative practices of the domain. The basic elements of the argumentative superstructure identified in the corpus, epistemic topoi, are described in terms of their relations, semantic functions, and linguistic manifestations. To demonstrate the theoretical and practical implications of these findings, I assess the argumentative superstructure of the domain against the model of decision-making argumentation.

The seventh chapter sums up and appraises the study results and draws up its overall implications and conclusions. Specifically, I argue that the view of research ethics as a distinct phenomenon from knowledge is seriously misguided. I also suggest that reductionist argumentation models can and should be tackled by addressing their social underpinnings.

Chapter 2: Meet an old kid on the block: Epistemic topoi

> If we can relate the linguistic patterns (grammatical, lexical, and even phonological) to the underlying functions of language, we have a criterion for eliminating what is trivial and for distinguishing true foregrounding from mere prominence of a statistical or absolute kind.
>
> M. K. Halliday

The excerpt above, taken from Halliday's 1971 paper on literary style, explicates the assumption underlying much of language and communication studies. Halliday talks about a kind of code that would provide direct access to meaning through analysis of the surface features of text and discourse. In descriptive and critical studies its existence is typically taken for granted and does not count as a particularly interesting issue. On the other hand, in NLP and other applied fields the search for this code has been going on in earnest for a few decades but has so far produced no definitive results. The slow progress is often attributed to poor understanding of the semantic organization of natural text and discourse (e.g. Edmundson, 1969) or blamed on inadequate research practices (e.g. Swales, 2004). Some analysts have even expressed scepticism about the very existence of objective links between meaning and language (Hyland & Tse, 2004; Mann & Thompson, 1988; Teufel, 1999). But the idea remains attractive, and the body of positive results is growing. The purpose of this dissertation is to contribute to this work.

Before I embark on describing the linguistic realizations of argumentative organization, I will introduce some relevant theoretical concepts and survey the social, disciplinary, and methodological contexts of my inquiry. This chapter will offer a review of the state of knowledge about argumentative organization in informatics and knowledge management. It will also set up theoretical and methodological frameworks for my investigation.

Social background

Information explosion

The motivation behind this study is the favourite bogeyman of modern-day epistemicists, information explosion. It is well documented. For example, it has been estimated that the volume of research literature doubles every fifteen years (e.g. Hersh, 2003, p. 26). Of course the name of the phenomenon could as well be information bonanza. Indeed, the new reality creates unprecedented opportunities for learning and research, both primary and secondary. Importantly, it creates very real opportunities for the sharing of knowledge across and beyond disciplinary borders:

> The diffusion of innovations across science could be markedly increased by making solutions developed in one area visible to specialists still searching for them in a different field. (Rzhetsky, Seringhaus, & Gerstein, 2008, p. 10)

However, people have yet to learn to deal with "unimaginable amounts of information of unprecedented complexity" (Candy, 2007, pp. vii-viii) that they publish.

The problem is especially acute in biomedicine and healthcare where the paradigm of evidence-based knowledge and decision-making exerts pressure on specialists on the ground to keep abreast with research (Hersh, 2003, pp. 75-82; Rosser, 2003). In 2002 the Medline database alone contained 11.7 million citations (e.g. Lusignan & Robinson, 2007). Known diseases, drugs, tests, and procedures now number in the thousands (Dwivedi, Bali, & Naguib, 2007). This new reality has produced profound changes in professionalization and research, extending expertise beyond memory-intensive lore to include adeptness in information and knowledge management (Dwivedi, Bali, & Naguib, 2007). A major task for the fields of knowledge management and informatics is then to bring together technology, organization, and user expertise. In their present state, the interface between these key elements is far from problem-free.

One obvious point in case is information retrieval (IR). The purpose of IR systems is to provide access to information stored in digital collections or on the internet. Some of the major concerns here are the efficiency of search engines and relevance of the retrieved content. The information is organized and retrieved with the help of metadata, which result from indexing the stored content. An important method of automatic indexing in health and biomedicine consists in mapping the lexis of documents to controlled domain-specific vocabularies (Hersh, 2003; 2009). Controlled vocabularies include information on the semantic relations among specialized terms as well as nonterm attributes, such as text types and elements of textual structure (e.g. Hersh, 2003, pp. 149-160, 415-420). When tied to the semantics of the search terms, this information increases the effectiveness of the retrieval.

In spite of rigorous indexing, the comprehensiveness and relevance of retrieved content are as much an issue nowadays as they were at the inception of IR. The quality of IR depends, among other things, on the sophistication of text and discourse models that inform the structure of the controlled vocabularies, the generation of metadata, and the design of the search options. Popular IR systems 'know' little about the organization of discourse and knowledge beyond the thematic make-ups of individual documents. This means that contemporary IR envisions information and knowledge as a sum of discrete lexicalized entities. The interconnections between such entities are mostly described in terms of density, proximity, and sometimes arrangement. With such 'flat' models of knowledge and discourse, it is no surprise that intelligent content systematization, such as the generation of directories, bibliographies, abstracts, or reviews, is beyond the grasp of modern IR systems (Hersh, 2003). The 'flat' organization also explains why users often get lost in hyperspace, overwhelmed with enormous amounts of unstructured information (Hersh, 2003, p. 17).

Positivist approaches in informatics and knowledge management

Users have very little help in dealing with the mammoth amounts of poorly structured information. Arguably, a major barrier for developing efficient, intelligent information retrieval (IR) and knowledge management (KM) systems is uncritical use of positivist analysis methods. In Jordan's (2002) terms, this situation is a symptom of "shotgun empiricism" sweeping knowledge-intensive domains (p. 106).

In the situation of information explosion expert and professional users heavily depend on compressed and synthesized information (Hersh, 2003, pp. 46- 48, 264; Rosser, 2003). Such information comes in the form of abstracts, annotations, reviews, and other types of 'surrogates' (Borko & Bernier, 1975, p. 5). Hersh (2003) suggests that automatic summarization and synthesis of all available evidence will become the basis of "next-generation EBM [Evidence-Based Medicine]," which will create better opportunities for healthcare stakeholders' well-informed decisions (p. 81). Rzhetsky, Seringhaus, and Gerstein (2009) see text- and literature-mining as "a powerful approach, one we expect to substantially bolster the scientific reporting and discovery process in coming years" (p. 3). This is an inspiring vision but an unlikely near prospect. Certainly technology has removed the need for manual word processing and created opportunities for automated and semi-automated content analysis. But the technological power by far outstrips available meta-theory. Worse yet, technology tends to amplify its creators' epistemic inadequacies (Jordan, 2002). For example, the increasingly popular method of quantitative meta-analysis is essential for evidence-based medicine (EBM). Not surprisingly, one of EBM's weaknesses is rooted in meta-analysis, raising criticism that EBM is partial to statistical rigour and positivist heuristics at the expense of flexibility and comprehensiveness (Hersh, 2003, p. 82).

In informatics positivist approaches are also a powerful influence (Hjørland, 2005). For example, Rzhetsky, Seringhaus, and Gerstein (2009) suggest that, in text mining,

> the *preponderance* of evidence could assist in identifying and resolving *errors*.... we might *probabilistically argue*, then, that [a] lone conflicting statement is false and should be disregarded – unless it is supported some other way. (pp. 3, emphasis added)

This suggestion sources from the assumption that knowledge can be objective (e.g. Tagore & Einstein, 1984), which has two important corollaries: (1) learning is probabilistic and, therefore, strictly cumulative, and (2) conflicting data are erroneous data. It follows that information can "vet and prune itself by examining the consistency among many entries" (Rzhetsky, Seringhaus, & Gerstein, 2009, p. 2).

In contrast to reductionist models of knowledge, Bazerman's (1985) analysis of scientists' reading techniques revealed that experts have sophisticated ways of dealing with abnormal evidence. In fact contrasting and even incommensurate findings have been found to be essential for advancement of knowledge. In Flower's (2002) words, people learn by exploring the "generative possibilities of conflicting ideas and competing realities" (p. 239).

It seems that at the root of information explosion lies not the amount of available information but a lack of understanding how communities and individuals can benefit from it. Medicine and

healthcare may need more, not less, information along with more intelligent methods of research and knowledge management. For example, it is well understood – in IT as elsewhere – that users' information needs vary a great deal depending on their specific situations, states of knowledge, and the stages of their searches (Hersh, 2003). It has been suggested that clinicians seek, organize, and use knowledge differently from patients (Jordan, 2002), as well as from other healthcare professionals and from researchers (Dwivedi, Bali, & Naguib, 2007). Yet, as Rzhetsky, Seringhaus, and Gerstein (2008) tell us, in IT and KM the most popular "models describing how text is generated in the human mind… are deterministic or probabilistic contextfree grammars" (p. 10). Such heuristics tend to clash with users' "intelligent rules of thumb" (Lusignan & Robinson, 2007, p. 15) by filtering out the very information that creates learning opportunities and allows for knowledge growth. The disparity between human and computational heuristics and dynamics is cited as a major reason behind failing IT innovations (Chowdhury, 2007; Liebovitz, 2007). It can sometimes be resolved through user education (Fennessy & Burstein, 2007) and adaptation of medical and healthcare routines to new systems and strategies (Lusignan & Robinson, 2007). But above all, IR needs to be "optimized for discussion, to allow disagreement, or to represent uncertainty" (Rzhetsky, Seringhaus, & Gerstein, 2008, p. 11).

Machine learning

Machine learning is believed to emulate human learning and thus is often seen as superior to deductive, top-down approaches, which impose alien generalizations on the tasks at hand. So far this method has produced mixed results.

Even though in terms of resource efficiency machine learning may fall behind the capacity of human learning (Kononenko & Kukar, 2007, p. 56), its outcomes bear clear marks of human epistemic handicaps. For example, in supervised machine learning the input often consists of corpora of natural language artefacts coded by human annotators. The computers are expected to learn replicating the patterns that the annotators 'perceive' in the discourse. But of course such input is as good as the prevalent folk theories of knowledge (Stich & Nichols, 1993, pp. 264-266). On the other hand, some unsupervised machine learning approaches purport to 'discover' patterns and associations in discourse in abstraction from received theories of language and discourse organization. However, in practice they typically depend on existing 'knowledge sources', such as dictionaries (Manning & Schütze, 2000, p. 232). Moreover, it would be naïve to expect the outcomes of machine learning to be independent from the system designers' assumed conceptions of learning (Drummond & Japkowicz, 2010; Witten & Frank, 2004, Chs. 1, 2). The link between machine learning and 'folk theories' is further reinforced at the evaluation stage, since the outcomes are either evaluated statistically (Drummond & Japkowicz, 2010) or based on users' approval (Witten & Frank, 2004, pp. 26, 43). Thus, rather than produce uninhibited generalizations about discourse, machine learning is used to elicit the models of discourse organization that are implied in the input (Drummond & Japkowicz, 2010, p. 77; Kononenko & Kukar, 2007, p.1; Manning & Schütze, 2000, pp. 231-232).

Given the heavy dependence of machine learning on the received conceptions of language, discourse, and knowledge, it is clear that cavalier attitudes to the epistemic underpinnings of informatics and knowledge management (Drummond & Japkowicz, 2010; Manning & Schütze, 2000, p. 311) present serious ethical and methodological problems for these domains (Drummond & Japkowicz, 2010; Witten & Frank, 2004, p. 35 ff.). The identification and description of 'essential' (as distinct from 'accidental') patterns of text and discourse semantics call for complex approaches involving synthesis of primary and secondary induction (Kononenko & Kukar, 2007, p. 55). That is why such analysis requires not only logistical but also solid theoretical and methodological resources (Drummond & Japkowicz, 2010).

Of course it is tempting to treat text and discourse as a Popperian world of disembodied ideas since this is the form in which knowledge presents itself to the users and analysts of document repositories. In fact this kind of treatment has proven to be quite effective for a number of tasks in data mining (Witten & Frank, 2004, Ch. 1; e.g. He & DiMarco, 2005) and discourse analysis (e.g. Biber, Csomay, Jones, & Keck, 2004). Yet the peculiar reductionism of the current methods of natural language processing and text harvesting can also impose serious limitations on their outcomes. Theory is here rarely recognized as a contingent and malleable system of ideas and methods. Instead, theoretical statements are often seen as accurate representations of the natural world. For example, it is often assumed that an unmodified sentence like *Hyphae-specific genes, HWP1, RBT4 and ECE1, were activated in the elongated filaments caused by the Cdc28p depletion* reports "an actual finding" and invokes more certain evidence than a sentence with modifiers: *We suppose that an increased LI in breast tissues of this group of patients may help explain the association between BC and thyroid autoimmunity* (Wilbur, Rzhetsky, & Shatkay, 2006, p. 357, emphasis added). Of course this assumption makes good sense. Other analysts (Myers, 1992; Salager-Meyer, 1994; Thomas & Hawes, 1994) also found that metadiscourse (including reporting verbs like *suppose*, hedges like *help*, and modals like *may*) indexes the community's state of knowledge. But the level of confidence is just one of the multiple meanings communicated with metadiscourse. That is why there is a fair amount of variation in metadiscoursal styles between individual authors. Importantly, metadiscourse also marks up propositions for their argumentative meanings. In other words, hedging reflects not only the authors' certainty about the proposition but also its argumentative function in the text. That is why the same proposition (such as *an increased LI in breast tissues of this group of patients [explain] the association between BC and thyroid autoimmunity*) will have different metadiscoursal markups in different parts of the argument. For example, key findings tend to be stated in a more tentative way in introductions than in conclusions (Salager-Meyer, 1992). Yet the expression of greater confidence at the end of the paper hardly endows a higher 'factual' status on the proposition.

Rhetorical theory warns us that "see[ing] professional scientific writing as the impersonal statement of facts that all add up to the truth" is "a very dangerous myth" (Crismore & Farnsworth, 1990, p. 118), and the philosophy and history of science remind us to tread lightly when it comes to 'facts'. Such caveats should not incapacitate the progress of technology – and thankfully, they never

do. But apart from caveats large and small, epistemic disciplines have accumulated a lot of knowledge that can benefit situated research in very practical ways. For example, the concept of schematic organization of text and discourse could be a useful addition to the positivist toolbox of the domain. Above all, the theory of situated knowledge and learning could radically change the state of the art in annotation and machine learning.

Theoretical resources

Epistemic topoi

Argumentative organization is often discussed in terms of schematic logics and their elements: topoi, or topics. The idea of such organization is easy to grasp. For example, most communicators know that an argument is not complete unless it has at least two parts: a standpoint and 'proofs'. Of course more elaborate arguments branch into more than two components. For example, Toulmin's (1969) argumentation model includes a CLAIM, supporting EVIDENCE, a WARRANT linking the evidence to the claim, a BACKING that supports the warrant, a QUALIFIER and REBUTTAL, which moderate and limit the claim. Research publications have an even more intricate organization. Descriptive studies provide multiple examples of rhetorical topoi and their conventional sets and sequences from various mediums and genres of communication. For example, Trawiński (1989) found fifty-three 'content elements' in a corpus of information science articles. These elements include such statement categories as the SCOPE OF DOCUMENT, IDEA OF SOLUTION, MODEL USED, PRELIMINARY ACTIVITIES, and SIDE EFFECTS.

The diversity and complexity of natural argumentation make the formalization of empirical observations related to topical organization quite challenging. In fact the very definition of topoi is one of the grey areas in argumentation theory (Huseman, 1994; Miller & Seltzer, 1985; Rubinelli, 2006). Besides, the phenomenon is known in linguistics and rhetoric by different names. In linguistic analyses topoi are referred to as speech acts (Myers, 1992), "content elements" (Trawiński, 1989), or "components of information" (Liddy, 1991). In rhetoric the concept is also anything but straightforward. The notion of rhetorical topoi covers not only statement types but also so-called material topics. In linguistics the latter type of organization loosely corresponds to sentence and discourse topics[2] (Van Dijk, 1980, esp. pp. 94-98). Such topics belong to the 'information structure' (also called 'dynamic perspective' or 'functional perspective'). A material topic is the part of a syntagmatic unit (a sentence, clause, or text) that the rest of the unit talks about or builds on.[3] Such topics are believed to be explicitly present in discourse, typically falling on the first half of syntagmatic units.

In contrast to material topics, some topoi are implied rather than stated or named in discourse. Saying *I'm honest* does not necessarily constitute honesty, and mentioning *comparison*

[2] Also referred to as the *focus*, the *given information*, and the *theme* (Goustos, 1997).
[3] E.g. Halliday (1994, pp. 36, 59).

does not always entail making a comparison. Implicit topoi are often understood as a kind of logical relationship. It is believed that they manifest themselves through indirect cues. Rubinelli (2006) defines the topos as "a pattern of argumentation based on linguistic usages" (p. 256). Huseman (1994) calls topoi "implicitly or explicitly stated enthymemes" (p. 197), and Aristotle explains that such enthymemes correspond with their implied "propositions" as "Signs" with "Probabilities" (*Rhetorica*, I.2. 1357a). According to Aristotle, these enthymemes often miss an explicit conclusion that would label the topic. For example, in

> such a saying as 'This treaty is a far nobler trophy than those we set up on fields of battle; they celebrate small gains and single successes; it celebrates our triumph in the war as a whole'… both trophy and treaty are signs of victory. (III.10. 1411b)

The topos *victory* is not named in Aristotle's example but can be inferred from it. *Victory*, *honour*, and *the good* are material topoi – culturally significant and thus recognizable appeals. Another type of implicit appeals is so-called formal topoi (Huseman, 1994; Prelli, 1989), which do not concern notions but, rather, label typified relations among them. In the contemporary literature on text linguistics and discourse analysis, formal topoi go by a variety of different names: connections (Van Dijk, 1980, passim), rhetorical relations (Mann & Thompson, 1988), and patterns of organization and development (e.g. Kane, 1983, pp. 102-202).[4]

There is clear evidence that argumentative meanings are signalled with the linguistic features of the clauses that communicate them (Swales, 1990, 2004; Paice, 1990; Taboada, 2009; Teufel, 1999), but the nature of the links between the meanings and their linguistic manifestations remains evasive. A good question to start with is how communicators perceive text and discourse semantics. For example, most readers will probably agree that the clause *Crichton et al. confirmed the same issue* talks about consistency between the reported results and earlier findings, and that *To the best of our knowledge, the effect of brimonidine on POBF has not yet been reported* states an open issue. Yet these designations have little to do with the linguistic topics of the sentences. Nor are the meanings obvious from the diction since the first statement has no mention of *consistency*. It does mention an *issue*, but this is not its topos.

How can we make sense of such discrepancies? It seems that to a great extent the recognition of topoi depends on what in modern literature is typically termed *coherence*. Depending on the nature and course of a particular discourse, people expect one another to say or write certain types of utterances and to arrange them in certain ways (Miller, 1984; Van Dijk, 1980, pp. 228-249; Schryer, 1993). In other words, the knowledge of topical constellations and their application in various situations is shared among community members. Such constellations correlate with the conventional structures of text and discourse, such as the IMRD structure, but they are a distinct phenomenon[5] (Van Dijk, 1980). Since antiquity they have been called *schemata* (Fahnestock & Secor, 2002; Lauer, 2004); to contemporary analysts they are also known as *topical logics* (Prelli, 1989), *illocutionary*

[4]Van Dijk (1980) also lists among topics such textual elements as summaries and paraphrases (pp. 100-103).
[5] Refer to Chapter 5 for a discussion of the relations between textual and schematic organization.

logics (Rouveyrol et al, 2005), *frames*, *scenarios*, *demons*, or *scripts* (Van Dijk, 1980, p. 229). Topical constellations are inextricably linked with human agency. They reflect and shape the schematic patterning of cognition and social life (Miller, 1984; Schryer, 2001; Schryer et al., 2007). They also underwrite the procedures, mechanisms, and relations involved in knowledge discovery, exchange, and maintenance (Arthos, 2000; Connely & Johnson, 1980; Dreher & Singer, 1989; Hersh, 2003, p. 66; Van Dijk, 1980, passim). When epistemic topoi become explicit in discourse, they are usually referred to as *metalanguage* (Berry, 2005), *paralanguage* (Trager, 1958), *metatalk* (Schiffrin, 1980), or *metatext* (Dahl, 2004).

To sum up, the notion of topos covers both the formal and material manifestations of argumentative meanings. In other words, it includes both their conventional linguistic realizations and names. It might be tempting to view material and formal topoi as separate or even mutually exclusive forms of meanings. Yet, as will be explained in the next subsection and in Chapter 6, there is no clear divide between them in actual language and discourse. That is why it makes sense to approach topoi as semantic, rather than lexico-grammatical or syntagmatic, phenomena. However, in this study I limit the scope of my analysis to statement types that have regular correspondences with argumentative meanings. Therefore, what is here meant by a topos will most of the time be a statement type with a certain recurrent meaning, which functions as an element of a conventional argumentative schema and is signalled with recognizable linguistic features.

Epistemic metadiscourse and metalanguage

Epistemic topoi constitute a flexible and fluid system with more and less articulate elements. Both types are often studied as a kind of metadiscourse. Metadiscourse can take various forms: from passages of explicit authorial commentary (Crismore & Farnsworth, 1990) to typographic features (Kumpf, 2000) and intonation (Thompson, 2003). Here is Hyland's (2005) take on the phenomenon:

> It is a specialized form of discourse which allows writers to engage with and influence their interlocutors and assist them to interpret and evaluate the text in a way they will see as credible and convincing. As a result, metadiscourse is intimately linked to the norms and expectations of particular communities through the writer's need to supply as many cues as necessary to secure the reader's *understanding and acceptance of the propositional content*. (p. 60, emphasis added)

That is, in Hyland's model, metadiscourse is that which gives meaning to propositional content.

Hyland's list of metadiscoursal signals offers a glimpse of the scalar nature of this level of discourse organization. It includes signals from different morphological categories with otherwise similar semantic identities. Let us take the following set from the categories of transition and engagement markers: *but*, *by contrast*, and *contrast*. The first is a conjunction, the second a prepositional phrase that can act as an adverbial modifier, and the third is (in Hylands's usage) a verb (pp. 52-54). Note that even though they all point to essentially the same type of semantic relationship between ideas, only the second and third name this relation, while the first just indexes it. In

cognitive terms, there is a difference in the degree of conceptualization between them: *contrast* reifies *but* and is thus cognitively 'heavier' (Nuits's, 2004). The high frequency of words like *but* in most discourse domains shows that they are more indispensable for human communicators than epistemic abstractions. That is why most people will learn *but* before *contrast* (unless they learn from a dictionary). Yet the invention or apprehension of a lexeme for a former je-ne-sais-pas-quoi is a radical change in the development of communities and individuals. For such lexemes I will use the term *epistemic lexis* or *metalanguage*.[6]

The distinction between metadiscourse and metalanguage brings into focus the difference between conceptualized and articulated meta-knowledge. For an illustration of this difference let us make a brief foray into the beginnings of stasis theory. Aristotle may have been the first to start cataloguing the phenomenon of meta-knowledge, but he certainly did not discover it. His description of the court procedure is especially relevant here. According to Aristotle, the typical contention points "fall under one of four heads. (1) … that the act *was not committed*,… (2) … that the act *did no harm*… that (3) the act was *less* than is alleged, or (4) *justified*" (*Rhetorica*, III.17.1417, emphasis in the original). In modern rhetoric such topical organization is typically referred to as heuristic due to its utility in rhetorical invention. The specific pattern that Aristotle talks about is now called *stasis* (e.g. Fahnestock & Secor, 2002; Lauer, 2004; Nadeau, 1998). The 'discovery' of the pattern is usually attributed to Hermogenes. Indeed, Aristotle does not call it by its conventional name. In fact he has no name for it at all. Cicero's account of the stases in *De Inventione* is somewhat similar to Aristotle's:

> Every subject which contains in itself a controversy to be resolved by speech and debate involves a question about a fact, or about a definition, or about the nature of an act, or about legal procedures. (I.VIII.10)

Yet his conception is clearer than Aristotle's since his analysis is couched in a more elaborate specialized vocabulary. Cicero credits the invention of this procedure to Hermagoras but claims to be the first rhetorician to include it into the stasis model: it is "not that orators did not use it before this day – many did use frequently – but… earlier writers of text-books did not notice it" (I.XI.16). Cicero has a systematic vocabulary for the schema. He alternately labels its elements *issues* (or *questions*), *causes*, and *statements*, and he defines these terms.

So here is the difference between conceptualization and articulation. Both Aristotle and Cicero advance conceptions of stasis. But Cicero works with a more elaborate epistemic lexicon than Aristotle, and this allows him to produce a more explicit and elaborate analysis.

Modern-day commentaries on Cicero's and Aristotle's works demonstrate the significance of articulated meta-knowledge. While Cicero is recognized as a major contributor to the stasis theory of argumentation (Prelli, 1989), the Aristotelian conception of stasis is believed to have a limited range (Dieter, 1994; Lauer, 2001, pp. 19-20; Nadeau, 1998). It seems that in absence of explicit labels, readers have difficulty attributing significance to ideas or even noticing them. They read Aristotle's

[6] Cf. Goddard, 2008; Wierzbicka, 1986.

account of stasis and learn from it but do not necessarily perceive it as a conception.[7] Here is an insight from Stannard (1965) into the difficulty of interpreting non-lexicalized epistemic concepts: "It is not always easy to catch the force of ancient arguments because what has been preserved is not labelled as 'premise' or as 'conclusion'" (p. 197).

Epistemic metalanguages allow discourse communities to preserve and share their knowledge of the topoi and schemata, as well as to negotiate this knowledge and its applications. Willard's (1989) analysis of argumentative "interactional structures" (p. 53) offers a helpful commentary on the dynamic relations between the stable and fluid elements of argumentation. Arguments, he says, are "ordered serially according to conventional principles…, yet they are also emergent" (p. 89). The emergence of arguments depends on what Willard calls *hypothesis-testing*. Communicators make hypotheses about communication in general as well as about specific encounters. The juxtaposition of the two types of hypotheses allows participants to interpret the argument. The interpretation is enabled by shared 'organizing schemes', or schemata. In the process of communication the participants follow schematized procedures as they put to test their linguistic and social expertise:

> Guided by schemata, impression formation involves interpretation and inference plus the progressive elaboration of one's belief system to accommodate new information. Hence a circular relation exists between assimilation and accommodation: schemata organize our expectations – we interpret and organize new information to fit the schemata we have chosen… (p.22)

Of course it is communication that gives rise to hypotheses in the first place. Willard calls the interdependence and circularity of experience and performance "a benign circle… of inferences, messages, and social environments" (p. 40). In addition to organizing schemata, hypothesis-testing also depends on epistemic lexicons that make a stock of shared experiences and thus create a common conceptual ground for communicators:

> Expressions do not come from thin air. They are indexical to something... We assume that a speaker takes it for granted that we can draw the links between his or her expressions and the bodies of knowledge or practices to which the expressions refer. (p. 59)

In short, it is epistemic lexicons that organize arguments "according to conventional principles" and that allow arguments to be "also emergent" (p. 89).

Meta-knowledge and meta-theory

According to Willard, epistemic knowledge emerges through communication. How exactly do people acquire it? Aristotle explains that like any other lore, the art of argumentation can be apprehended by observation or demonstration:

[7] Cf. Harris (1998) on the concept of the Max Planck effect.

> [T]o a certain extent all men attempt to discuss statements and to maintain them, to defend themselves and to attack others. Ordinary people do this either at random or through practice and from acquired habit. Both ways being possible, the subject can plainly be handled systematically, for it is possible to inquire the reason why some speakers succeed through practice and others spontaneously; and every one will at once agree that such an inquiry is the function of an art. (*Rhetorica*, I.1.1354a)

Aristotle's analysis sheds light on the links between folk theories of knowledge and its systematic study. The students of knowledge, he explains, share interest in argumentation with ordinary people. They have no secret lore about it or any privileged access to its channels. Like lay communicators, scholars are able to learn "through practice" or "spontaneously." Yet there is a difference between knowledge and meta-knowledge. Aristotle explains that not only can people learn the 'knack' of argumentation – they can also take charge of their learning, and with the systematic handling of argumentation they can go even farther. They can turn learning into a subject in its own right, inquiring into the mechanisms of argumentation and its apprehension ("the reason why some speakers succeed through practice and others spontaneously"). The systematic treatment of the subject allows the students of argumentation to look beyond the ever-popular technical issues (how "to discuss statements and to maintain them, to defend themselves and to attack others"). Such a desire and ability to transcend the here-and-now and how-to of everyday communication is to Aristotle the mark of art, and his contribution to this art is unmatched in the Western tradition. His *Organon* offers a comprehensive and systematic treatment of meta-knowledge. His concern with the explication and compilation of lexicons underlies all his inquiries into the conceptual and linguistic resources of communication. He believes this lore to be "the same in all cases, in philosophy and in any art or study" (*Prior analytics*, II.30. 46a28-46a31).

The distinction that Aristotle draws between knowledge and meta-knowledge allows him to claim for rhetoric the status of an epistemic discipline in his foundational definition of this discipline "as the faculty of observing in any given case the available means of persuasion" (*Rhetorica*, I.1.1355b). The focus on knowledge and argumentation is even more prominent in the Aristotelian blueprint for rhetoric and dialectic,[8] both of which "are concerned with such things as come, more or less, within the general ken of all men and belong to no definite science" (I.1.1354a). Aristotle sees a strong methodological connection between the two fields:

> [T]he true and that which resembles it come under the purview of the same faculty, and at the same time men have a sufficient natural capacity for the truth and indeed in most cases attain to it; wherefore one who divines well in regard to the truth will also be able to divine well in regard to probabilities. (I.1.1355b)

Aristotle's own approach to the study of communication is based on observation and guided by the practical needs of education. Very much like contemporary methodologists and ethno-methodologists – and much like the sophists before him and generations of rhetoricians, philosophers, and linguists

[8] Refer to Alexandrova (1987) for a detailed analysis of the links between rhetoric and argumentation theory.

after him – Aristotle painstakingly gathered and synthesized the epistemic concepts developed in various fields by lay communicators, experts, and scholars.

His major objective in the *Rhetoric* is analysis of the resources of effective persuasion in various communicative situations. Of course once the observational frame expands from argumentation to the learning of argumentation, the former *why*s will morph into new *how*s, as in *how to help people with different learning styles and personality types learn to speak in public*. This shift can start yet another epistemic loop involving a new series of observations, recontextualizations, analyses, generalizations, reframings, and reifications (Goffman, 1974). Like any other kind of epistemic expansion, the proliferation of epistemic dimensions is kept in check by what the Ancient Greeks called *phronesis*: practical wisdom or common sense. Absolute clarity is unattainable and not always desirable: "life would not be long enough to reckon all the possibilities" (*Rhetorica*, I.13.1374b).

Communicators have little trouble navigating the stratified linguistic resources provided by their epistemic lexicons. However, fitting these resources into "the bipolar construct mold" (Willard, 1989, p. 21) of language and communication theory can be a challenge. Classification of topoi is one of the tasks that provide analysts with a range of options and challenges. For example, in addition to the popular material/formal opposition discussed above, Aristotle cites the division into "specific topics, which are called particular and special" and "common or universal" (I.2.1358a). Aristotle offers elaborate lists of both categories and detailed recommendations on how orators should use them. However, he is prudently circumspect on which topics refer to which category.[9] Indeed, the material vs. formal and special vs. universal divisions of topoi are neither obvious nor fixed. For example, contrast may be set up via contrastive diction or via so-called balanced constructions (e.g. Kane, pp. 253-259) and hence can operate as a formal topos. It may also become a material topos in discourse *about* contrast (such as this sentence). The same difficulties apply to special and universal topoi. For example, how should we classify the topoi that are infrequent but pervasive, or the topoi that, on the contrary, have high frequencies in a limited range of discources?

Clearly, binary oppositions cannot capture the complexity of topical organization. However, they provide some insight into the nature of epistemic analysis of biomedical discourse. As Kitcher (1981) explains, "Arguments may be similar either in terms of their logical structure or in terms of the nonlogical vocabulary they employ at corresponding places" (p. 518). Epistemic investigations are concerned with 'logical' structures. According to Kitcher, analysts can discern their presence in discourse as recurrent patterns (p. 518) – that is, as common topoi and their constellations. To describe and classify such structures in my corpus, I had to reify them from the specific subject-matter of the publications. For the purposes of the present investigation, I will refer to the system of such recurrent topoi as the domain's meta-knowledge, which is distinct from the content specific to each publication.

[9] See, for example, McBurney's (1994) and Huseman's (1994) analyses of Aristotelian topoi.

Methodological resources

Integrated research models

The literature has numerous theoretical and descriptive accounts of epistemic schemata (e.g. Gross, 1990; Harmsze & Kircz, 1998; Liddy, 1991; Miller & Seltzer, 1985; Prelli, 1989; Salager-Meyer, 1994; Swales, 1990, 2004; Thompson, 1993; Van Dijk, 1980). There are also many descriptions, classifications, and comparative analyses of the language of argumentation (e.g. Afros & Schryer, 2009; Butler, 2003; Fahnestock, 1999; Gross, Harmon, & Reidy, 2002; Hyland, 2005; Nuyts, 2001; Salager-Meyer, 1991, 1992 1994; Schryer et al., 2007; Teufel, 1999; Thomas & Hawes, 1994).[10] The missing piece in the puzzle is the nature of the links between semantic and linguistic units of organization. In informatics and knowledge management, experts often place hopes of a breakthrough on the integration of top-down and bottom-up approaches (e.g. Hersh, 2003, pp. 397 ff.; Rzhetsky, Seringhaus, & Gerstein, 2008, p. 11). Indeed, what are seen as strictly top-down or bottom-up approaches are likely to produce a vicious circle rather than a comprehensive and coherent picture of natural argumentation. The state of research into epistemic topoi is a clear case of such a circle. On the one hand, it is hard to describe them in absence of a viable classification; on the other, the complexity of natural argumentation makes a reliable classification of topoi hard to 'intuit' in abstraction from empirical data.

Binary models of knowledge processes and disciplinary organization offer no escape from the conundrum. They are typically based on the assumed division of all research into theoretical and empirical. Theoretical research is believed to encompass top-down, or deductive, approaches, while empirical research is thought to proceed inductively, from the bottom up:

> Reading experimental or descriptive papers in science, we invariably experience an inductive process, a series of laboratory or field events leading to a general statement about natural kinds; in theoretical papers we experience the opposite movement, a series of deductions whose conclusions invoke or imply confirming observations. (Gross, 1990, p. 83)

Halloran (1982) finds that deductive reasoning and empirical research are viewed in education as competing paradigms. Yet they have much in common. Both types of research are often conducted on the premise that order naturally inheres in human language and communication. So theorists and empiricists are expected to meet halfway between abstract rules and elemental observations and eventually to synthesize their findings into a body of cumulative and incontrovertible knowledge. On this view, linguistic and discursive patterns are 'natural kinds': regularities that wait to be discovered by insightful thinkers and impartial observers.

To an extent this faith has been rewarded. Regularities exist in discourse as patterns and clusters of features that are variously linked to communicative and cognitive meanings and

[10] Refer to Swales (1990, 2004) for reviews of linguistic literature on research articles and to Teufel (1999) for a review of literature on argumentative organization across research domains. For a comprehensive review of argumentation theory, see van Eemeren et al. (1996).

behaviours. They can be identified by various observation methods: introspection, reader response and ethnomethodology, text and discourse analysis. Throughout the history of language and communication studies scholars have produced an abundant literature describing 'natural laws', which are often introduced as rules or recommendations for those who wish to speak correctly or communicate effectively. Of course every now and then iconoclasts throw cold water on the well-oiled disciplinary machines by pointing out contradictions or inadequacies in received theories and models of language and communication or even raising the issue of their relevance. In the second half of the last century the role of such criticisms in knowledge processes was a popular topic in the philosophy, history, sociology, and rhetoric of science. An important outcome of these investigations was a renewed appreciation of paradoxical thinking and a growing popularity of the strong programme of social constructivism among scholarly epistemicists (Fuller & Collier, 2004, passim; Korobov, 2001).

Quite understandably, the positions of experts and analysts on the ground are less radical. Rather than embrace the rigid rules of the old school or the relativism of iconoclasts, many practitioners have argued for a compromise between the unqualified optimism about the power of empiricist methods, on the one hand, and the paralyzing scepticism about their utility, on the other. Increasingly, researchers raise the issue of the soundness, social accountability, and relevance of their investigations (Davies & Elder, 2004).

Nowadays it is well understood that concepts or phenomena admit of any number of characterizations, and, in Schegloff's (1997) words,

> none of these characterizations can get an adequate warrant by saying that it was employed because it is *true* – even though it *is* true. They are *all* true.
>
> At a time when there appears to be deep skepticism about the possibility of establishing *anything* as true, we have here an embarrassment of truths. And of course this is why we have such a skepticism; because each truth, or at least many of them, is said to be appropriate to the product of, but relative to, the perspective brought to the matter of hand. And in the apparent multiplicity, and continuing multiplication of perspectives, truth seems to disappear in a hall of perspectival mirrors. (p. 166)

Clearly, empiricist and positivist inquiry methods alone cannot bring about a breakthrough in the theory of knowledge and information technologies (Clarke, 2006; Hersh, 2003; Kimble & Hildreth, 2004), and that is why systematic knowledge and situational factors motivating research cannot be dispensed with. However, it is not always clear how the diverse elements and factors of research can be accounted for in viable and manageable study designs.

Aristotle and Kneale on situated knowledge and learning

In the philosophy of science synthesis of empirical, theoretical, and applied research methods is known as primary and secondary induction[11] (Kneale, 1949). This combination of terms may suggest a linear sequence of research 'modules' in a study. However, the positivist idea of disinterested, abstract analysis leading up to theoretical generalizations that are in turn applied to practical tasks is seriously misguided. Aristotle analyses the complex interaction between primary and secondary induction in the *Nicomachean Ethics* where he looks into the psychological and social underpinnings of decision making. On his view, knowledge is part and parcel of communal agency. It emerges from activities involving both learners and 'philosophers'; it is gained through engagement with the communal lore and the natural world; and it is invoked in response to specific exigencies. Systematic knowledge is the domain of "things that are universal and necessary" (VI.6.1141a). It can be taught by demonstration or discovered inductively. In isolation from practical wisdom, knowledge is "remarkable, admirable, difficult, and divine, but useless" (VI.7.1141b). What makes knowledge relevant to people and communities is practical wisdom, which has multiple links with agency. Not only is it "concerned with action" (VI.7.1141b), it also requires knowledge of "particulars, which become familiar from experience" (VI.8.1142a). Neither systematic knowledge nor practical wisdom is possible without comprehension, which is unattainable through formal education or observation but is essential for both learning and decision making. In Aristotle's words, comprehension "is concerned with the ultimates in both directions" (VI.11.1143b). One kind of comprehension consists in matching concepts to phenomena. It "grasps the unchangeable and primary definitions" (VI.11.1143b), introducing learners to the "principles of everything that is demonstrated and of all knowledge" (VI.6.1141a). The other kind of comprehension grasps the particulars of the situation that calls for a decision: "the starting-points of that for the sake of which" (VI.11.1143b). Thus learning is impossible without comprehension, which in turn emerges through judgement from agency.

Aristotle's analysis shows that researchers are faced with complex tasks. Their prose must not only be valid, 'well turned', and forceful but also ethical and well informed. The researchers position their work in multiple contexts and speak to multiple realities: phenomenal, interpersonal, disciplinary, and social. The situational factors are more than a control mechanism subordinating creativity to prudence; they are essential for the selection and disambiguation of otherwise limitless observations about 'natural kinds'. Situations impinge on research in many ways. The disciplinary discourse provides researchers with a conceptual apparatus. By matching concepts to the tasks at hand they make their observations comprehensible and draw power from available theory and meta-theory. The interpersonal and social contexts allow them to formulate what Aristotle calls the final and effective causes for their investigations. In other words, research addresses certain exigencies that exist outside isolated investigations, but each of them pursues more specific objectives set up as

[11] Cf. Wenger's (1998) 'participation' and 'reification'.

subordinate to the external exigencies.

Aristotle's message is clear: ideas do not come out of the blue and have no value in isolation from praxis. In this sense his model captures the nature of my study quite accurately. Indeed, my investigation was motivated by what I perceived as a void in the state of the epistemic art during my involvement in three research projects: *Crossing Borders: Sites of Discursive Negotiation in Healthcare Practice* (Schryer et al., 2007) and *HealthDoc* (http://www.cs.uwaterloo.ca/~cdimarco/research/healthdoc.html) at the University of Waterloo and the Toronto-based *Using Simulation to Promote Team-Based Disclosure of Errors* (http://www.patientsafetyinstitute.ca/English/Initiatives/simulation/Pages/Research.aspx). These projects allowed me to learn about the exigencies facing epistemicists on the ground and to match these exigencies to available theoretical resources. In Aristotle's terms, I got a chance to see "the unchangeable and primary definitions" of argumentation theory in the light of social and phenomenal reality, as well as to grasp "the starting-points" for my own investigation.

No matter how fertile for my project, these experiences predated the investigation, and so did many other formative events and encounters of my social and professional life. As Aristotle would have it, such experiences and events cannot be accounted for within the bounds of my dissertation. Of course this fact does not amount to a license for me to blindly follow my bliss with no regard to the state of the art or audience concerns. Such a project would not be tenable, and this is where my experience deviates from Aristotle's observations. According to Aristotle, comprehension provides access to true, and thus indisputable, knowledge. Pace Aristotle, my secondary induction was a learning experience rather than a rationalization of either a premeditated agenda or a preconceived theory. I did not have the luxury of founding "the first principle and cause" of my investigation on "something prized and divine" (I.12.1102a5-1102a25). Quite on the contrary, my identification and treatment of the subject matter, my search for solutions and decisions about their presentation involved a series of practical choices. Kneale's (1949) conception of transcendental hypotheses may clarify this point.

The key concepts of Kneale's work are possibility, necessity, and probability, but he is critical of their indiscriminate application. For the evaluation of scientific theories he proposes the notion of acceptability. He demonstrates that even though both probability and acceptability are derived by induction from methodological assumptions, they are products of very different procedures: one is formal and the other social. The acceptability of theories in empirical sciences depends on cognitive, rhetorical, and situational factors. Theories have to

- Subsume a great number of natural laws and predict new discoveries
- Explain and simplify the laws
- Be exact and economical and thus easy to apply and verify
- Embody social interests and chart new research venues
- Satisfy human partiality for universal explanations and aesthetic pleasures.

In his analysis of the notion of theory, Kneale makes an interesting comparison between primary and secondary induction. The former serves the purposes of observation, while the latter

allows communities to model the world and develop research programmes. Kneale explains that the knowledge of a research field "can be presented as a system of general propositions entailed by a few postulates of high generality… Such a system is often called the theory of its field" (p. 92). Kneale's term for these "postulates of high generality" that constitute theory is 'transcendental hypotheses'. They do more than subsume observations; they also extrapolate the observations onto new discoveries which are yet to be made. In other words, the hypotheses entail both the known and unknown phenomena. Knowledge is never complete, so new observations can corroborate the hypotheses but can never demonstrate them to be true (p. 106).

Kneale offers a useful reminder of the contingent nature of situated knowledge when he observes that comprehensive knowledge is not only unattainable but also unnecessary. This is why explanation and demonstration are not the only or the main functions of hypotheses. They work for communities by organizing them through shared perceptions of what constitutes 'reality' and what kind of activities this 'reality' calls for: "secondary induction is not, like primary induction, a policy for finding good things, but rather a policy for welcoming good things when they are found" (p. 250; cf. Engeström, 1999; Flower, 2002).

Two major functions of hypotheses make them indispensable. On the one hand, they make knowledge manageable by organizing phenomena into complex conceptual systems. On the other, they provide the lexis for further research:

> Natural laws which have been formulated originally in the perceptual object terminology can therefore be translated into the transcendent object terminology. Thus translated they naturally appear more complex, because the new terminology is, so to say, of finer grain. (p. 95)

Such linguistic innovation creates discursive spaces for the field's theory to be "gradually developed by greater definition of all the necessary detail" (p. 96). Kneale alerts us to a special kind of conceptual and social integration.[12] His transcendental hypotheses allow knowledge to be continually translated between basic, empirical, and applied modes of research, as well as between the field's shared discourse and particular situated studies. Rather than treating theory as a depository of abstract forms for any occasion, Kneale presents us with a conception of adaptable theory that communities develop for tackling their practical tasks.

Implications and summary

The prevalence of reductionist methods of text and discourse analysis in natural language processing

[12] Flower's (2002) notion of 'working theory' can add some fine detail to our understanding of how hypotheses enable communal enterprises:

> A working theory not only makes an idea operational, it reveals the conditions under which it might [..] work out—or unravel. It previews possible outcomes and predictable problems. It creates a qualified claim that locates [an idea] or an option within the complexities and [contradictions] of a human activity. It prepares participants to act and adapt. (p. 272)

and knowledge management is not an indicator of lacking methodological sophistication. In fact I found no dearth of reflexivity in these domains. I also found that their experts are awake to the social nature of knowledge, making great strides in harnessing the power of the collective mind (e.g. Coakes & Clarke, 2006). What the domains seem to be missing, however, is the understanding of how research contexts shape observations and knowledge, and this has implications both for the domains' own research practices and for the argumentation models that inform text and discourse analysis. Whereas the previous generation of NLP and KM experts looked for certainty to either deductive or probabilistic analysis, their latter-day colleagues expect objective findings to emerge from discourse within the communities of practice. The search for certainty has merely shifted to a new medium without shaking the wide-spread belief in the absolute value of generalizations and without alleviating the information overload (Kimble & Hildreth, 2004).

Aristotle's and Kneale's models shed light on the processes by which generalizations about 'natural laws' acquire meaning through situated learning. They also demonstrate how learners derive a sense of direction from their practical tasks as well as from the intellectual resources available to them. Kimble and Hildreth's (2004) explain that situated learning (or Legitimate Peripheral Participation, in Lave and Wenger's terms) "is more than simply learning situated in a practice; it is learning as an integral part of a practice that [gives] meaning to the world" (p. 328). 'Objective' observations are, in Aristotle's words, "remarkable, admirable, difficult, and divine, but useless" (*Nicomachean Ethics*, VI.7.1141b), and from modern-day analysts we also know that they are boundless and shapeless. People make information into knowledge by organizing it for specific tasks. That is why for informatics and knowledge management the question of how exactly researchers and communicators organize information in natural text and discourse is of the essence.

Epistemic topoi and their schemata work as an important organizing principle in argumentation. This type of organization is typically present in argumentation as implicit linguistic patterns. They roughly correspond to common formal topoi. However, in authorial commentary and in meta-theory epistemic topoi get articulated as lexicalized material topoi. Such diverse manifestations of epistemic topoi, as well as the complexity of argumentative schemata call for complex analytic methods and procedures. I found that the analytic frameworks based on binary oppositions are not helpful. The complexity of topical organization calls for more elaborate argumentation models, as well as for integrated research methods that combine observation, conceptual analysis, and decision-making.

For the purposes of the present study epistemic topoi are defined as statement types with recognizable linguistic features communicating recurrent meanings, which comprise the conventional argumentative superstructure of a particular genre of publications in a particular research domain.

Chapter 3: Theoretical and situated studies of argumentation

> The problem is that academics are enjoined not to intervene in ongoing social processes until they have acquired a comprehensive understanding of how those processes work, by which time the academic is often persuaded that the independent character of the processes transcend her ability to influence them.
>
> S. Fuller

In the previous chapter I reviewed the analysis methods of argumentative organization used in informatics and knowledge management. I suggested that the positivist research models prevalent in these domains create methodological and conceptual obstacles for productive inquiries into this important matter. As an alternative to these reductionist models I proposed Aristotle's and Kneale's models of situated knowledge and learning. Yet the discrepancy between the prominence of topical and schematic organization in the literature, on the one hand, and the state of knowledge about it, on the other, suggests that methodological barriers also exist beyond informatics and knowledge management. This poses an important question for the whole field of argumentation studies. With a long and rich history of research into the phenomenon and with a very real need for its better understanding, why is so little known of epistemic topoi[13]? In search of answers in this chapter I will first review the state of knowledge on the links between argumentative meanings and linguistic organization across argumentation studies. Next, I will examine the status of situated knowledge and learning. In the third part of the chapter I will take scope of the current sensibilities and trends by surveying epistemic journal titles. Last, I will consider the implications and manifestations of these sensibilities in the literature of the field.

Theoretical and methodological background

Argumentative organization and its linguistic realizations

There is a lot of evidence showing that argumentative organization is related to the distributions of lexis[14] and other linguistic features in texts. These inquiries received a comprehensive review in

[13] Kienpointner's (1987) review reached a similar result. He attributed the problem to the vagueness of the conception.

[14] I use *lexis* in the linguistic, not rhetorical, sense. It refers to lexical items: so-called content words and phraseological units, as well lexemes (e.g. De Beaugrande, 1997, Ch. IV).

Swales (1990) who drew up a large body of secondary and primary evidence on the links between surface features of research articles (paragraph development patterns, reporting statements, tense, voice, and authorial comment) and the four generic 'moves' of the IMRD structure (Table 3.1):

Feature	I	M	R	D
That-nominals	high	very low	low	high
Present Tense	high	low	low	high
Past Tense	fairly low	very high	very high	fairly low
Passive voice	low	high	variable	variable
Authorial comment	high	very low	very low	high

Table 3.1. Swales's (1990) summary of the known distributions of linguistic signals of argumentative organization in academic texts (adapted from p. 137).

Two of the most comprehensive later inquiries into the distributions of linguistic features in argumentative texts were Salager-Meyer's 1994 paper on hedges in medical publications and her 1992 analysis of the distributions of verbal forms across the parts and genres of medical abstracts. Statistical investigations continued in the past decade, looking into the correlations between isolated lexical markers and textual genres (Hersh, 2003, pp. 62 – 3), the relative frequencies of metadiscursive signals in different types and parts of research publications (e.g. Hyland, 2005), and the distributions of linguistic signals in academic papers (e.g. Bondi, 2006).

Apart from the statistical research, a significant body of publications has followed in the footsteps of Edmundson's 1969 paper, which investigated the links between text semantics and so called linguistic cues. The analytic units in such investigations were semantic rather than structural and thus were smaller than text sections. Edmundson's model, for example, included the following categories of content:

- *Subject Matter.* Information indicating the general subject area with which the author is principally concerned (i.e. *what?).*
- *Purpose.* Information indicating whether the author's principal intent is to offer original research findings, to survey or evaluate the work performed by others, to present a speculative or theoretical discussion, or to serve some other main purpose (i.e. *why?).*
- *Methods.* Information indicating the methods used in conducting the research. Depending on the type of research, such statements may refer to experimental procedures, mathematical techniques, or other methods of scientific investigation (i.e. *how?).*
- *Conclusions or Findings.* Information indicating the author's conclusions or the research results.
- *Generalizations or Implications.* Information indicating the significance of the research and its bearing on broader technical problems or theory.

- *Recommendations or Suggestions.* Information indicating recommended courses of action or suggested areas of future work. (pp. 267-268).

Edmundson also developed an elaborate list of lexical cues which were variously associated with these argumentative meanings. Paice's 1990 review of such investigations found that "cue expressions and indicator phrases [such as 'we have shown that'] provide valuable clues to the superstructural class of a sentence [such as 'Findings']" (p. 184). The research also revealed associations between argumentative meanings and verbal forms, albeit "[l]ess obviously" than cues and indicator phrases (p. 184).

A series of more focused inquiries have been undertaken into the cues of specific elements of argumentative organization, such as Myers's 1992 exhaustive paper on the linguistic features of "self-referential introductory statements," Woodward's (2000) analysis of natural law statements, Mercer and DiMarco's 2004 paper on the correlations between cohesive links and hedging cues, and Radulov's 2008 thesis on the linguistic cues of citation types. Yet generally speaking, the community seems to have adopted a cautious outlook on the prospects of identifying one-to-one relations between text semantics and lexical cues, (Azar, 1999; Inbar, 1999; Mann & Thompson, 1988; Taboada, 2009; Teufel, 1999). Hyland and Tse (2004), for example, explain that in spite of the ubiquity of metadiscourse and in spite of its connections with the underlying conceptual and contextual relations, there is no simple, one-to-one correspondence between the two levels. That is why "functional classification and analyses of texts" (p. 157) cannot be automated. Teufel (1999) reached a similar conclusion when she failed to relate "subject-matter key words" in the text to her "rhetorical zoning" model.

Such mixed results have not stopped research into unique identifiers of argumentative meanings, but what are now seen as potential markers are larger units than isolated lexemes. Such are, for example, are Biber's "lexical bundles" (Biber & Barbieri, 2007). Two papers have used combined descriptions of the semantic elements of abstracts: Liddy (1991) on empirical abstracts and Salager-Meyer (1992) on medical abstracts. Thompson (2003) used a similar approach in her analysis of the semantic organization of academic lectures. Wilbur, Rzhetsky, & Shatkay (2006) proposed an annotation scheme based on a mixed set of semantic and linguistic 'dimensions' (p. 357).

Appendix A offers a compilation of five major models of argumentative organization across the research genres: Liddy's (1991) "discourse-level structure" of empirical abstracts, Thompson's (1993) "structural model of argumentation," Salager-Meyer's (1994) list of moves making up the IMRD sections in medical publications, Harmsze & Kircz's (1998) "modular model," and Swales's (2004) CARS model. Much of the research into the textual and schematic organization of arguments is reviewed in detail in Teufel (1999) and in Swales (1990, 2004). Despite this persistent tradition of investigations into the links between argumentative and linguistic patterning, inquiries into the language of research communication and the schematic organization of arguments have been mostly conducted as two parallel streams of descriptive research. On the one hand, linguistic analyses have produced numerous classifications of the lexis and metalanguage throughout academic genres, such

as Mann & Thompson's (1988) classification of connectives, Thomas and Hawes's (1994) taxonomy of reporting verbs, Adam Smith's (1984) categories of authorial commentary, Segal's (1993) classification of persuasion techniques, Salager-Meyer's (1994) taxonomy of hedges, Teufels' (1999) lexicon of "subject-matter key words," as well as Beauvias's (1989), Vande Kopple's (1985), Hyland's (2005), and Ifantidu's (2005) metadiscourse classifications. On the other hand, analyses of schemas, frames, and text structures have brought forth a range of classifications of the statement categories across research genres.

These two streams of research are not entirely disconnected. The authors of linguistic studies often provide semantic interpretations of their findings, and the authors of rhetorical and textual analyses typically offer linguistic profiles of the phenomena they observe. Yet the findings are fragmented and hard to generalize because of the diversity of the writing genres that they deal with. Another barrier is the scant methodological information in most publications as well as their diverse study objectives. As a result, linguistic analyses of research publications seldom lead to concerted accounts of text semantics, while text semantics is typically intuited rather than derived from linguistic data. But perhaps the greatest barrier between the two bodies of lore is their terminological 'poliglossia'.

The status of situated knowledge and learning

Many investigators over the past few decades have urged and worked for greater integration among the disciplines involved in the study of argumentation (Ceccarelli, 2001; Fuller & Collier, 2004; Harris, 1991, 2002, 2005a; Hyland, 1997, 1998, 2005; Latour & Woolgar, 1979; Myers, 1990; Prelli, 1989; Salager-Meyer, 1994; Schryer, 1993, 1994, 2000; Swales, 1986, 1990, 2004; Willard, 1989). The magnitude and complexity of the phenomenon certainly calls such integration, yet the field seems to remain in the grip of the Platonic epistemic tradition, which privileges binary oppositions and agonistic reasoning strategies. 'Scientific revolutions' (Hacking, 1981; Kuhn, 1962), 'science wars' (Fuller & Collier, 2004, pp. xvii-xviii), 'linguistics wars' (Harris, 1993) – such appellations testify to the field's struggles to take account of its own vicious circles. Albeit fascinating, this part of the field's discourse would have been tangential to my project had the development of argumentative meta-theory not been so slow. Like all situated research, my project depends on available meta-theory, and reductionist models and methods have serious limitations when it comes to situated research.

The agonistic models of reasoning, which dominate argumentation studies, work reasonably well for the analysis of introductions and discussions in research publications but provide a very limited understanding of expository argumentation, such as the results sections (Thompson, 1993). Similarly, the binary models of text and discourse organization are easy to grasp but fall short of capturing the complexity of natural communication. As a result, the current argumentation models lead to "accumulations of incidental findings" (Swales, 2004, p. 253; cf. Ceccarelli, 2001, pp. 6-7). I found little secondary evidence in the literature that would help me to piece together a "general

picture" of research publications (Swales, 2004, p. 253). For my primary analysis, the contemporary epistemic research was quite inspiring but of little help in terms of meta-theory. A few times during the study I had no methods but trial and error to rely on for escape from the well known but poorly understood "'dead ends' problem" of exploratory research (Swales, 2004, p. 254). Argumentation studies are an empirical field (Halloran, 1984; Harris, 1991), yet I found argumentation experts to show surprisingly little interest in the methods of empirical research.

Sociological and rhetorical approaches are gaining momentum in argumentation studies (Artemeva, 2004; Bazerman, 1989; Harris, 1991, 2002, 2005a; Schryer, 1993; Swales, 1986, 1990, 2004). Many epistemicists now readily recognize discourse as a medium of agency with essential links to the phenomenal world, social relations and conventions. It is well understood that worlds, relations, and conventions are shaped, sustained, and negotiated in discourse. It is also granted that language plays a central role in these processes. But in spite of this awareness of the multiple and complex factors involved in communication and knowledge, research is only beginning to move beyond the declarations of the need for integrated communication models and integrated research.

On the issue of observation and induction, which are essential for research and learning, scholarly epistemics seems to have little to offer beyond the long-standing controversies around the status of these types of reasoning. Scholarly disputes tend to follow either of the two well-trodden paths: whether or not certainty can be obtained through reference or explanation, or how reference or explanation in natural communication can be elevated to the formal standards of 'rationality' or 'reason'. Too often, induction analysts "[spend] their days trying to formalize induction by making it into a deduction of probabilities" (Scriven, 1987, p. 32). Scriven links such narrowness of epistemic discourse to what he calls 'negative' approaches (pp. 17-18). Prescriptive approaches fall into the same category of studies focused on the reasoning patterns that should be either avoided or encouraged. Both these low-context research strands provide limited insight into actual communication practices.

Disciplinary divisions and narrow treatment of the context of argumentation also seem to be responsible for the stalling of epistemic theory. Argumentation is often cut up into two types of reasoning. The philosophy of science lays claim to one, and the rhetoric and sociology of science to the other. Fisher (1987) refers to these parts as the technical and rhetorical logics:

> Technical logics aim at true knowledge; their procedures and criteria are formal and removed from context; and their conclusions are pan-historical, true always and everywhere. Rhetorical logics deal in probable knowledge; their procedures and criteria are analogs to those of technical logics or are distinct in content and function; and their conclusions are time-bound, contingent, civic, and cultural. Technical logics concern argument as inference or implicature; rhetorical logics concern arguing – reasoning with an audience, which, in Aristotle's philosophy, has a capacity for "practical wisdom."
>
> The precise elements of rhetorical logics (which are not always precise themselves) may be specified as follows: conceptions and classifications of reasoned modes of discourse, most often argument; canons by which reason in discourse can be

> assessed, most often variants of the standards of technical logics; topics, questions that distinguish rhetoric as an art from the subject matters with which it may be concerned, "lines of argument," proper and improper strategies of arguing, and so on; and stasis, doctrines of issues dictated by the "logics" of different forms of advocacy, such as forensic and deliberative address. (p. 4)

Like many modern-day epistemicists, Fisher traces the origins of rhetorical logics to Aristotle, contrasting them with Baconian technical logics (cf. Gross, 1990. Ch. 6). But of course Aristotle's *Organon* treats of both these types of reasoning plus induction, and to Aristotle, induction is a distinct type of argumentation from both advocacy and demonstration. In fact Aristotle believes that induction underwrites all knowledge. He states this idea throughout the *Organon* (Lesher, 1973), and in the *Posterior Analytics* and *Nicomachean Ethics* he analyses the psychological and social mechanisms which allow people to learn from observation. Aristotle's survey of available epistemic models sounds surprisingly relevant to the modern-day state of epistemic discourse:

> For the one party, supposing that one cannot understand in another way… claim that we are led back ad infinitum on the grounds that we would not understand what is posterior because of what is prior if there are no primitives; and they argue correctly, for it is impossible to go through infinitely many things. And if it comes to a stop and there are principles, they say that these are unknowable since there is no demonstration of them, which alone they say is understanding; but if one cannot know the primitives, neither can what depends on them be understood simpliciter or properly, but only on the supposition that they are the case.
>
> The other party agrees about understanding; for it, they say, occurs only through demonstration. But they argue that nothing prevents there being demonstration of everything; for it is possible for the demonstration to come about in a circle and reciprocally. (*Posterior Analytics*, I.3.72b)

Aristotle recognizes numerous formal "difficulties" with the formalization of natural reasoning, but his purpose is to derive a feasible procedure of inquiry from analysis of natural and formal logic, rather than to divide them or to subordinate one to the other.

Compared to Aristotle's work on persuasion, formal logic, and dialectical argumentation in *Rhetoric*, *Prior Analytics*, and *On Sophistical Refutations*, his work on induction has so far received little attention from epistemicists (Putnam, 1981). One likely reason is the complexity of his conception (Lesher, 1973; cf. Foley, 1993). But perhaps its poor fit with the received dichotomous models of reasoning and research present an additional challenge. Moreover, Aristotle's preoccupation with observation is irrelevant for the ongoing dispute between constructivism and its rival paradigms that consumes empiricists these days (Fuller & Collier, 2004; Woolgar, 1986). Constructivism is in style (Korobov, 2001), so the perception of epistemics as a kind of entertainment or showmanship is seldom disputed or questioned (Fuller & Collier, 2004, esp. p. 235; Harris, 1998; Kneale, 1949, p. 242). Even the recent shift in the popular perceptions of epistemic studies as "consciousness-raising activities" does not seem to have produced a sea change in the field (Swales,

2004, pp. 247-248).

A narrow treatment of the context of argumentation is not the least of the factors behind this situation. The proponents of two major argumentation models, persuasion and explanation, are wont to evade the parts of arguments that are related to agency. Much epistemic research is focused on so-called 'universal' argumentative patterns to make it appealing and understandable to Perelmanian 'universal audiences' (1982, p. 17). On the other hand, atechnic proofs – the content brought into the argument rather than 'invented' by the communicators – is underrepresented in the literature. Thus what is typically referred to as 'content' or 'subject matter' is outside the purview of mainstream argumentation theory. Similarly excluded are the so-called ethical aspects of argumentation that outstrip the text: the character and reputation of the 'flesh-and-blood' communicators, as distinct from their 'implied' personae (Booth, 1983), and the social implications of the encounter (Booth, 1988; Fisher, 1987).

Aristotle's extensive justification of such narrow treatment of argumentation in rhetoric involves the social value of advocacy along with a peculiar brand of metaphysical optimism: "things that are true and things that are better are, by their nature, practically always easier to prove and easier to believe in" (*Rhetorica*, 1.1.1355a). Present-day persuasion research is often more radical than its classical version. Rather than attempt to justify their "it's-all-about-argument" stance (Harris, 2005a, p. 15), latter-day persuasion analysts often simply reduce all argumentation to rhetorical invention. The long-term effects of communication are irrelevant for this paradigm (Paul, Charney, & Kendall, 2001).

Explanation theorists tend to approach research publications as demonstrative arguments (Suppe, 1998), so learning has no place in this paradigm even in the form of invention. Such analyses eschew the conceptual apparatus of the rhetorical theory (Suppe, 1998), and their narrow focus on certainty and formal validity speaks to a similar lack of interest in atechnic proofs. As a result, explanation models reduce clusters of causal factors from research publications, which are variously related to the phenomena at hand, to singular, unique causes that condition or 'predict' the phenomena with certainty (Niiniluoto, 1981; Salmon, 1985; Tuomela, 1981; Woodward, 2000). In applied research the adherents of this paradigm equate certainty with statistical significance (Farrington & Loeber, 2000).

Thus the god term of persuasion studies is *effectiveness*, whereas *reason* and *rationality* are the god terms of explanation studies. Yet in spite of these differences, both schools are unified in their tendency to downplay the role of learning in argumentation. One might imagine that this gap should draw interest. However, in the literature I have found no rush to mend it. Bazerman (1985) explains that expert readers do not usually have sufficient time and attention resources to venture far afield from their major pursuits. That is why popular issues are likely to draw more attention than those that are marginalised. It is no surprise then that few writers are willing to step out of their disciplinary grooves, let alone tackle the themes that the majority of their readers are likely to see as irrelevant.

Environmental scan

The relevance claims of my own argumentative edifice have clear links to the traditional epistemic complaints about reductionism and disciplinary fragmentation. As such, it is open to charges of a stereotypical view of the field. A survey of the state of epistemic discourse can help to verify superficial impressions, and a literature review is a popular way to go about such a survey.

Reviews can take the form of background information in research articles and figure in academic discourse as a writing genre in its own right. Fahnestock's (1989) inquiry into the rhetoric of literature reviews is a helpful reality check for those of us who mistake this form of writing for an accurate representation of the disciplinary discourses. Fahnestock finds that reviews tend to reflect not so much the actual state of knowledge as the reviewers' vested interests.

So are there any ways for researchers to get an alternative perspective on the state of the art? Should they even try? Both questions are far from trivial, but the latter seems to be of more interest to epistemicists. Some authors insist on the importance of environmental awareness, while others believe that it dispensable (Korobov, 2001; Schegloff, 1997). Here is a representative academic opinion on the tasks of sociological research: "our job is to study society. If you ask why and to what end, I would answer: because it is there" (Goffman, 1983, pp. 16-17). Much of the controversy around environmental awareness may be due to the gap between the importance of reviews for the disciplines and their comparatively low prestige among academics (Swales, 2004, pp. 16-17, 208-213). The controversy also likely reflects the increasing frustration of researchers about the volumes of literature that they have to deal with (Bazerman, 1985; Swales, 2004, passim).

Argumentation research is nowadays sustained and disseminated through an impressive range of publication forums. The diversity and breadth of epistemic studies spells doom for an attempt to write a review that is both systematic and comprehensive. Systematic reviews are typically bounded with at least two parameters such as a specific period of time, topic, journal, or country, and thus provide only a limited view of a research domain or topic. In these terms, my own review of the state of knowledge about argumentative organization of research papers was anything but systematic. I focused on three key issues:

- The organization and language of research papers
- The methods of text and discourse analysis in science and technology studies
- The nature, methods, and logistics of organized research.

Two more boundaries that circumscribed my review were of linguistic and disciplinary nature. I mostly worked with English sources and approached the matter from the perspective of a communication specialist.

Within these limits, I allowed myself to select sources by the opportunistic method of 'browsing'. I followed promising references and tracked the work by the authors that seemed insightful and interesting to me, and in my database searches I occasionally lingered in the journals where I found especially promising papers. As a result, I ended up with an uncontrollably sprawling bibliography with papers coming from over ninety journals and spanning sixty years.

Yet the randomness of a review can be a blessing in disguise. Randomly selected materials can be used a cross-section of the medium from which they are collected. Thus it is possible to use the literature as a type of material whose analysis can be verified and complemented with the results of a review.

Title analysis as a method of environmental scan

Content analysis of titles may seem like an oxymoron at first approach, but they are an interesting type of "metacommunication" (Nord quoted in Busch-Lauer, 2000, p. 79). They label concepts, artefacts, and institutions and thus enable discourse about such entities. In the epistemic field, one of the long-standing discourses of this type concerns the disciplinary boundaries and the overall identity of the field. Most classical epistemic texts available to us feature *philosophy* as a badge of honour and *sophistry* as a typical name for foils and scapegoats. In Plato's dialogues rhetoric found itself guilty by association with sophistry. Rhetoricians are portrayed as conspiring against Socrates in the *Apology*, and the textual environment of the term *rhetoric* in "The Republic" is quite revealing. Here a "lively-minded ingenuous youth" muses on the concepts of justice and injustice:

> Around and about me I will draw the simple garb of virtue, but behind I will trail the subtle and crafty fox… But I hear some one exclaiming that wickedness is not easily concealed; to which I answer that nothing great is easy. Nevertheless, this is the road to happiness ; and the way by which we must go, following in the steps of the argument; and as to concealment, that may be secured by the cooperation of societies and political clubs. And there are professors of rhetoric who teach the philosophy of persuading courts and assemblies; and so, partly by persuasion and partly by force, I shall make unlawful gains and not be punished. (II, 365, pp. 186-187)

Plato suggests that in the debate on the meaning of justice and injustice rhetoric finds itself on the wrong side. In the *Phaedrus* Plato keeps on flogging 'bad' rhetoric for disregarding substantial issues, and one of his foils is Isocrates, a prominent Athenian educator whose school Plato perceived as a competition to his own school, the Academy. One element of Plato's marketing strategy was the labelling of Isocrates as a *rhetorician*, contrasting him to the *philosopher* Socrates.

Interestingly enough, Isocrates also expressed a measure of uneasiness about sophistry and rhetoric in his own works. In contrast with Plato's designation, Isocrates referred to himself as a *philosopher*. But Isocrates, in *Antidosis*, also left us a pretty elaborate discussion of the relations between philosophy, rhetoric, and sophistry. Much like Plato in his discussion of rhetoric in the *Phaedrus*, Isocrates suggested that there is good and bad (or ancient) sophistry. The latter concerns itself with metaphysical questions irrelevant to human life.

Philosophy, the heir of sophistic statesmanship, is a powerful tool of social organization and a vehicle of progress. Isocrates claimed that philosophy is not what many believe it to be. Philosophers, according to him, specialize in the study of speech, which alone makes man superior to beasts and is responsible for all human virtue and achievement. Through their studies philosophers

help to maintain social order and progress. Rhetors also possess superior decision-making skills since persuasion consists of the same types of arguments as reasoning. Despite the differences between the two sophistries, in the Isocratic system of liberal education there is place for both. The new sophistry, philosophy, plays a major role in the rearing of statesmen and good citizens, the old sophistry, along with other arts, prepares the students for this higher stage by developing their mental faculties and accustoming them to hard work and concentration. Isocrates seemed at a loss for a name for the synthetic profession whose advent he harbingered, and he eschewed the term *rhetoric* – perhaps because of Plato's criticism. Yet he related it to the art of deliberative oratory, explaining its distinction from forensic oratory, philosophy, and sophistry.

Nowadays scholarly epistemic disciplines have agreed to differ on the meanings of *sophistry*. The disciplinary border between the most ambitious players in the field, philosophy and rhetoric, serves as a watershed between the attitudes to Plato, the official saint of the former and the Great Satan of the latter (Harris, 2002, p. 8). But the search for a common name is still on. For example, in his overview of the field's literature Bazerman (1989) talks about *rhetorical knowledge*[15] that is spread across "three separate departments in the modern American academy: philosophy, speech, and English (which usually houses the teaching of writing)" (pp. 3-4). Another three promising contenders are *argumentation theory*, *probative logic*, *epistemics*, and *Science and Technology Studies*. *Argumentation theory* purports to encompass rhetoric, logic, and dialectic (Perelman & Obrechts-Tyteka, 1969; Tindale, 1999; Toulmin, 1969). *Probative logic*, according to Scriven (1987), is a "fallacy theory and explanation theory has to draw heavily on information theory and cognitive/perceptual psychology" (p. 21). Willard (1989) sets up *epistemics* to subsume argumentation and informal logic, which are "ultimately unifiable in their common concern with opposition and decision making" (n. 1, p. 238). Finally, Fuller and Collier (2004) propose a version of *Science and Technology Studies* as "rhetorically sensitized" social epistemology (p. xiv).

Research organization and trends through the prism of journal titles

There is much going on in the field beside disciplinary divisions and mergers, and journal titles can offer some insight into some of these processes. Content analysis is one of the most popular methods of analysis of large volumes of textual material. It consists in thematic classification. Intuitive classifications are often treated with suspicion in the literature, so the categories are usually arrived at by consensus between collaborators (e.g. Afros & Schryer, 2009; Crismore & Farnsworth, 1990). But the content can also be classified based on a combination of its semantic and linguistic characteristics (e.g. Ifantidu, 2005), and this is the method of categorization that I used for my analysis. My interest was in the organization of the field as a system of organized activities with spontaneous order (Butos & Koppl, 2003; Forstater, 2003). In other words, I wanted to know how the field 'constructs' itself.

[15] Cf. Harris, 1991, p. 296; Fuller & Collier, 2004, pp. 14-19.

The list of journal titles from my bibliography[16] presented me with a cross-section of the field's present state and trends. It named the disciplines involved in the research, its sites, participants, patrons, and stakeholders. It also revealed some likely trends in the field.

The major disciplines involved in epistemic research turned out to be communication and language studies, information science, philosophy, psychology, rhetoric, and social science (cf. Bazerman, 1989; Fuller & Collier, 2004; Harris, 1991, 2005a; Schryer, 2000; Swales, 1990). Quite predictably, philosophers have the longest track record, their journals rivaled in seniority only by psychological forums. The philosophical journal *Mind* was founded in 1876, and *The American Journal of Psychology* in 1887; both of them to this day remain in print. The first half of the 20th century saw the emergence of a few more journals that proclaimed with their titles an interest in specialized research types:

- Scholarly research: *The Classical Quarterly* (1906) and *The Social Service Review* (1927)
- Interdisciplinary studies: *Synthese* (1936)
- Empirical research: *English Studies* (1919) and *The Quarterly Journal of Speech* (1928)
- Applied research: *Philosophy of Science* (1934) and *The Journal of Personality Assessment* (1936)
- Professional matters: *College English* (1939).

The juxtaposition of the titles with the editorial policy statements of the journals confirms that the titles are carefully crafted as epitomes of the boards' messages to certain segments of the community. The policy statements in turn elaborate and reinforce the appeals conveyed by the titles. For example, the contributors to *Philosophy of Science* are expected to "advance the discussion in some area of philosophy of science or the philosophy of a particular science in a way that is of direct interest to experts in the field" (http://journal.philsci.org/edpolicy.html), and the papers in *The Quarterly Journal of Speech* "will generally consider the theory and criticism of situated discourse in its various forms and venues, including the oral, the written, and the visual; official and vernacular; direct and mediated; historical and contemporary" (http://www.tandf.co.uk/journals/journal.asp?issn=0033-5630&linktype=44).

Synchronic analysis

For titles to work as an instrument of community construction, they need to clearly communicate the profiles of the journals. We should bear in mind, however, that titles are a short form of metacommunication. That is why in my bibliography I found the editorial boards' expressive options to be restricted to five major title categories. They identified the journals as specializing in five major options: scholarly, interdisciplinary, empirical, applied, or professional research (Appendix B).

The titles that 'carve out' an audience with an interest in scholarly issues contain names of academic disciplines or domains. Many of them also contain such 'normalization' (Kuhn, 1962) ideas

[16] Needless to say, my complete bibliography outstrips the list of references at the end of the dissertation.

as *science*, *issues*, or *theory*, or use the word *review* to announce their mission of synthesizing the research dispersed between various publication venues:

e.g. *Annual Review of Applied Linguistics*
Communication Theory
Journal of Information Science
Philosophical Issues
Sociological Inquiry
The American Journal of Psychology
Theory and Psychology
The Classical Quarterly

Another group of titles foregrounds the value of interdisciplinary research either by combining the names of the disciplines that the journals seek to integrate or by making metaphorical or metonymical references to creativity and integration:

e.g. C*onfigurations*
Leonardo
Philosophy and Rhetoric
Synthese

None of the titles in these two groups make explicit references to research specifics, such as its subject matter, audiences, stakeholders, or contexts, and this sets them apart from the next three groups, the situated research titles.

Like scholarly journals, empirical research journals have one obligatory element in their titles: the subjects or mediums of investigations in their papers:

e.g. *Argumentation*
Cell
Discourse and Society
English Studies
Health
Journal of Artificial Intelligence Research
Journal of Second Language Writing
Written Communication

Readers and authors likely have little trouble understanding that *Mind* appeals to those interested in studies of mind, whichever academic disciplines inform its methodology. The distinction between academic disciplines and domains, on the one hand, and research subjects and mediums, on the other, may raise objections. Indeed, the line between theoretical and empirical research is fine and ever shifting. So to an extent the distinction is a judgment call, especially in the times of transitions. As a result of these transitions, we may soon find philosophy as dispersed as rhetoric and argumentation,

while former nebulous research fields may take on clearer institutional forms (cf. Harris, 2005a; Prelli, 1989; Willard, 1989). (In fact some of the empirical research titles contain the words *research* or *studies* emphasizing the centripetal forces within their domains.)

Yet however slight, the semantic differences between knowledge domains and research domains manifest themselves through linguistic distinctions. The received notion of academic disciplines (knowledge domains) implies a fairly unified methodological and conceptual apparatus; that is, disciplines are expected to have well articulated epistemic lexicons. In Davies and Elder's (2004) words, "the labeling [of domains as disciplines or subjects] is a way of assuming coherence" (p. 4). Thus we usually think of linguistic, psychological, or rhetorical research as a body of investigations carried out *by means of* linguistic, psychological, or rhetorical methods. Such research pursues objectives that comply with the field's general sense of direction (Kuhn, 1962; Gilbert, 1976), and we know how vehemently disciplines guard their boundaries and maintain the purity of their paradigms (Bazerman & De los Santos, 2005; Putnam, 1981). In contrast to disciplines, research domains typically draw writers and readers from diverse disciplines and are mostly unified with a shared sense of *what* they investigate rather than *how* they go about it. For example, discourse studies concern themselves with investigations *into* discourse, not *by means of* discourse.[17]

The journals that appeal to the authors and readers with an interest in real-life applications of research tend to name these applications in the titles:

e.g. *Applied Linguistics*
English for Specific Purposes
Philosophy of Science
Science and Engineering Ethics
Social Work
TESOL Quarterly
Theory into Practice

The idea of applications can receive a mere mention, as in *Applied Linguistics*. Alternatively, it can be featured as a kind of activity, such as *Social Work*, or as a subject or medium of investigations, such as *science* in *Philosophy of Science*. The latter type resembles some of the interdisciplinary titles in that it has two elements: a discipline or methodology and subject or medium of investigations. Thus the title *Philosophy of Science* suggests that the journal seeks to foster research of science with the methods of philosophical inquiry. Yet while in the interdisciplinary titles the two elements are coordinated, in applied research titles the subject is either subordinated to the methodology, as in *Philosophy of Science*, or attached to it appositionally, as in *Science and Engineering Ethics*. Depending on how broadly the editorial board conceives of its discourse community, the title can be more or less specific. For example, *Theory into Practice* projects a pretty vast community. It communicates an almost messianic appeal to its contributors' conscience without

[17] To think of it, the latter would be true for any research, hence accurate but redundant.

specifying who those contributors might be. It also calls out to those readers who either want to see practical benefits of academic research or feel frustrated with the dearth of such – a potentially very broad audience. On the other end of this spectrum are titles like *TESOL Quarterly*, which carve out a rather cohesive and egalitarian community. Such titles does not suggest any division of the participants into readers and contributors or between the medium of research and the medium of its applications.

There must be discourse communities that find designations like *science*, *practice*, or even *TESOL* too general since some titles have explicit references to the people who participate or hold stakes in the research. There also seem to be organizations that host discourse communities powerful enough to sustain their own forums. Whatever the reasons behind the phenomenon, a fair number of journals on my list project themselves as forums for specific professional groups, organizations, or industries:

e.g. *Educational Researcher*
IBM Journal of Research and Development
International Journal on Digital Libraries
Journal of English for Academic Purposes
Journal of the Association for Computing Machinery
Rhetoric Society Quarterly
The American Journal of Clinical Nutrition

One of the titles profiles the discourse community (*Educational Researcher*); others name the patrons or stakeholders as social entities (*Association*, *Society*) or as sites (*Academic*, *Clinical*, *IBM*, *Libraries*).

Some of these fine semantic details do not capture the reality behind the labels. For example, *Applied Linguistics* stresses orientation toward language-in-use. Yet we also know this domain to be a branch of the well organized linguistic tree where empirical research serves the purposes of coherent theoretical knowledge about language (Davies & Elder, 2004; Manning & Schütze, 2000, Ch. 1). Another feature of the titles that oversimplifies the reality of research is the clarity of the division between research types. Actual research practice has more complex relations between scholarly, interdisciplinary, empirical, applied, and professional research (Brown, 2004; Davies & Elder, 2004). Even the very designations of situated and basic research depend on the vantage points. For example, a linguist may think of a rhetorical project as situated research, and vice versa. Yet such disparities between titles and underlying institutional practices should not worry us if we are interested in the messages and appeals that editorial boards communicate to their discourse communities. Such appeals provide a helpful, albeit indirect, outlook on the communities' activities and self-perceptions. They present us with a view of the field as a multifaceted yet well organized system or ideas and relations. Apart from naming the academic disciplines or methodologies involved in the research, they also show that the researchers conceive of their activities in terms of participants, audiences, and stakeholders, as well as subject matter, mediums, and sites. Table 3.2

shows how these elements are distributed between the journal titles in the field:

	Scholarly	Interdisciplinary	Empirical	Applied	Professional
Disciplines	++	+		+	+
Subject matter or mediums			++	+	+
Applications				++	+
Participants, stakeholders, patrons, or sites					++

Table 3.2. The types of epistemic journal titles and their semantic elements. (Single plus signs show optional elements; double plus signs indicate the elements present in all titles of the specific types in my bibliography.)

Diachronic analysis

Apart from the conceptual organization, journal titles can reveal some of the field's past and present tendencies and trends. They act as vectors that orient epistemics from its perceived 'states of affairs' to desirable future states, or as mini-narratives that represent the field's symbolic dynamics. For example, a few journals on my list have changed their titles at certain points of their histories:

Computers and the Humanities (1982) – *Language Resources and Evaluation* (2005)
Journal of Chemical Documentation (1961) – *Journal of Chemical Information and Computer Sciences* (1975) – *Journal of Chemical Information and Modeling* (2005)
Journal of the American Society for Information Science (1950) – *Journal of the American Society for Information Science and Technology* (2001)
Text (1981) – *Text and Talk* (2001)
The Journal of Typographical Research (1967) – *Visible Language* (1971)
The Journal of Philosophy, Psychology, and Scientific Methods (1904) – *The Journal of Philosophy* (1923)

Such metamorphoses reflect the attempts of the editorial boards to attune the titles to the discourse communities' self-perceptions and aspirations. Shifts like *Text – Text and Talk* represent the most frequent pattern of title change in my bibliography (three journals). The pattern projects the idea of growing communities and expanding research domains. In contrast, the transformation of *The Journal of Philosophy, Psychology, and Scientific Methods* into *The Journal of Philosophy* communicates a trend to greater disciplinary and methodological cohesion. Finally, in two journals the titles have shifted in the direction of greater emphasis on applied research:

> *Computers and the Humanities – Language Resources and Evaluation*
> *Journal of Chemical Information and Computer Sciences – Journal of Chemical Information and Modeling.*

Such transformations reflect the growing value that the communities place on the real-world effects of their research. They also likely speak to the editorial boards' desire to foreground this value. In this sense the appeals communicated with the titles not only reflect but also create social reality. Thus it makes sense to view title changes as a medium that reflects and enables negotiations between communities and gatekeepers about the present and future of the field.

The field dynamics can also be gleaned from the histories of domains and research types as they are represented in the titles. Let us take the domain of communication research. Along with *society*, *philosophy*, and *information*, *communication* is one of the most frequent terms in the titles. (Each of them occurs ten times.) The oldest journal on my list which has *communication* as part of its title is *College Composition and Communication* founded in 1950. The title suggests that the journal orients itself towards professional research. In the title *Journal of Communication* (founded in 1951) *communication* took on the statute of an empirical research domain. It then maintained this status in the titles of the journals founded during the next four decades until in 1991it became cohesive enough to claim the status of a knowledge domain – at least in the eyes of the discourse community behind *Communication Theory*.

The term *language* presents us with an inverse trajectory. The journal with the scholarly title *Language Sciences* was founded 1968 (and went out of print in 1977). In the eighties and nineties *language* figured as an empirical research field in *Language and Communication* (1981), *Research on Language and Social Interaction* (1987), and *Journal of Second Language Writing* (1992) and as an applied research domain in *Natural Language Engineering* (1995).

The semantic trajectory of *society*/*social* is more like a zigzag than a straight pattern:

- Theoretical in the twenties (*The Social Service Review*, 1927)
- Applied in the fifties (*Social Work*, 1956)
- Theoretical in the sixties (*Sociological Inquiry*, 1961; *Social Science Information*, 1962)
- Applied in the seventies (*Social Studies of Science*, 1975)
- In the eighties and nineties, interdisciplinary (*Social Science and Medicine*, 1982), empirical (*Research on Language and Social Interaction*, 1987; *Discourse and Society*, 1990), and applied (*Social Science Computer Review*, 1988; *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 1999)

In general it seems that the second half of the twentieth century saw a rise of interest in empirical and applied studies, while the interest in theoretical studies ebbed. It is risky to draw far-reaching conclusions based on the titles from my list. The earliest and latest periods are likely underrepresented because of my browsing search method. Another likely source of bias is my interest in meta-knowledge. Yet I think it is safe to make generalizations at least about the trends in the second half of the 20th century. It is also not unreasonable to believe that the effects of these trends last into the present state of the field.[18]

The quantitative diachronic analysis of the titles (Appendix C) shows that since the 1970s applied and especially empirical research has received greater prominence. At the same time epistemicists have all along maintained a fairly steady interest in professional activities. Quite on the contrary, the status of scholarly research, including interdisciplinary investigations, seems to have started declining in the eighties.

Discussion

What are we to make of all these perceptions, sensibilities, and trends? In the first part of this chapter I argued that the theme of learning has a low profile in epistemics. The results of the survey of the journal titles bear out this observation by revealing that epistemicists tend to conceive of theory, observation, and agency as distinct pursuits rather than aspects of a complex enterprise. The results also suggest a tendency away from theoretical and methodological investigations towards empiricist, purely observational approaches. This may indicate that the field is developing towards a positivist paradigm similar to the one we witnessed in the domain of informatics and knowledge management, which might be a negative tendency.

The assumption that categories naturally emerge from 'facts' is misguided (Aarts, 2008, Ch. 10; Bazerman, 1985; Harris, 1991; Lessl, 2007; Segal, 2007). Of course natural kinds and laws are discovered through observation. For example, Biber, Csomay, Jones, and Keck (2004) use statistical methods for identifying discourse types that in language and communication theory are typically referred to as 'styles' or 'tones'. The problem is that context-free postulation of natural laws is prone to be trivial or irrelevant (Scriven, 1975). Moreover, empiricist methods are often powerless when it comes to interpreting the obtained generalizations. For example, the "dead ends" problem haunting inductive investigations of text and discourse (Swales, 2004, p. 254) may not have so much to do with the difficulty of finding regularities as with their overwhelming amounts. Language and communication are immensely complex phenomena with multiple links and relations among their infinite facets and dimensions, so 'terministic screens' are not only unavoidable but also indispensable for the selection of meaningful analytic methods and generation of significant results.

[18]To find out about the trends specifically in the epistemic research field, I excluded from analysis the professional journals whose titles show no obvious links with argumentation, language, or communication: *Australian Critical Car*, *Cell*, *IBM Journal of Research and Development*, *The American Journal of Clinical Nutrition*, *The Canadian Medical Association Journal*, and *The Journal of the American Medical Association*.

The theory of the field is a major source for various types of 'terministic screens'. For example, Gieryn (1982) proposes the metaphor of 'constitutive questions' for the sense of direction that the researchers gain from engagement with disciplinary discourses:

> 'Constitutive questions' define the problematics of the field – the ultimate question too large for any single study, but which serve as guides to decide significance in more manageable questions of lesser scope. (p. 281)

Gieryn tells us that theory works as a channel of ideology and social cohesion within research communities. Apart from motivating communities, it provides them with a system of shared reference points and conceptual entities (such as units or phenomena) (Fleck cited in Bazerman, 1983, p. 162). Thus it provides researchers and learners with the means of communicating with one another as they engage with their social and natural environments. Theoretical knowledge also works as an organized and therefore memorizable record of experience in the form of events and generalizations (King, 1982, Ch. 12; Fuller & Collier, 2004, p. 217). Finally, theory teaches readers and writers the methods of engaging with the subject matter. For example, researchers tend to expect "that the science articles will lead to specific proposals and altered actions," while the literary essays are "concerned essentially with fresh ways to celebrate their subjects" (Fahnestock & Secor, 2002, p. 71). In this sense theoretical knowledge may work as a system of 'disciplining' constraints. However, it also carries epistemic lexicons that allow researchers to take charge of the course and outcomes of their investigations (Forstater, 2003; Schryer, 1993).

Such a broad conception of the theory of the field puts it into a different category than what is typically understood by theory. In Aristotle's categories it combines scientific knowledge with practical and philosophical wisdom (*Nicomachean Ethics*, VI.6.1141a). The ability to apply such theory constitutes 'art' (II.4.1105b), which is distinct from ability to comprehend or demonstrate it. Artistic excellence can only be achieved through practice (II.1.1103b).

It is obvious to most researchers that the narrow conceptions of theory that represent their 'arts' as isolated research modes do little justice to the actual nature and organization of the 'arts'. However, these conceptions exist as methodological assumptions and thus have very real effects on what researchers do and achieve. The perceived divisions between various research types that we observed in the semantics of the journal titles are a factor of disciplinary organization. In the literature they take the form of binary oppositions. Applications are routinely pitted against 'pure' research, and research is often conceived of as either theoretical or empirical.

Research vs. practice

Argumentation studies are often seen as something that is done for the enlightenment and social liberation of the human race. However, the epistemic disciplines themselves could derive numerous benefits from greater attention to meta-theory. As we have seen from the journal title analysis, the field sprawls far and wide. Indeed, what Aristotle called the art of reasoning, these days is studied under many labels: argumentation, cognitive science, cognitive rhetoric, communication theory,

cultural studies, discourse analysis, education, epistemics, epistemology, ethics, informatics, literary theory, library and information science, philosophy, semantics, text linguistics – the list will keep growing as long as the subject is dispersed across fields and disciplines. There are numerous historical, cognitive, and social reasons underlying and motivating the fragmentation and proliferation of labels (Bazerman, 1989; Fuller & Collier, 2004; Harris, 1991, 2005a), and the division is exacerbated by the existing perceptions of the research organization in epistemic disciplines. The most popular models of organization and knowledge processes in the field are based on binary oppositions. For example, Willard (1989) remarks on a division of labour between disciplinary centres and peripheries in what concerns the maintenance and advancement of knowledge. While the processes at the centre are aimed at the normalization and systematization of ideas, the marginal and borderline processes import from other domains "new ideas [providing] grist for the cognitive mills" of the discipline (p. 218). In 'solar' models the basic research is often seen as dependent on situated research for feedback and innovation. As Fuller and Collier (2004) explain,

> funding for research into the health of factory workers has rarely been done to advance the frontiers of medicine – although it sometimes has had this effect. (p. 192)

In turn, situated domains supposedly look to scholarly centres for theoretical concepts that would help them to carry out research and professional activities 'on the ground'. To an extent, the field of epistemic studies complies with the received solar models, but the existing division of labour is not universally seen as benevolent.

The most obvious applications of articulate meta-knowledge are education and informatics. Closely related to them is another traditional concern of epistemic studies, evaluation. All the three applications are represented in English for Specific Purposes (ESP), one of the most cohesive situated epistemic domains with its own journal. For a few decades researchers working in ESP have pointed out that the domain is underserved by theoretical research. For example, Malcolm (1987) explained that

> teaching loses elegance and simplicity when we do not incorporate our explanations into a broader understanding of how English works. A list of "uses" to memorize, for example, is much easier to forget than a general understanding of how temporal references affect tense choices. (p. 41)

Salager-Meyer (1992) confirmed that a better understanding of the "relationship that exists between form and function" would benefit the field (p. 94).

Educators working in English as a Second Language, English for Science and Technology, technical and academic writing often point to a gap between the established traditions of college instruction, on the one hand, and writing in professional and academic contexts, on the other. In contrast with ESP, professionals working in these domains often complain about their weak epistemic base. For example, Hill, Soppelsa, and West (1982) reported that technical materials were underrepresented in ESL textbooks and classes (p. 333). Adams Smith (1984) observed a similar disparity between received reasoning models in education and professional reasoning practices:

"there is a real dearth of materials in EST [English for Science and Technology] incorporating practice in recognizing emphasis, advice, or evaluation" (p. 36). Carter (1990) found that report writing in school and university "does not make a particularly good preparation" for report writing on the job (p. 189). Willard, in his 1989 monograph on argumentation theory, also talked about the pressure from situated studies on scholarly domains to develop more encompassing and adaptable models of argumentative phenomena:

> Toulmin's claim-warrant-backing-[data] model – argumentation's prevailing paradigm case – functions here as a pedagogical device and occasional analytic instrument but not as an interesting case of "argument." (p. 217)

More than two decades on, the problem of the gap between teaching and research seems to remain as acute as before (Chan, 2009).

A similar gap between practice and research exists in medical education. Connelly and Johnson (1980) attributed the inadequacies of epistemic practices in healthcare to the deficiencies of available problem solving and decision making models: "A large share of the perceived overuse of diagnostic and monitoring laboratory tests may result from faulty decision making on the part of the physician" (p. 413). The authors suggested that existing education models fail to account for the fact that, in addition to acquiring substantive knowledge, novices "must internalize new ways of integrating knowledge and experience" (p. 412). Connelly and Johnson reported some improvement in medical school curricula: "Recently laboratory medicine courses tailored toward clinical problem solving have been developed" (p. 417). Yet present-day medical education does not seem to have benefited from this trend so far (Gill & Griffin, 2009; Regehr, 2010).

Student socialization and the assessment of academic performance is another area that could benefit from closer links between epistemic theory and practice. A significant body of research suggests that both students and instructors or markers often have vague and divergent concepts of good academic communication. For example, Read and Francis (2001) found that university students tend to judge the quality of their writing by more superficial criteria than instructors. The substantive matters of academic writing that they underrate include contextual awareness and the quality of evidence. Moreover, the disciplinary meta-theory is of little help:

> [M]any students struggle to acquire this academic 'literacy'. Conventions are not made explicit, leaving students feeling that they are having to learn to play a game for which the rules remain hidden. Information that does exist (often in the form of marking schemes) has made little impact in clarifying the confusion. (p. 397)

The problem outstrips basic academic literacy. There is evidence that students encounter serious problems at all levels of academic activities. Ironically, the problem may be more acute in the disciplines that are traditionally seen as the seat of epistemic expertise. An average doctorate in education takes seven years, compared to an average of four years in aerospace (Swales, 2004; p. 249).

'Holistic' marking, which is widely spread in academia, raises even more serious questions. For example, de Haan and van Esch (2004) discovered remarkable disparities between graders'

judgements when they were "asked to apply their own criteria": "in one dramatic case… the essay that came out worst in one grader's ranking was considered to be the best by another" (p. 274). The results of the authors' own quantitative analysis of the essays based on available models also turned out to be "so far… not unambiguous" (p. 278).

Evaluation is also prominent in the epistemic literature in relation to the assessment of faculty contributions to the discourse. The exposure and impact of publications, authors, and publication venues are known to define academic careers, as well as the organization of research fields. The belief that the success of a publication depends exclusively on the impact factor of the venue or that it is static is well understood to be an oversimplification (Paul, Charney, & Kendall, 2001). Nonetheless, bibliometric evaluations are now the major criterion of academic success in the Western world. Such evaluations tend to distribute literature along the continuum of prestige and authority measured in publications and references (Hersh, 2003). This framework, which ascribes the greatest impact to a limited number of influential works and large journals (Hersh, 2003, p. 28-33), is based on a system of simple binary oppositions (Swales, 1986), including the assumed distribution of authority between the disciplinary centres and margins. What may potentially create further problems for the disciplines is the undervaluing of the disciplinary 'community service', such as mentorship or the writing of textbooks and literature reviews.

Theory vs. observation and experience

In hopes of more elaborate and comprehensive conceptions of argumentation and knowledge epistemicists often look to empirical evidence (e.g. Gilbert, 1997, passim, esp. p. 77; Harris, 2005b; van Eemeren et al., 1996, pp. 275-276). Yet in spite of the general perception that the field's theoretical foundations need empirical reinforcement, 'more is better' does not quite capture the spirit. Rather, there seems to be a growing discontent about the fragmentation of epistemics. Some analysts have complained about the poor fit between the prevalent research agendas and the practical needs of situated domains. In the field of natural language processing, Litman (1996) found that the long-standing controversy about the non-propositional status of metadiscourse takes away attention from the practice of metadiscourse analysis. And here is an angrier complaint about the aloofness of the scholarly epistemic discourse from Wilson and Herndl (2007):

> For more than a decade, academics studying workplace discourse have theorized and documented the systematic differences between the discourses produced by different communities. The theoretical description of this problem is now familiar, as are the practical difficulties in dealing with the sorts of rhetorical situations such discursive and social difference creates. These studies of disciplinarity, discursive differentiation, and rhetorical mechanisms for legitimizing and policing knowledge are powerfully explanatory. But in a complex sociotechnical organization…, we often need to move back to practice and back to managing communication and knowledge flows to facilitate action. To borrow Star's (1995) words: "Among other things, science is a job" (p. 16).

> And so, sometimes, is rhetoric. (p. 131)

Gieryn (1982) expressed concern about the "relativist/constructivist" analyses of scientific writing that he believed to be mostly animated by the question of "how is science similar to religion or to the arts" (p. 281). In the same vein, Myers (1990) noted that the established tradition of literary approaches to scientific texts serves the needs of scholarly analysis rather than the interests of the people on the ground. Such investigations tend to extrapolate the features of literary texts to scientific publications and to overlook the characteristic features of the latter. Their primary analytic method is example: "selecting a few telling features, organizing them into a pattern, and taking them to define whole texts." As a result, literary studies of scientific texts "enrich our understanding of works in the literary canon. Very rarely do literary critics use their skills to help us understand science" (p. 10). Paul, Charney, and Kendall (2001) reviewed criticisms raised against rhetorical analyses of science. In turn, Harris (2002; 2005a) responded to such criticisms. But Harris also corroborated Myers's and Paul, Charney, and Kendall's observations that in scholarly research the development of theoretical conceptions tends to precede empirical studies:

> In fact, most of the early papers on science in the rhetorical literature were general rather than specific, and they drew their warrants, often undigested, from the philosophical literature. Now that rhetoric of science has taken the plunge these early papers proposed, the majority of work is in the form of rhetorical case studies-examining particular rhetors, movements, theories, or periods. (Harris, 1991, p. 296)

In linguistics this mainstream scholarly approach is known under the name of "theory-then-research" and viewed as "essentially deductive" (Davies & Elder, 2004, p. 10). Paul, Charney, and Kendall's (2001) analysis shows that "theory-then-research" investigations are often aimed at demonstrating the validity of popular assumptions. A similar pattern dominates semantic and logical investigations where the assumptions are explicitly set up as hypotheses to be probed with introspective 'crucial tests' or 'thought experiments'. Such studies are useful in education since they demonstrate the techniques or the applicability of specific methodologies to specific kinds of materials. Yet the importation of prima facie scholarly conceptions into situated domains may take the form of prescriptivism, which is sometimes exacerbated by dismissive attitudes to situated inquiries. Witness this tell-tale admonition from Salmon's (1985) discussion of the relations between 'pure' and applied science:

> …there is the question whether science provides statistical explanations of individual occurrences… Even granting that pure science may not be concerned with them, applied science surely tries to furnish them (e.g., in explaining accidents). We should not ignore applied science. (p. 652)

It is no surprise that formal philosophy, logic, and linguistics are often resented in situated research for ignoring social and phenomenal reality and "prescribing how scientists in an ideal world would discover the truth" (Gilbert, 1976, p. 289). Similarly, postmodernist and social-constructivist approaches are often criticized for dictating cynicism and relativism as the norms of scientific research (e.g. Fuller & Collier, 2004, pp. 261-284; Gieryn, 1982).

This bad blood is at least partly responsible for a reported lack of communication between epistemic research domains. For example, MacMillan and Koenig (2004) found that in social sciences theory has little impact on the quality of empirical investigations. Similarly, Manning and Schütze (2000) remarked that "linguistic theory… has been surprisingly underutilized in Statistical NLP" (p. 311). Swales (1986) found no cross-referencing between citation studies conducted within the frameworks of content citation analysis, on the one hand, and applied linguistics and discourse analysis, on the other (p. 44). Wilbur, Rzhetsky, and Shatkay's 2006 study into the methods of text annotation in bioinformatics exemplifies the gap between theory and empirical research. The authors and nine other annotators took over a year to develop the study design and heuristics before starting the annotation of a hundred and one sentences selected from ten research articles (p. 358). The results on inter-annotator agreement were not very encouraging:

> Some insight can be gained from our data about training of annotators. Obviously, a good understanding of the English language and experience in reading scientific literature are important for performing the annotation task as prescribed in our guidelines. It is surprising that even with these skills, (arguably possessed by all 12 annotators), some annotators still performed poorly… (p. 361)

The proposed solution involved ever more effort and greater logistical complexity, and so far the results have not been reported in the literature. An especially notable feature of these authors' study design is the fact that, apart from Mann and Thompson's work on textual cohesion, they have not at any point considered turning to theoretical conceptions of argumentation. They derived their coding scheme from their perceptions of linguistic regularities in the materials, coining their own terms for these regularities.

Resistance to scholarly interventions and dismissive attitudes to scholarly epistemic research are also often reported in the literature. Here, for example, is Myers's (1990) perplexity about biologists' responses to his investigation into biological research genres:

> I hoped at the outset that… it would reveal the real science beyond the apparent science, like many studies of ideology in other cultural realms. But I have found that the biologists who read my chapters… were not surprised by what I had to say, and were only surprised by the lengths to which I went to say it… (p. xi)

Brown (2004) provides us with an expanded view of such attitudes as he takes scope of TESOL professionals' attitudes to linguistic theory:

> One of the questions I asked them was how they defined research. The diversity of answers was staggering, ranging from short, idealistic answers about what research is (e.g., "Careful, thorough study" and "The search for the truth") to very cynical answers (e.g., "Something that profs at that grant advanced degrees do because they don't teach and need to publish" and "Ignoring the obvious"). (p. 477)

Dismissive attitudes to scholarly research should cause alarm, and they do with most investigators that observe them. More troublesome yet is the notion revealed by such surveys that theory, empirical research, and praxis can somehow exist in isolation from one another.

Summary

In this chapter I have reviewed the state of research into argumentative organization and its linguistic realizations, as well as the status of the integrated models and practices of argumentation that such research calls for. My survey of journal titles in the field has demonstrated that the division between scholarly and situated domains is a fairly crude approximation of the organization of research in the epistemic and other domains. Epistemic domains seem to have diffuse organization with complex interrelations between the traditions and agendas of scholarly and situated research. The semantic types of epistemic journal titles suggest that the researchers conceive of their activities in terms of participants, audiences, and stakeholders, as well as subject matter, mediums, and sites. The most prominent domains pursuing inquiries into research publications were found to be communication and language studies, information science, philosophy, psychology, rhetoric, and social science. Despite such elaborate organization, my survey results suggest that epistemicists see the field as fragmented along the lines of numerous binary oppositions. Applications of argumentation theory are seen as separate activities from research, while research is conceived as either theoretical or empirical.

These divisions are often criticized as counter-productive or even damaging for both argumentation research and its stakeholders. Indeed, my literature review has revealed that epistemics, both 'basic' and 'applied', is in need of more elaborate models of argumentation and knowledge than a system of binary divisions. It also demonstrated a growing sense of concern among epistemicists about the fragmentation of the field. The recent historic trends apparent from the journal titles suggest that the field is increasingly turning to empirical, applied, and professional research, while the status of scholarly research is declining. However, what in the journal titles appears as the trend away from theoretical research may in fact reflect an active search for more inclusive argumentation models and research methods.

Chapter 4: Dichotomous thinking and its alternatives

The reward of futile victories is fatigue.

Anonymous

From Aristotle and Kneale we know that, in situated inquiries, observation is inseparable from decision making and systematic knowledge. Yet my survey of the popular research models and sensibilities across epistemic disciplines discussed in the previous two chapters suggested that analysts typically view their modes of investigation as purely theoretical, empirical, or applied. I also established that the issues of situated knowledge and learning are below the radar of a majority of epistemicists. These findings indicate that argumentation studies are dominated by 'dichotomous' rather than 'complex thinking', to use Berlin's (1990) phrasing. This type of reductionism is not just a methodological issue that creates difficulties for situated studies; it engenders serious problems for the field of argumentation studies in general.

In this chapter I will inquire into some causes and effects of dichotomous thinking. My first objective is to consider the analysis methods and traditional research objectives across the epistemic disciplines. Further, I will inquire into the implications that the dichotomous argumentation models and practices have for the whole field and for particular publications. I will then consider the cognitive and social substratum of dichotomous thinking, as well as its textual manifestations. The chapter will end with a review and analysis of the methods that have been proposed in the literature for amending dichotomous models and practices.

The methodological resources of argumentation studies

Every now and then we are reminded to maintain a critical view of our own meta-theory and meta-knowledge. For example, Schryer (1993) sees an unresolved contradiction in genre classifications that seek to pigeonhole fluid textual forms. She insists on the need for the domain's epistemic lexicon to develop in such a way as to accommodate "the evolving and contextual nature of genre itself" (p. 208). Similarly, Bazerman (1988) stresses the importance for epistemicists to recognize the limitations of theory as "a way of creating order in the ever-fluid symbolic world," a world of "rhetorical innovation" that can "hardly [be] contained within the bounds of the idealized model" (p. 319). Such critiques channel epistemicists' attention from universal and timeless epistemic forms to their realizations and applications in discourse. Indeed, to appreciate the significance of various modes of research, it helps to know what methods and ideologies epistemic domains adhere to and what "constitutive questions" (Gieryn, 1982) underwrite these methods and ideologies.

Analytic methods

It is generally believed that induction and deduction are the major methods of empirical analysis. Aristotle and Kneale use the term *induction* for the method aimed at identifying regular patterns in the phenomenal worlds; in contemporary literature it is also referred to as observation. In many epistemic domains induction, or observation, is resented and even maligned (MacMillan & Koening, 2004, p. 183), but it is also generally misunderstood (Scriven, 1987). Studies based on this method provide ample illustrations of and insights into both its benefits and peculiar difficulties.

Induction is believed to work well when researchers have to control their biases during "hypothesis forming" (Brown, 2004). Those who use it tend to say little of their frameworks and procedures (Foster, Tonkyn, & Wigglesworth, 2000; MacMillan & Koening, 2004), and the volume constraints on journal papers reinforce this tendency (Foster, Tonkyn, & Wigglesworth, 2000). So the authors simply state that the categories are arrived at inductively (e.g. Thompson, 1993, p. 112) or invite their readers to witness the presence of the patterns in a few representative examples (e.g. Quirk et al., passim). The idea of induction may also take the form of references to the authors' expertise and familiarity with the materials (e.g. Suppe, p. 402) or to consensus within the research group (e.g. Crismore & Farnsworth, 1989, p. 100). Occasionally appeals to inductive methods take the form of references to the community of experts who are expected to share the authors' insights or even to all the "intelligent and educated people… over the centuries" (Inbar, 1999, p. 33).

In scholarly epistemic domains biases are not necessarily seen as defects. Original perspectives are highly prized, and 'essence', the right and ability to speak on behalf of a social group, is viewed as a condition of effective engagement with disciplinary discourses. In fact in scholarly publications originality and essence are often valued higher than formal rigour (Schegloff, 1997). What here is typically understood by analysis is top-down argumentation that introduces 'intuited' conceptions (e.g. Burke, 1969) or 'imported' models and frameworks and demonstrates their benefits (e.g. Segal, 1993). In many scholarly genres social action overshadows analysis. Analytic conceptions, models, and frameworks are used in such suasive works as sources of supporting evidence and vocabulary for political and ideological statements rather than as instruments of discovery. That is why scholars' essentialist or political contributions, such as Bertrand Russell's or Noam Chomsky's essays and advocacy publications, often have little to do with their theoretical works.

Halfway between induction and deduction is experimental analysis. Its best known form is the so called crucial test. This popular positivist method allows investigators to inquire into the validity or accuracy of theoretical conceptions. With this method, observations contradicting the theory count as evidence against it. A softer version of crucial tests inquires into the overall utility or applicability of models and conceptions. The outcomes of such tests are typically used to elaborate or adjust theories, rather than refute them. These methods of "hypothesis testing" (Brown, 2004) are distinct from the version of experimental analysis that is popular in applied research. The latter consists in putting a model or concept to an analytic task in order to generate data or explain observations. The purpose of such analysis is not to advance the field's theory or methodology but to

use existing knowledge for practical tasks. The distinctions between these different types of experimental analysis are not always clear. In fact experiments involving coding or machine learning tend to fade into crucial tests. For example, in recent years numerous epistemic studies of this type involved analysis of metadiscourse (e.g. Thomas & Hawes, 1994; Teufel, 1999).

Every analytic method presents analysts with a distinct set of opportunities and challenges. Exploratory studies tend to be circular and iterative (Brown, 2004). The reason for the circularity and iteration is the need to select among the regularities that 'emerge' from the materials and to organize them into a usable and convincing yet empirically sound conception. Such 'bottom-up' approaches are different from their 'top-down' counterparts in that they typically involve testing multiple hypotheses and frameworks. An important distinction between inductive and experimental analyses is the fact that, in inductive inquiries, the parameters of correlation and categorization emerge from the investigation, rather than get stipulated at the start (Crookes, 1990; MacMillan & Koening, 2004).

The procedural differences create a very different set of logistical issues for inductive research compared with the well charted procedure of experimental analysis (Fuller & Collier, 2004, p. 199-201). Experimental studies face the danger of arriving at 'anomalous' or even negative results if the researchers fail to match the conceptions to observations. Anomalous results are likely to come up against the burden of proof, running the author into unplanned protractions. Negative results are likely to create even more trouble. Their status is uncertain in empirical disciplines (Hersh, 2003, pp. 44-45), but in predominantly theoretical disciplines audiences are hardly prepared to take *no* for an answer. In my corpus of biomedical (empirical) publications a significant number of authors present their results as negative or not 'statistically significant'[19]. At the same time, my bibliography, which is larger than my corpus by an order of magnitude, has numerous theoretical publications. This entire bibliography contains just two works reporting on negative or statistically insignificant results, both works being from the applied field of computational linguistics.

While experimental analysis is prone to run into anomalous or negative results, those who embark on inductive analyses struggle to arrive at any results at all. Here is testimony from Latour and Woolgar (1979):

> If we return to the situation… where the naïve observer visited the "strange" laboratory, it is clear that he constructed his preliminary accounts out of disorder. He neither knew what to observe, nor the names of the objects in front of him… The early notebooks reveal the confusion of the first recordings: trivia, noise, and more noise.
>
> The observer was obliged to create some stable pockets of order out of this flood of impressions. He attempted this, first by a crude imitation of the methods of his informants… In another instance, he distilled the pattern of citations received by group members from the mass of citation data…: a relatively modest achievement, admittedly, but one which granted him a brief moment of contentment. On the basis of this result, he could make a statement… and this had the effect of quietening his audience, at least

[19] See Chapter 6 for more detail.

temporarily.

> In the course of a few months, our observer accumulated a sizeable body of similar figures, documents, and other notes… as he progressed further, he realized that it was no longer possible to make just *any* statement on the basis of this accumulated material… He began to write articles and to operate in his own agonistic field. (pp. 254 - 255)

This strange ode to inductive methods from two arch-social-constructivists and proto-network-analysts lends itself to all kinds of de- and reconstruction. But to me it rings very true: the initial confusion and noise, the clumsy imitations, the first inklings of a conception rewarding the researchers and appeasing the stakeholders and sponsors, and the negotiation of a conception.

The majority of epistemicists easily grant that the traditional straight lines of reasoning and discovery narratives from research papers are rationalizations rather than accounts of actual research processes. However, it is interesting that Latour and Woolgar's 'observer' does not publicize his findings until he discovers "pockets of order." Nor does he start writing about his research until he formulates a conception. This procedure adds interesting shades to the authors' notorious metaphor of scientific research as the manufacturing of papers. It also makes the process of discovery from their epic self-report strikingly different from the popular view in mainstream epistemics that discovery and rhetorical invention are one and the same thing.[20]

The unpredictability of results of analytic induction calls for elaborate study designs with escape routes and alternative investigation lines. For example, to minimize the losses from dead-end investigations, some research communities have worked out a procedure which prevents analysts from investing more effort into dead-end analysis than is absolutely necessary. Here is how Strong (1988) describes a typical procedure of inductive trial and error:

> [T]he researcher is urged to collect only a small, initial body of data; to derive from it some initial hypotheses; to collect a further body of data; to test and modify the hypothesis on this fresh evidence; and to continue this sequence of data-gathering and hypothesis-testing until no further body of data produces any significant modification to the developed hypothesis. (p. 239)

Indeed, papers reporting on the results of empirical studies occasionally mention abandoned or adjusted lines of investigation (e.g. Moravcsik & Murugesan, 1975, pp. 89-90; Brandow, Mitze, & Rou, 1995, p. 677).

Exploratory studies are time-consuming and labour-intensive, and thus not the favourite option with most analysts (Afros & Schryer, 2009). However, there seems to be no alternative for obtaining results that can be generalized and extrapolated to other inductive investigations (Swales,

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[20] Bazerman (1983) offers a more encompassing view of invention. In his view, invention starts with the perception of an issue:

> The writing process may be said to begin… the moment one focuses attention to a topic with the hope that thinking a data-gathering will lead to a written statement, one starts to engage in activities that will shape what finally appears on page. (p. 165)

2004, pp. 252-257; Taboada, 2009, p. 134). Of course the open-endedness of exploratory studies should not blind us to the fact that their results have little to do with the everything-goes approach. Rather, they represent carefully selected observations that are interpreted in a way that fits the researchers' objectives. The criteria of their selection are routinely assumed or suppressed (Lessl, 2007), but some authors take the trouble to shed light on this part of their epistemic procedures.

Disciplinary epistemic traditions

No discipline is in a position to pursue purely theoretical, empirical, or applied research. From Aristotle and Kneale we know that researchers derive the motivations and 'terministic screens' for their observations from their field theories, as well as from their agencies and social environments. Thus the contextual factors used for resolving the indeterminacy of observation results may be quite diverse: situational parameters and research objectives (Swales, 2004, p. 254), the investigators' perspectives and the effects of their research interventions (Crookes, 1990; Fitch, 1998; Foster, Tonkyn, & Wigglesworth, 2000; Putnam & Borko, 2000), the economy and aesthetic merits of the results (Aarts, 2008, Ch. 10), or the possibility of their compact presentation (Foley, 1993). A special kind of context is what Whewell termed 'consilience' and what in contemporary sociology is called 'triangulation' (Lazarton, 2002). It is based on correlation of regularities obtained through different analytic modes. With this method, different types of evidence anchor one another, providing a kind of selection and interpretation contexts. For example, the results of primary analysis are considered meaningful when they pick out the same regularities as the ones observed by the informants, analysts, and secondary sources. Finally, what Aristotle called comprehension can also be viewed as a kind of 'consilience' between primary data and systematic knowledge: "a perception akin to that by which we perceive that the particular figure before us is a triangle" (*Nicomachean Ethics*, VI.8.1142a-1142b).

It is well understood that terministic screens are part and parcel of all observations, but methodological reasoning rarely reaches the surface of research discourse (Nash, 2001; Myers, 1990). Some literature reviews bear out this contention. For example, MacMillan and Koenig's review (2004) established that uncritical use of analytic software is sweeping social sciences in spite of the fact that they "are well served with literature on qualitative methods" (p. 181). Lazarton's review (2002) identified similar problems in discourse analysis.

Instead of analysis of the situational motives that underwrite the studies we often see abstract god terms that appeal to a wide range of audiences but offer little insight into the nature of the authors' pursuits (cf. Bazerman, 1985). Such fuzziness devalues exploratory studies. In absence of comprehensive methodological commentary, it is hard to use their results for secondary analyses (Swales, 2004, p. 253; cf. Ceccarelli, 2001, pp. 6-7). Moreover, it is not always clear whether the authors present us with the results of their explorations into the organization of discourse or into their intuitions about such organization.

In the sociology of science the 'true' reasons behind researchers' methodological choices are

often attributed to mercenary or narcissistic motives (e.g. Latour & Woolgar, 1986; Nash, 1990). Rhetoricians (e.g. Booth, 1974a; Burke, 1969) tend to follow Aristotle in attributing the reification of research from its natural and social contexts to researchers' pursuit of formal perfection. Of course the very challenges of methodological self-analysis are reason enough to make it unattractive for most writers. Combined with the conventional expectations of coherence and consistency, it accounts for the peculiar circularity of epistemic research. Try, for example, analysing induction by means of induction or writing about reflexivity in a self-conscious way.

In search of more tractable causes of the wide-spread methodological mystification, several authors have pointed out that the current editorial practices 'squeeze' elaborate methodological analyses out of journal publications (e.g. Foster, Tonkyn, & Wigglesworth, 2000; Gill & Griffin, 2009). The disciplinary traditions and ideologies that underwrite epistemic practices have also received some coverage, and this is the path that I take in this chapter.

In spite of the popular perception of scholarly disciplines as the domains of pure basic research, they have numerous practical tasks and agendas that must be met with original research. Much scholarly literature is devoted to the maintenance and dissemination of knowledge, as well as to "keeping seemingly disparate notions related in the student's mind" (Fuller & Collier, 2004, p. 217). In Kneale's terms, such studies are focused on the translation of knowledge. Clarity and conclusiveness, as well as creativity and rhetorical impact are highly prized in such deductive arguments. These arguments are not usually expected to produce discoveries, but they allow the audiences to appreciate and experience existing knowledge from new perspectives (Fahnestock & Secor, 2002). Primary evidence tends to be used here as the epideictic counterpart of induction: examples aimed at demonstrating or illustrating theoretical concepts.

This part of scholarly research heavily depends on secondary sources. However, *under*standing of sources fades into their *over*standing when commentators start analyzing their sources instead of submitting to them (Booth, 1988, p. 115). Such switches in the rank and mode of analysis are not surprising. Among scholars an argument holds greater sway when it is complete with meta-theoretical commentary (Bazerman, 1985). Besides, textual and print artefacts are an important type of materials that scholarly epistemicists use for their primary analyses. Thus popular or promising educational materials often become the objects of methodological inquiries focused on their educational value or proposing new applications for them. Commentaries on such materials are often grounded in popular values and norms.

Alternatively, scholarly research may be designed as participatory studies involving the researchers' colleagues and students. But of course nothing is as accessible to scholarly analysts as their own minds. Cognitive investigations usually go under the names of introspection and self-reporting and are indispensable in philosophy, literary theory, linguistics, psychology, and logic. Where such studies lack in breadth, they sometimes make up in depth, providing insights into the ways in which minds engage with the world and discourse. Not all authors using introspection and self reporting recognize their methods as such. In fact studies of this type are sometimes presented as analyses of 'reality', social and even natural. This methodological confusion is one likely reason

behind the misgivings that introspection and self-reporting tend to raise (e.g. Biber, 1993). Indeed, any attempt to reduce social and natural reality to a figment of an epistemicist's imagination can make a fascinating read but has obvious limitations.

Whereas the well established liberal disciplines stress the importance of continuity and coherence of traditions and theories, the younger domains, such as computational linguistics, natural language processing, and ethnography, stress the value of empirical evidence. In this paradigm, investigations are often rooted in empiricism or grounded theory, with data processed and even interpreted with machine learning or quantitative methods (Fuller & Collier, 2004, p. 189; Stich & Nichols, 1993). The data may also be categorized or interpreted based on 'folk theories' that are either derived through analyses of lexical cues or 'intuited' by the researchers. Some radically-minded investigators go as far as to deny the utility of models and theories altogether, stressing the inadequacy of the scholarly accounts of language and communication for the needs of empirical research. Among this type of studies, Biber and his coauthors' work (Biber, 2006, 2009; Biber, Conrad, & Reppen, 1994; Biber & Barbieri, 2007) has received much prominence in the literature and brought forth some of the most interesting results. The group finds that in mainstream linguistics,

> researchers have… relied on the linguistic properties of word sequences, identifying pre-fabricated sequences based on intuition or perceived salience, rather than on evidence from actual linguistic production and comprehension… Extremely frequent word sequences do not meet these criteria, and thus they have been typically disregarded in earlier research. (Biber & Barbieri, 2007, p. 283)

The researchers use the concept of "lexical bundles" for such "prefabricated" four-word sequences, insisting that the frequency of lexical bundles points to their "important discourse functions" and warrants greater attention from the community (p. 284). Of course this school's disavowal of the received linguistic and rhetorical theory does not amount to the researchers' emancipation from any theory whatsoever. Rather, it suggests adherence to positivist methods (Hjørland, 2005).

Biber and colleagues' approach is representative of the general trend in computational linguistics and natural language processing towards the development of original models based on local empirical data. Yet it gravitates towards the same educational paradigm as other domains of scholarly research whose purpose is to demonstrate the utility of a concept or method (Berlin, 1990; Ceccarelli, 2001, p. 3) and to allow readers to learn from the demonstration.

The limits of reified theory

Apart from educating students, showcasing achievements, sharing and accumulating knowledge and experience, many academics look for ways to engage with the world as social agents. Such investigations carry the ideological marks of their scholarly paradigms. Rooted in the conventions of advocacy, they provide scholars with a rather limited repertoire of research and writing forms.

Epistemic fieldwork

A majority of empirical analyses in epistemics is essentially fieldwork. Like anthropological expeditions, such studies seek to enrich existing theories with fresh evidence (Myers, 1990, p. 10). An anticipated outcome of such "[quests] for understanding" (Heath, 1994, p. 129) is growing sophistication of the theory (Berlin, 1990, p. 52). In scholars' messages addressed to the world, theory often features as a thing for itself. Such essays convey observations about 'reality' (such as the nature of 'man') and allow the authors to showcase the intellectual potential of their disciplines. Here, for example, is an excerpt from Halloran's (1975) manifesto for rhetorical analysis: "The end of rhetorical analysis is to discover a man in his words, whether that man is the Ciceronian Orator or the lonely modern anti-hero" (p. 631). The interpretations of such observations tend to take the form of critiques, positive at times (Berlin, 1990; Fahnestock & Secor, 2002) but more often negative (Scriven, 1987). For example, the studies performed within the humanities paradigm are founded on the traditional ideals of liberal education. Here is Bazerman's (1989) take on these ideals:

> What all the varieties of rhetoric hold in common is a practical concern for improving our mastery of language, so that we can see what others are doing to us through language and can use language to greater effect ourselves. (p. 4)

Similarly, "[a]pplied linguistics is often said to be concerned with solving or at least ameliorating social problems involving language" (Davies & Elder, 2004, p. 1). Such investigations often postulate social change as their ultimate goal. The liberalist agenda is especially prominent in the critical and social-constructivist traditions. For example, Bazerman (1989) testifies to the tendency in the sociological school of the rhetoric of science towards what he calls "investigative research." The authors working in this tradition reveal "nonrational arguments" working "behind a public facade of rational argument," "[look] at the dark side of consensus formation," and "[expose] the sleight of hand" used to mask the true complexities of decision making and to misplace important issues (pp. 4-5).

One obvious limitation of this evaluative tradition is the reduction of the researchers' social agency to a narrow range of arguments that in literary theory are termed *responses*. Another problem is the abstract or speculative criteria that scholars use in their evaluations, as well their frequent failure to live up to their own standards, which Fuller and Collier (2004) call "schizoid existence" (p. xiv). Indeed, meta-theoretical expertise does not make epistemicists naturally self-conscious. In Aristotle's words, "[t]he fact that men use the language that flows from knowledge proves nothing" (*Nicomachean Ethics*, VII.3.1147a). All disciplines are prone to such gaps between theoretical knowledge and praxis, but in epistemic disciplines they are especially revealing. Witness, for example, Crawshay-Williams's (1957) criticism of the motivation and procedures of popular philosophical disputes on reference:

> It used until recently to be almost an occupational disease of philosophers to say things like "We can never know that anyone else has toothache" and "'Napoleon' is not a proper name"… It must be admitted, though, that once their context is determined, these statements lose some of their appeal. The sparkle of "The laws of mathematics and logic

> are really rules of grammar" is dimmed if we translate it into "For the purposes of understanding what the laws of mathematics and logic are 'about' and how they are guaranteed, it is informative to assimilate them to rules of grammar and to differentiate them from laws of nature". This second statement is so unsurprising as to seem hardly worth making. The assertion of a surprising statement is after all a philosopher's dignified way of blowing his trumpet. (p. 222)

Whether or not epistemic domains can benefit from their metalinguistic prowess, is a matter of local conditions. In the sociology of science it is standard nowadays to provide rich methodological commentary along with the primary subject matter. For example, Schryer (1993) offers a detailed explanation and justification of her methodology. She carefully sets up her research questions and explains how she arrived at them; she even explains her choice of citation style in an endnote (p. 230). But such works constitute a minority among my sources. A great part of epistemic discourse is presented in an agonistic way, with god terms of the day being invoked in lieu of methodological backing. This is deceptive simplicity (Bazerman, 1983), and it comes at a price for those who wish to move beyond the 'lo, phenomenon!' type of work (Harris, 2005a, p. 41).

The fact that their findings do not lend themselves to 'translation' or extrapolation may be a minor issue for many epistemicists. Oftentimes they address their deductive inquiries to educators. Their critiques are aimed at promoting theoretical ideas or argumentation models and do not seek to produce generalizable results. The situation, however, is very different in empirical research. Here investigators depend on one another for secondary data, so curtailed methodological information can diminish the utility of a paper. Trawiński (1989) analysis of eighty information science publications is a case in point. To my knowledge, this is one of the most concerted exploratory investigations into argumentative organization. The paper features an impressive list of fifty-three 'content elements' (Appendix D), yet it has a very low profile. According to Google Scholar, in two decades since its publication it has been cited by just twelve other authors. This is quite low exposure for a field where the citations of some papers number in the hundreds. Scant methodological information and the author's reluctance to translate his results into standard terminology may explain this lack of attention from the readers.

Trawiński's account of the 'layers' of organization in the papers from his corpus suggests that he talks about epistemic topoi. In his study design Trawiński seems to combine experimental and inductive analysis. Unfortunately, for interpreting or using Trawiński's results, the readers have little to go on besides guesswork. In spite of the title "A methodology for writing problem-structured abstracts," the paper provides no insight into the author's criteria or analytic procedures for identifying the 'content elements'. The idea of the levels of organization and of links between them are assumed rather than arrived at empirically (pp. 695, 698). The model for the 'information layer' is borrowed from psychology, and the 'content elements' are identified based on "recommendations for writing scientific papers" from "16 manuals and instructions for authors and editors of scientific literature" (p. 695). Trawiński intimates that in the course of the study he altered the original models but offers little insight into the reasons or the process of adaptation, apart from stating that

"redundant content elements were removed and new elements, not identified previously, were incorporated into the structure" (p. 695). The author makes no effort to classify the 'elements' or to relate them to existing taxonomies of topoi. His free-style descriptions of the 'elements' and fragmentary analysis of their links to the 'information layer' are also of little help.

Suasion analysis of the paper would pick out some obvious problems with Trawiński's ethos, such as the unmoderated confidence of his tone or his tendency to represent the results of introspection as objective observations. Yet in a domain that favours positivism, such stylistic peculiarities should not be an insurmountable barrier, seeing that the paper contains valuable information. The problem is that Trawiński's style is a symptom of a truly impassable barrier: the take-it-or-leave-it design of his argument.

Trawiński's tribulations are not unique. Epistemicists across the disciplines seem to be stuck in the paradigm of enlightenment and demonstration, and dichotomous thinking is an important factor behind this limited range of argumentative strategies. The rhetorical manifestations of epistemic reductionism are over-reliance on contrast and agonistic argumentation practices, with god terms working as an essential link between them. In his interview with the Emory Report, Booth (2000) offers a candid commentary on how god terms inform his work: "for me, [reconciliation] is a supreme value. I would almost call it my religion" (par. 6). The supreme value of reconciliation follows to Booth from his belief that it is the only alternative to violence:

> It has always seemed to me that there's really only one alternative when there's real controversy, one alternative to violence or silence or continuing enmity, and that is rhetorical exploring, where you're talking and then trying to find some kind of common ground from which you can proceed. If you don't find that, then you just go on being enemies. (par. 3)

It is no coincidence that Booth's justification of his preferred god term is rooted in a false dichotomy (enmity vs. assent). This trick makes his position as unassailable as any idealistic or solipsistic conception. It is possible that Booth 'dumbed down' his arguments for rhetorical impact (Fuller & Collier, 2004, p. 282). A speculation about the motives behind his methodological mystification or about its effects on readers would be a diversion in my investigation.[21] Yet the implications of the general uncritical use of dichotomies in epistemics are worth a brief review.

Interdisciplinary studies

A growing number of epistemicists speak in favour of interdisciplinary research as an escape from the narrow disciplinary paradigms. For example, Paul, Charney, and Kendall (2001), calling for a more critical treatment of the notion of rhetorical success in the analyses of scientific texts, explain that such treatment is impossible within any isolated epistemic domain. Rather, it invites complex

[21] Refer to Harris (1993) and Ceccarelli (2001) for thorough investigations of long-term effects of methodological choices in linguistics and biology.

and interdisciplinary approaches:

> Historical methods are apt to overemphasize the moment, observational methods to overemphasize a particular author or reader, and formal textual analyses to overemphasize norms. But the limitations of one method may be overcome by complementary analysis with other methods. In practical terms, no one researcher can master all these methods. And no one study can include them all… Although every individual study may provide only a partial answer, as researchers, we can gain a more comprehensive understanding by using a wider array of methods. (p. 395)

A growing body of work over the past few decades suggests that the process of the field's theoretical and methodological (re)integration is underway. For example, Miller & Seltzer (1985) used a combination of methods for analysis of rhetorical topoi. Specifically, they applied comparative textual analysis, ethnomethodological methods, and interviews (pp. 328-329). Liddy (1991) derived her superstructure of empirical abstracts from a combination of interview and linguistic data. Ceccarelli (2001) merged text and discourse analysis in her discussion of the rhetorical and linguistic strategies which inspire interdisciplinary research. Schryer (2001) and Schryer et al. (2007) combined linguistic and ethnographic methods in their inquiries into the institutional and social effects of business correspondence. Fuller and Collier (2004) incorporated the methods of rhetoric and informal logic into their sociological version of science and technology studies. Hyland (2005) used the results of linguistic corpus analysis to gain insight into the uses of rhetorical appeals in academic discourse. Last decade also witnessed a large compilation of works in the rhetoric of science whose authors tackled one of traditional philosophical topics: incommensurability (Harris, 2005c). Of course the translation of perspectives and knowledge in a field encompassing dozens of epistemic domains is a gargantuan task, so the process is going by fits and starts. In spite of the old tradition of integrated approaches and the animation of situated inquiries in this post-inquisition era, we have just begun "scratching" around the vast field of epistemics (Harris, 1993, p. 31).

The existing disciplinary divides resist interdisciplinary enterprises. Of course the shifts between research types, sites, and communities seem more casual these days than three decades ago when Latour and Woolgar (1979) described transition from a science laboratory into education or industry as a fall from grace. Centres and areas of epistemic activity emerge wherever researchers find logistical opportunities and intellectual resources for situated studies. Oftentimes such studies draw researchers from different domains. Moreover, whole research and education fields are emerging along the borders of the disciplines that variously concern themselves with knowledge and argumentation. For example, the University of Waterloo now offers its students an interdisciplinary programme and seminar in cognitive science involving philosophy, psychology, linguistics, computer science, and systems design engineering (http://www.arts.uwaterloo.ca/InterDis/cogsci/about.htm). Its English Department's graduate programme has a course in cognitive metonymy (english.uwaterloo.ca/grad_PHD.html), and the Department of Psychology offers the option for Ph.D. students to specialize in cognitive psychology (psychology.uwaterloo.ca/gradprog/programs/phd/cognitive/index.html).

Berkenkotter, Huckin, & Ackerman (1991) investigated a student's socialization into a somewhat similar programme at the English Department of Carnegie Mellon University, the Rhetoric Ph.D. The authors describe the programme as a radically interdisciplinary enterprise where the "faculty include cognitive psychologists, classical and contemporary rhetoricians, a linguist, a speech communication specialist, and a computer scientist" (p. 194). In terms of learning activities the Rhetoric Ph.D. is like most graduate programmes where "[c]ourse work often includes carrying out research projects, giving oral presentations, and writing 'publishable' or 'national conference'-quality papers" (p. 194). But it also involves training in various research modes and methods:

> As students proceed through their graduate work, they take several courses in historical rhetoric and contemporary rhetorical theory. But the spine of the program is the training that graduates receive in empirical research methodology. (p. 194)

Apart from the epistemic classics, the students are introduced to invention theory, ANOVA tables, experimental design confounds, and the Pearson product-moments. They also become well versed in the field's organization as they learn to write for forums as diverse as *College Composition and Communication* and *Research in the Teaching of English*. Such hands-on epistemic training is dictated by remarkably ambitious aims:

> The rhetoric program's interdisciplinary curriculum appears to be aimed at producing an intellectual hybrid: a scholar familiar with historical and contemporary rhetorical theory… yet also a competent researcher, who can write social science expository prose for educational research publications… (p. 194)

According to the department's website, the progmamme founded in 1980 flourishes to this day and boasts high job placement rates: the majority of its graduates are gainfully employed, mostly in tenured, tenure-track, and full-time positions in education and research (http://english.cmu.edu/degrees/phd_rhetoric/phd_rhetoric.html). This is an impressive record of achievement against the generally bleak background of epistemic Ph.D. careers. But achievement is just one part of the story. The programme's webpage has no information on its drop-out rates, but some of the numbers, in conjunction with Berkenkotter, Huckin, and Ackerman's data, suggest that these rates may be quite high. In its twenty-nine years of operation, the programme has seen fifty-five graduations – an average of two graduations a year. Berkenkotter, Huckin, and Ackerman's study initially enlisted two participants, but one dropped out in the first year. The authors offer no commentary on the reasons of the withdrawal, and from what I see and read in the literature, the topic is not quite the darling with scholarly researchers. But Berkenkotter, Huckin, and Ackerman offer a glimpse of this part of epistemics reality. Their analysis of the socialization of the 'surviving' candidate is a story of struggle:

> [T]he transition from composition teacher to composition researcher… involves a difficult passage from one academic culture to another… most entering graduate students struggled to gain competence with either key issues or the locally preferred conventions for reading and writing. (p. 211)

The authors place these tribulations among regular growth pains, but there may be more to the issue

than the eye meets. Star and Griesemer (1989) explain that interdisciplinary research has all the dubious benefits of marginal life:

> People who inhabit more than one social world - marginal people - face an analogous situation… The strategies employed by marginal people to manage their identities - passing, trying to shift into a single world, oscillating - provide a provocative source of metaphors for understanding objects with multiple memberships. Can we find similar strategies among those creating or managing joint objects across social world boundaries? (p. 411)

Life and work between worlds is "volatile, elusive, or confusing" (p. 412) yet these cognitive challenges pale in comparison with the role of a scholarly pariah that

> 'stakes out' territory, either literal or conceptual. If a state of war does not prevail, then institutionalized negotiations manage ordinary affairs when different social worlds share the same territory... Such negotiations include conflict and are constantly challenged and refined… (pp. 411-412)

Star and Griesemer suggest that "the central cooperative task of social worlds which share the same space but different perspectives is the 'translation' of each others' perspectives" (p. 412).

Rhetorical manifestations of dichotomous thinking

If the tasks of knowledge translation and compliance with divergent disciplinary traditions may not seem fun enough, the cultural and social forces that maintain disciplinary divisions can add their share of excitement to interdisciplinary studies. Disciplines often use opposition and hostility for constructing their collective identities (Bazerman & De los Santos, 2005) and for defining their stances towards the phenomena and events of the natural and social worlds (Miller, 2005). This thought pattern is often seen as a purely cognitive phenomenon. Moreover, it is often assumed among epistemicists that dichotomous thinking has no alternatives. This assumption deserves special attention.

What is a dichotomy? The term can refer to any binary classifications or oppositions (e.g. Berlin, 1990; Farrington & Loeber, 2000). Here, however, I use it as a designation for the reductionist patterns of thought, behaviour, and social organization that James (1997) terms "hierarchical dualisms." There is little formal difference between these two phenomena. Rather, the distinction lies in their applications. Dichotomies result from uncritical or abusive application of binary oppositions.

There is a growing body of scientific evidence for what has been part of common sense all along: dichotomous thinking can be detrimental for individuals (Litinsky & Haslam, 1998) and for communities (Meyer, 2000; Killingsworth & Jacobsen, 1999). Nonetheless, the conventions of the monological forms of academic communication encourage agonistic tactics that pit the self against the other. One of these tactics requires the communicators to erect and extol one standpoint as their own supreme and timeless choice (Berlin, 1990); its counterpart, the negative tactic, is aimed at

constructing and attacking an evil or inferior opponent (Scriven, 1987). Most research publications combine both of these patterns (Bazerman, 1983; Segal, 1993; Suppe, 1998; Swales, 1990). Philosophy and critical studies permit even more narrow rhetorical strategies; here negative tactics alone can constitute fully fledged arguments (Dewey, 1941). As readers and listeners, communicators are socialized to respond along the same lines, that is, in either positive or negative ways: "criticism, follow-up, or replication" (Segal, 1997; p. 258). Harris gives the name of "the Max Planck effect" to the discursive tradition of asserting new ideas by impeaching old ones (1998). Within this agonistic tradition, discourse is conceived as a dialectical movement through an endless succession of dichotomous "turns" (Segal, 1997, p. 258). The winner-take-all reward system of organized research reinforces the trend, so every now and then discourse degenerates into my-way-or-no-way impasses (Fahnestock, 2005).

We are often reminded that binary patterning is more deeply rooted in human psyche and behaviour than any other pattern (e.g. Berlin, 1990; Booth, 1974a; Flower, 2002; Harris, 2005a; Meyer, 2000). However, over-reliance on it has serious pitfalls. (e.g. Bialostosky, 1995; Killingsworth & Jacobsen, 1999). Flower (2002) directly blames antagonism hampering the field on dichotomies:

> The standard conceptual tools of both cognitive and cultural theory are better at dichotomizing… than they are at helping us get at the *interaction* of cognition, social processes, and worldly action that is at the heart of intercultural dialogue. (p. 241)

Scholars have done much to expose the traps of dichotomous thinking, but to this day universities remain the seat of what Barton (1993) calls the "contrastive framework." Based on her analysis of a sample of American expert and student essays, Barton comes to the conclusion that the "authoritative and competitive" stance is "privileged implicitly by the gatekeepers" since students who construct a less combative stance in their essays tend to get lower grades in writing courses (p. 766).

Dichotomies are ingrained in the rhetorical conventions of scholarly writing and the practices of scholarly research. For example, the introductory rhetorical 'move' establishing the significance of a study often takes the form of criticism of predecessors' work (Fahnestock, 1989; Salager-Meyers, 1992; Swales, 1990). Controversy is also deeply worked into the fibre of academic discourse, so a graceful jab or kick at an opponent never fails to earn the writer a few extra points from the connoisseurs (Booth, 1974a; Meyer, 2000; Nash, 1990). But dichotomous thinking is more than an epistolary convention. It is perpetuated by the existing disciplinary organization and professional practices. Some academic communities view controversies as a marketing tool. Indeed, agonistic argumentation seems to work well for attracting spectators into the disciplinary colosseums (Harris, 1998, 2005a) without disturbing their well established "buddy systems" (Flower, 2002, p. 272). Here is Fisher's (1985) digest of some of the traditional controversies in rhetoric:

> Michael Calvin McGee and Martha Anne Martin… contrast Bitzer's "idealistic" view with a "materialist's" perspective. Walter M. Carleton… attacks Farrell's distinction between social and technical knowledge, arguing that all knowledge is rhetorically generated and sustained. Regardless of who "wins" these disputes, the status of rhetoric

> is enhanced[22]; its historic connection with *logos* is reaffirmed. (p. 85)

In fact in logocentric academic discourses many authors depend on one another for context and even for substance. Perelman (1982) explains that

> [w]hile the specialist who addresses a learned society and the priest who preaches in his church know the theses upon which they base their expositions, the philosopher[23] is in an infinitely more difficult situation. (p. 17)

The abstract "appeals to common sense or common opinion, to intuition or to self-evidence" create a "necessity for a dialogue that would bear on all controversial points." This makes "controversy… central to philosophical argumentation" (p. 17). Addressed to disembodied universal audiences, scholastic controversy heavily depends on abstract values, which in turn depend on dichotomies, such as the opposition between 'men' and 'things' (p. 29). These relations of mutual conditioning make dichotomies and 'hierarchical' values (p. 29) into the semantic pillars of agonistic argumentation.

Stannard's (1965) inquiry into the origins and history of scientific explanation sheds more light on the semantic mechanisms of academic controversy. He posits that in contemporary research the popularity of any method depends on its reliability: "Generally, a method is found to be objectionable, or at least highly suspect, when the guarantee of its reliability is external to it" (p. 204), such as the notion of divine truth. Stannard believes that in expunging teleological concerns from discourse, "modern explanatory methods" radically depart from the ancient methods (p. 205). There are also differences in the status of the guarantee. The relentless pursuit of certainty compels modern science to shut out all factors 'external' to the 'phenomena'. In absence of external criteria, the discourse itself, *logos*, takes on the status of a standard by which the communities judge their theories. Stannard points to an interesting feature of god terms like *truth*. They function as a logical guarantee no matter whether they are admitted or denied:

> Even the equally-frequent denial that truth can be attained points in the same direction for, in no case in presocratic literature, does the denial of the attainability of truth lead to a suspension of the method which permits that assertion. (p. 205)

Since denial is as good as affirmation, probabilism and relativism can become, "like truth, forms of a guarantee" (p. 206).

The latter observation seems to capture the nature of the preferred logoi in social domains (Fuller & Collier, 2004). In other fields the situation is somewhat more complicated since the god terms here are seldom brought up for discussion. Yet whether explicit or implicit, appeals to reified values, such as *truth*, *understanding*, *fact*, *statistically significant*, *change*, or *democratization*, underwrite most research writing.

Any technical term can be elevated to the status of a god term in band-wagon arguments, which may sometimes produce comical effects. For example, there are numerous pedagogical papers

[22] Cf. the paradox of Tisias and Corax cited in Harris (2005a, pp. 8-9).

[23] Perelman adheres to the classical notion of philosophy which I discussed in the third chapter. To him, philosophy subsumes rhetoric and dialectic (p. 5).

eulogizing popular concepts, such as *deliberative argumentation*, without as much as specifying what these concepts mean. Conversely, any god term can be 'brought down to earth' when it becomes the subject of methodological analysis. In *Rhetoric* and *Nicomachean Ethics* Aristotle undertakes ethnomethodological inquiries into some congratulatory and derogatory terms of his day. Modern epistemicists also show interest in contemporary god terms. For example, van Eemeren et al. (1996) review numerous semantic analyses of two god terms of argumentation theory, *reasonable* and *rational*; Willard (1989) analyzes the notion of *freedom* in terms of rhetorical theory (Ch. 8); and MacIntyre (1988) performs a historical study of the notion of *justice*. Yet the most abstract god terms are rarely analysed in modern epistemics, even though they occasionally become the subjects of didactic arguments, such as Booth's work on assent and ethics (1974b; 1983; 1988). Perhaps the most influential abstract default values in modern research are *survival* and *power*, which are quite uniformly assumed as supreme 'goods' (e.g. Bourdieu, 1991; Maslow, 1970).

What is the purpose of such systemic reification of scholarly discourse? Some commentators suggest that it allows academics to claim the status of a revolutionary force challenging "conservative societies" (Perelman, 1982, p. 28); others believe that epistemic discourse fits the profile of entertainment (Fuller & Collier, 2004, esp. p. 235; Kneale, 1949, p. 242).

Perhaps the choice of the persona varies by the confrontationist, but the self-defeating nature of the confrontation itself is not lost on either scholars (Ashmore, 1996; Fuller & Collier, 2004; Hacking, 1981; Harris, 2005b) or the stakeholders of scholarly research (Brown, 2004; MacMillan & Koenig, 2004). From Aristotle and modern-day rhetoricians we know that the criteria for judging the merits of argumentation lie not only in its formal features and suasory power but also in its relations with the social and natural worlds. That is why agonistic argumentation is not entirely harmless. Outsiders consider it 'mean'; insiders call it "bad press" (Woolgar, 1986, p. 309). With the contexts of arguments deeply buried inside the disputes, the stakeholders are often left empty-handed (Harris, 1993; Fahnestock, 2005; Miller, 2005). Another side effect is less public but painful nonetheless. Agonistic reasoning commits researchers to entrenched positions (Harris, 1993, passim; Harris, 2005, p. 174). Thus, to a great extent, it defines the range and quality of their own research.

Many authors draw inspiration from the suasion and copia techniques collected and demonstrated by the ancient sophists (including Plato's Socrates[24]). Perhaps another important lesson that we can learn from sophistry is that there are no limits to the expansive power of agonistic argumentation when it is abstracted from its social and natural environments.

Alternatives to dichotomous patterning of text and discourse

Burke tells us that social order depends on its member's acceptance of their positions in it. But first and foremost, order depends on people's acceptance of the order itself. Many epistemicists now take this idea seriously. Over the past century they have taken issue with the prevalence of agonistic and

[24] Fuller & Collier (2004, pp. 261-262).

dichotomous practices in argumentation and education (e.g. Dewey, 1941, Fisher, 1987, 1994; Flower, 2002; Fuller, 1995; Fuller & Collier, 2004, esp. xi-xxix; Gross, 1990, Ch. 11; Kimble & Hildreth, 2004; Russell, 1993; Star & Griesemer, 1989; Vygotsky, 1962b). Much of the literature on dichotomies aims at raising awareness of the prevalence of dichotomies in discourse or provides general educational advice on how to deal with them. In their own works epistemicists also use a broad range of textual techniques to counteract the pattern.

Dialectical reasoning, pluralism, and reflexivity

Popular advice in the literature on how to resist dichotomies involves 'dissolving' or 'reworking' them. In some cases such resistance becomes an important source of epistemic innovation. According to Berlin (1990), such discursive processes can generate sufficiently complex concepts as long as they get continuously "subsumed by a larger truth" (p. 54). On the other hand, dialectical 'responses' often create new dichotomies, which in turn get 'dissolved' and 'reworked' in the subsequent loops of perpetual dialectical transcendence.

It is well known that dialectic is dangerously close to dichotomous reasoning (Harris, 2005a). Perelman (1982) refers to dialectic as "the technique of controversy" (p. 17). The classical dialectical dispute allows for only two alternatives and requires the disputants to select one of them, albeit following an elaborate argumentative procedure.[25] Of course dialectic is indispensable for argumentation. It is easy to grasp and is therefore a popular analytic method (e.g. Schryer, 1993), a mechanism of identity formation and cognition (e.g. Booth, 1974a; Harris, 2005a), and a principle of social organization (e.g. Burke, 1969). In research writing it works well at the stage of "problematization[26] [which] takes place in order to provide a ground for the more specific purpose, thesis, point, or argument of an essay" (Barton, 1993, p. 748), and it can be quite effective for problem-solving (Van Eemeren, 1987).

It is believed that the limitations of the dialectical discourse can be negotiated by adjusting the force of argumentation. For example, Berlin (1990) explains that "efforts to correct [other authors'] excesses… seem to 'over- shoot the mark' and result in substituting one excess for another" (p. 49). Many authors seem aware of this pitfall. They often defuse the "Max Planck effect" (Harris, 1998) of their criticisms by either addressing them to anonymous opponents or by suppressing negative evaluations. Here is what the former strategy looks like in Dewey's (1941) discussion of dichotomous reasoning habits:

> If we did not have an alternative in the *pou sto* provided for us by present-day physical

[25] Refer to the work by van Eemeren and his colleagues for a body of research into the pragma-dialectical method (e.g. Van Eemeren, 1987; Van Eemeren & Kruiger, 1987; Van Eemeren, Grootendorst, & Kruig, 1987; Van Eemeren, Houtlosser, & Snoeck Henkemans, 2007).

[26] King (1982) relates this mode of reasoning to criticism and reminds us that it is a condition but not a guarantee of progress:

> Critical judgement does not discover new knowledge. It condemns what is faulty and opens the way for the innovators which will make the new discoveries. (p. 303)

> science, we too should "naturally" describe the world in teleological and qualitative terms. Any other procedure would strike us as artificial and arbitrary. I was strongly reminded of this fact in reading recently a book by a writer deeply imbued with the spirit of classic Greek philosophy. He uniformly refers to "philosophies of experience" in a disparaging tone. But, as uniformly, his own account of Nature is couched in moral and poetic terms appropriate only to Nature as it is directly presented in experience and inappropriate to nature as disclosed to us in physics. (p. 537)

The foils may recognize such veiled references to their works, but, unless they decide to issue a public retort, the controversy will be hidden from the eyes of most other readers.

Another method of subverting agonistic argumentation is, in rhetoric and literary criticism, known under the name of pluralism. This strategy was the topic and weapon in Booth's lively exchanges with his colleagues and critics (Antczak, 1995). The opponents here are confronted openly, but the confrontation is styled as a kind of good-humoured banter.[27] This strategy gives rise to forbiddingly complex prose and raises ethical questions for epistemic disciplines (MacDonald, 1990).

In education and social sciences, popular advice for resolving the conflicting pressures that writers feel from the numerous facets of their social identities is self-awareness, or reflexivity:

> All of us are well-advised to pursue a variety of passageways to understanding, allow the tension of contrasts, consider the partial nature of what we know, look for and ponder disconfirming information, and monitor our own judgment processes. The… flexible, self-searching, reflective perspective… would keep us open, keenly observant, ready to change our minds, ready to think differently, ready to try differently, and appreciative of multiple theoretical and intervention possibilities. (Berlin, 1990, p. 57)

Flower (2002) explains that resistance to reductionism and nepotism is as much a matter of good education as of conscious choice:

> … this is no easy stance to take; people must overcome considerable barriers, starting with established social practices that rush to hush awkward dissonance. They must resist deep-running cognitive processes and learned interpretive schemas that assimilate and nullify difference. And they must invoke literate practices of inquiry—from a Socratic dialogue to the scientific method—that invite and shelter the particular kinds of divergent thinking they value. In short, the real challenge of knowledge building is to embrace, not just tolerate, conflict. (p. 241)

Indeed, such efforts can keep binary oppositions from degenerating into dichotomies. In some cases the difference between a dichotomy and a contrast is in the strength of the claim:

> In order to establish the utility of particular methods…, it is useful to contrast one set of methods with another in order to identify their relative advantages, disadvantages, complements, overlaps, and ranges of convenience. But the [dichotomous] methods

[27] Nash's (1990) "ignoble research maxims" caricature this coy technique.

> arguments do not stop here. They go beyond the point of offering additional ideas about ways of gaining understanding and head toward establishing the intrinsic superiority of one set of methods over the intrinsic inferiority of another set. (Berlin, 1990, p. 48)

In other cases the difference lies in the coverage afforded to alternative views. Fisher (1985) provides us with a compact example of how conceptual conflicts can be embraced for the readers' benefit when he explains that his "narrative paradigm is fully in accord with [his predecessors'] views. It differs from dramatism in two ways. The first difference is subtle but important…" (p. 86). Note that despite the emphatic distinctions between his conception and dramatism, the author refrains from simplistic opposition to his counterparts or from direct attacks on them. He even withholds indirect attacks of Nash's (1990) "ignoble mimic maxims" type (*Notwithstanding… a highly original thesis, the book leaves some important questions unanswered*). Instead, Fisher undertakes a true comparison between the received 'paradigm' and the model he proposes by giving the rival paradigm more than a few off-hand remarks. So apart from demonstrating the benefits of his framework, he also educates his readers on what is 'out there' (cf. Hodge & Kress, 1993).

The limits of dialectic

The dialectical method is not problematic in itself, but the over-reliance on it should raise concerns. In epistemics we see whole research domains where problematization is the point of most discourse. Clearly this does not suggest any technical weakness. These days most epistemicists know better than rely on one research method. We triangulate our evidence, we test hypotheses, and we constantly remind ourselves and our readers about the limitations of our methodologies. Yet there seems to be a dearth of meaningful reflexivity and innovation in the field. The dialectical method cannot counteract such stagnation since it does not require any context apart from the dispute itself (Bakhtin, 1981). In Aristotelian terms, it does not call for 'comprehension' of the subject matter. All it takes to refute an argument in a dialectical dispute is to show that this argument falls short of formal validity or felicity. Such peculiarities of the dialectical method may be the reason behind Plato's recommendation in "The Republic" echoed by some modern-day epistemicists (Swales, 2004, p. 247) to refrain from teaching dialectical reasoning too early in the students' lives and careers.

Political and intellectual histories have numerous examples of failed dialectics, but Burke's (1969) version of such a failure is particularly instructive for epistemicists. *A Rhetoric of Motives* has some of the most macabre spectres of dichotomous thinking since Plato's dialogues. The theme of violence to Burke is as much an analytical object as a way of appealing to his readers' anxieties. Like Plato's Socrates, Burke mixes and shifts his terminology, taking on the statute of an ethical messiah. Here is a representative passage from the chapter called "Identification":

> As seen from this point of view [i.e. "in an essentially magnified or perfected form"], then, an imagery of slaying (slaying of either the self or another) is to be considered merely as a special case of identification in general. Or otherwise put: the imagery of slaying is a special case of transformation, and transformation involves the ideas and

> imagery of *identification*. That is the *killing* of something is the *changing* of it, and the statement of the thing's nature before and after the change is an *identifying* of it. (pp. 19-20; emphasis in the original)

Following a series of odd conceptual twists, the idea that "'war' is a '*special case of peace*'" (p. 20) becomes both a natural product of the book's abstract analytic method and a sobering result of a doomed thought experiment. Burke's argument hinges on dismissal of such obvious social phenomena as empathy, self-sacrifice, solidarity, and common sense. In the model of social organization that he assumes for his rhetoric nothing matters but personal survival, and the only evaluation criterion that he sets up for his work is Aristotelian entelechy: realization of inherent formal perfection. Burke's purpose is to test the limits of semantic subversion, and of course he finds no such limits. Through a series of transformations, war is abstracted from mass murder to a socially acceptable form of an "ultimate *disease* of cooperation" (p. 22) – little more than a gothic image for bored *bürgers* looking for a way to balance their mild moral qualms with the anticipated benefits of a distant war.

There is no dearth of comments on the theoretical, methodological, and educational significance of Burke's method. Some of the commentators believe, like Overington (1993), that Burkean dialectic "operates as a protection from the powerful influence of modal vocabularies of motives which have their roots in the property relations of society" because it affords a broader "understanding of social relations... than that legitimated by the ruling class and its intellectual servants" (p. 97). To others, like MacIntyre, Burke's analysis seems shoddy. I think there is truth to both opinions. Burke offers a fascinating demonstration of the limits of dialectical transcendence. Transcendence is a theoretical concept that Burke associates with the Aristotelian notion of entelechy, or potency, "which classifies a thing by conceiving of its kind according to the perfection (that is, finishedness) of which that kind is capable" (p. 14). It is by entelechy that

> all classes of things are hierarchically arranged in a chain or ladder or pyramid of mounting worth, each kind striving towards the *perfection* of its kind, and so towards the kind next above it, while the striving of the entire series head in God as the beloved cynosure and sinecure, the end of all desire. (p. 333; emphasis in the original)

Social hierarchies thus get their justification in nothing less than the Platonic natural order. What remains to the analyst is tranquil observation:

> But since, for better or worse, the mystery of the hierarchic is forever with us, let us, as students of rhetoric, scrutinize its range of entrancements, both with dismay and with delight. (p. 333)

This conclusion furnishes a spectacular anticlimax for a book whose manifest purpose is an inquiry into the causes of war. It also makes Burke's argument one of the most meaningful thought experiments of the past century. The author is honest for the benefit of his readers, so his demonstration strips bare the limits of dialectic. Dichotomies may have a comparatively short history (James, 1997), but within dialectical arguments they are unassailable.

Deliberative argumentation

Apart from limiting the range of communication options, agonistic argumentation models also limit the range and explanatory power of epistemic theory. Following investigations into cooperation mechanisms, such as Star and Griesemer (1989), some authors have found the dominant conceptions in need of reassessment. Wilson and Herndl (2007) pick up where Burke left off, by explaining how the agonistic models can be extended:

> [B]boundary work is driven by a *demarcation exigence*, by the desire to distinguish one group from another that is typically seen as an imposter... We… argue that a boundary object can also function as a rhetorical construct that encourages an integrative rather than a demarcation exigence… The model we describe suggests that boundary work can sometimes become a struggle for understanding and integration rather than a contest, controversy, and demarcation event. (pp. 131-132)

Similarly, Fisher (1987), who takes his cue from Aristotle and Isocrates, contends that the dominant "jurisprudential model" of argumentation treats the phenomenon too narrowly, downplaying context and consequence. Like Isocrates and a number of contemporary rhetoricians (Bazerman, 1989; Flower, 2002; Miller, 1989), Fisher places his hopes for a more comprehensive framework on the deliberative model of argumentation. In his 1994 study he proposes that the agonistic argumentation models privilege "knowledge of that" and "knowledge of how" over the "knowledge of whether" (p. 26). He traces the latter to Aristotelian practical wisdom, contending that "[t]he bedrock value of praxial consciousness… is love, that is, an abiding concern for the welfare and well-being of others." In contrast to the scientific "mind oriented to the here and now, to… technical means and values," the praxial mind "incorporates… knowledge with a compassion for the consequences of using this knowledge" (pp. 28-29).

We may agree or disagree with Fisher's treatment of love as an analytic primitive, but his analysis goes right to the root of reductionism in argumentation theory. In the second and third chapters I found that uncritical use of positivist methods are sweeping applied argumentation analyses and gaining ground in scholarly epistemics. Certainly reduction is unavoidable and indispensable for any kind of communication, including research. The question then is not whether or not research is an accurate representation of reality, but what are the purposes and effects of applying particular terministic screens to particular subject matters. The results of my literature review suggest that information on methodological frameworks and procedures tends to be cursory, and justifications of methodological choices receive even less attention. The tradition dictates casting research publications in the form of unproblematic demonstrations.

It is generally well understood that evaluation plays an essential part in decisions and that the evaluation criteria are "essentially contextual and communicational" (Scriven, 1975, p. 12). How can this complexity be accommodated? Specifically, what should count as comprehensive argumentation and inclusive decision-making? Two classical models of deliberative argumentation, forensic and political stases, provide a helpful framework relating argumentative practices to their objectives.

Stasis is a type of schema made up of issues that people are likely to address in the course of

their arguments under specific circumstances. According to Aristotle, political discourse "treats of wider issues" than forensic (Aristotle, *Rhetorica*, I.1.1354b). That is why, between these two models, political stasis presents us with a broader view of deliberation:

> The political orator aims at establishing the expediency or the harmfulness of a proposed course of action; if he urges its acceptance, he does so on the ground that it will do good; if he urges its rejection, he does so on the ground that it will do harm; and all other points, such as whether the proposal is just or unjust, honourable or dishonourable, he brings in as subsidiary and relative to this main consideration. (I.3.1358b)

For the purposes of litigation, such comprehensive argumentation is an overshoot since the parties' tasks in the court is to argue their cases,[28] while the decisions are up to the judges. On the other hand, in legislative deliberations the responsibility for decisions rests with the same people that make arguments. The context in which legislators ground their arguments includes facts, their causes and effects, the circumstances and the language of their presentation, their normative evaluation, as well as their expediency and possibility. They consider the past events as carefully as the need for future actions. They also need to account for the consequences of these actions and for available resources. Moreover, they have to be aware of the dynamic nature of the situation and of their participation in it as social agents.

Political stasis does not negate but subsume the forensic model. Of course its comprehensiveness can be a disadvantage. While forensic stasis is a compact structure of three to four issues (Fahnestock & Secor, 2002; Lauer, 2004), for political deliberations Aristotle proposes seven issues, and Hermogenes's stasis includes fourteen issues (Williams, 2001). Yet political stasis is worth the trouble if we wish to include decision-making into the purview of argumentation. We can boil down the ancient and modern models of deliberative argumentation (Aristotle, *Rhetorica*, I.1, II.7, III.16; Cicero, *De Inventione*, I.VIII.10-11; Fahnestock & Secor, 2002; Fisher, 1987; Williams, 2001, p. 111-113) to the following ten issues for decision-making argumentation: FACT, CAUSE/EFFECT., VALUE, ACTION, EXPEDIENCY, POSSIBILITY, PROCEDURE, DEFINITION, APPRAISAL, and OUTCOME.

Political stases in research discourse

Political stasis is highly relevant to research discourse since researchers pursue similar objectives to legislators. They also make decisions, both in relation to their specific studies and as members of their communities. So we should expect researchers to use argumentation models that are at least as elaborate as political stasis. Following Aristotle's conception of the four causes,[29] we can say that

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[28] Of course the model glosses over the fact that the parties make numerous decisions, even if outside the brackets of public discourse.

[29] Aristotle lists the material, efficient, formal, and final causes as the conditions of any human activity. Here, for example, is his discussion of the role of the causes in learning from *Nicomachean Ethics*:

> The origin of action—its efficient, not its final cause—is choice, and that of choice is desire and

such a superstructure should allow communicators to address natural and social phenomena (the material cause amplified into the issues of fact, cause or effect, and value), as well as the responses that the phenomena call for (the efficient cause as the issues of action, expediency, and possibility). It should also enable communicators to include methodological information (the formal cause as the issues of procedure and definition) and explain their decisions and suggestions (the final cause as the issues of appraisal and outcome) (Table 4.1):

Categories of content	Issues	Questions
Phenomena (the material cause)	Fact	Has the event occurred? Does the phenomenon exist?
	Cause/effect	What causes the phenomenon? Who or what is responsible for the event? What are the effects of the phenomenon or event?
	Value	How great is the harm or benefit of the event?
Solutions (the efficient cause)	Action	What kind of action should be taken?
	Expediency	How will the action address the problem?
	Possibility	What resources or circumstances will the action require?
Methods (the formal cause)	Procedure	How should the case be investigated or discussed? Is the presented evidence relevant and sufficient?
	Definition	What kind of phenomenon is it? In which terms should the event be described? What do the terms mean?
Situational concerns (the final cause)	Appraisal	Was the event lawful? Was its harm or benefits justified? Is the proposed action lawful and justified? Is it honourable or dishonourable?
	Outcome	What are the anticipated effects of the action?

Table 4.1. The issues of political stasis.

Scriven (1975) proposes a somewhat similar superstructure for scientific arguments. He suggests that in 'practical discourse' an argument is incomplete without a discussion of methodological choices and their situational underpinnings: an explanation "is appropriate because it involves an assessment of need…, a consideration of resources, a plan that matches needs and resources, and a direct answer

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reasoning with a view to an end. This is why choice cannot exist either without thought and intellect or without a moral state; for good action and its opposite cannot exist without a combination of intellect and character. Intellect itself, however, moves nothing, but only the intellect which aims at an end and is practical; for this rules the productive intellect as well, since every one who [makes] for an end, and that which is made is not an end in the unqualified sense (but only relative to something, i.e. of something)—only that which is done is that; for good action is an end, and desire aims at this. (VI.2.1139b, p. 1799)

The final cause of such complex activities, to Aristotle, is happiness.

to the question that expresses the plan" (p. 11).

Two empirical studies provide helpful insights into the most prominent argumentative issues across the disciplines. Fahnestock and Secor's (2002) analysis of argumentation in general science and literary criticism was based on a corpus of publications from *Science* and *PMLA*. The authors established that three stases are indispensable for both domains: fact, definition, and cause. On the other hand, the stases of value and procedure tend to be simply asserted or assumed rather than discussed in their corpus. Zappen (1983) derived his observations from a survey of research articles and proposals in sciences and technologies. He found that the mandatory elements of basic research publications are the statements of goal, current capacity, problem, solution, and evaluation criteria. In this genre, "potential applications are ignored or mentioned only in passing" (p. 133), unlike in applied research articles and research reports. The issue of future plans is typically suppressed in basic research. In research proposals, however, this issue is mandatory. In the categories of stasis theory, Zappen's findings suggest that in science and technology authors typically address the questions of fact, possibility, value, action, appraisal, as well as outcome and procedure. These analyses suggest that the research stases are unevenly distributed between the 'soft' and 'hard' disciplines (Table 4.2):

Categories of content	**Issues**	**Fahnestock & Secor (2002): general science and literary criticism**	**Zappen (1983): special sciences and technology**
Phenomena (the material cause)	Fact	+	+
	Cause/effect	+	
	Value	+/-	+
Solutions (the efficient cause)	Action		+
	Expediency		
	Possibility		+
Methods (the formal cause)	Procedure	-	+/-
	Definition	+	
Situational concerns (the final cause)	Appraisal		+
	Outcome		+/-

Table 4.2. Research issues found in literary criticism, general and special science, and technology.

Without information on the methods and selection criteria on which the two sets of observations were based, matching Zappen's results with Fahnestock and Secor's calls for a leap of faith. The identification of issues is not a straightforward task, so the categories of statements included in the categories will vary by the author. On the one hand, categorization is a matter of methodological

choice. On the other hand, different corpora call for different classifications. For example, to accommodate the specific nature of contemporary research, Fahnestock and Secor add the stasis of cause to the classical model of forensic stasis (p. 59). Finally, unlike Fahnestock and Secor, Zappen analysed segments of publications, which likely explains why he did not find the issue of definition in his samples.

Yet in spite of these difficulties, we can draw some cautious generalizations from these two studies. Fahnestock and Secor's findings pertaining to the research practices in literary criticism bear out my suggestion that methodological issues are underrepresented in scholarly epistemic disciplines. They also confirm that researchers' reluctance to consider the social contexts of their work is a peculiar feature of scholarly epistemics. On the other hand, it is clear that scholarly epistemics is not the only domain where methodological information receives cursory treatment. Rather, the weakness of methodological reasoning across the disciplines points to a broader tradition that requires communicators to construct their arguments as unproblematic demonstrations of 'true' observations.

Summary

The division of epistemic research into theoretical, empirical, and applied does not so much reflect the authors' disciplinary affiliations or research sites as the nature and objectives of their specific investigations. However, information on the circumstances and methods of research is not readily available in most epistemic publications. In this chapter I have surveyed the methodological resources available for epistemic studies.

Apart from pursuing this methodological task, I have inquired into the implications of narrow argumentation models and practices for situated research. I discovered that binary oppositions are more than a figment of methodological imagination; dichotomous thinking is powerful enough to tempt many epistemicists to exalt the value of one argumentation mode or method while downplaying or dismissing other facets. I also found that it is counterproductive to view dichotomous thinking as a purely cognitive phenomenon; this pattern is rooted in the culture of scholarly discourse and has a wide range of negative consequences. To a great extent it accounts for the limited repertoire of extramural scholarly studies, for the rigidity of traditional disciplinary organization, and for the narrowness of the theory of the field.

Political stasis is a viable alternative to agonistic argumentation models. It can serve as a conceptual basis for integrated models and practices because it has the potential of accommodating various modes of reasoning: explanation, persuasion, problem solving, and decision making. It also adds substance to the dominant models by relating argumentation to its situational underpinnings.

Chapter 5: Analysis of epistemic topoi in a corpus of research publications: Study design, conceptual framework, and catalogue of linguistic features

Something old, something new,
Something borrowed, something blue…
Puritan marriage rhyme.

The initial purpose of my project was to identify and describe epistemic topoi in ophthalmic research publications. Even though epistemic topoi are a familiar concept to language and communication experts, they are poorly described. This is not surprising since, in epistemics, there is no clear understanding of the methods of exploratory research. My literature review revealed a number of inadequacies in the meta-theory of argumentation that are linked to dichotomous argumentation models and practices. To address these inadequacies, I designed my project as an exploratory and methodological investigation. Apart from a taxonomy of the topoi and a catalogue of their linguistic features, it resulted in a description of the methods that produced these two classifications.

In the previous chapter I found that a comprehensive account of a situated investigation must cover at least four categories of issues: those related to the phenomenon or problem at hand, proposed actions, inquiry and communication strategies, and contextual parameters behind strategic decisions. This argumentative model is significantly more complex than the hierarchical and binary patterns that dominate the theory and practice of argumentation studies. That is why in this chapter I will analyse the methods for incorporating diverse research modes into a unified study. I will discuss my choice of research procedures, the results of my pilot study, as well as the analytic methods and catalogue of linguistic features that grew out of these results. In particular, I will specify the criteria that I used for selecting my materials, analytic procedures and units. I will also explain how I used the method of visual annotation for analysis of the semantic configurations that realize epistemic topoi. Finally, I will introduce the linguistic features that constitute these configurations.

Study design

The choice of research procedures

How does one look for textual and discursive units of organization in the sea of much poeticized discursive richness? One way is to survey discourse for statistical regularities, as Biber and his colleagues do in their work on lexical bundles (Biber, 2006; Biber & Barbieri, 2007; Biber et al., 2004). The assumption behind this approach is that statistical significance of word collocations in discourse points to their significance for discourse communities, even when such collocations appear like random combinations (Biber et al., 2004). Ethnomethodological approaches look for a slightly different kind of information. Some of the researchers working in this paradigm survey discourse for

'folk theories' of argumentative organization. Such is Schryer et al.'s (2007) investigation into the strategies of collaboration in eye care. Other investigators analyze discourse for signs of the effectiveness of specific communication strategies, as Ceccarelli does in her 2001 study into the genre of field-creating motivational texts.

I conceived my study along the lines of Willard's *human as scientist* (1989, p. 18), on the assumption that the analyst can learn about the significant discursive patterns in the same way as the field's novices do. Here is Atkinson's account of the way in which medical students are introduced to clinical practice:

> The teacher cannot 'have' the experience for the student. He or she can tell the students when they are 'right' or 'wrong', and when they are 'getting warmer'. But there is no way of guaranteeing that students will automatically hear, see or feel in precisely the same way as does a teacher. There are no rules that guarantee it, over and above the basic requirement of argued techniques and reliable technology. Ultimately all the teacher can do is to say 'Hear it this way', 'Feel it soft' and so on.
>
> However, in observing the 'objective' features of diagnostic signs, students have to learn the distinctive ways of perceiving. The consensus of such perceptions – which will warrant their status as objective facts – is provided by the grammar of perception that is shared by the community of practitioners who mutually recognise each other as competent. (p. 170)

Apart from grasping the received observation practices, the initiates must internalize their disciplines' topical logics. Atkinson explains that students

> have to piece together a… complex semiological field in order to induce an underlying pattern. The detective work depends upon the students' ability to arrange the various manifestations into a coherent pattern. Individual signs and symptoms gain their significance insofar as they can be located within a particular *Gestalt.* (p. 172)

In the same ways as novices apprehend organized theoretical knowledge, they learn to operate within their disciplinary discourses by grasping their logics.

Unlike novices, inductive analysts seldom have the benefit of being prodded into the perception of conventions and underlying patterns. Instead, they look out for similarities, differences, and associations in the discourse. To stay alert to such links in biomedical publications, I maintained theoretical and metatheoretical agnosticism as deep into the data-gathering phase as was possible. I generated my data inductively and did not turn to theories of text and discourse organization for results interpretation and translation until I had a body of (largely) pre-theoretical results. I used the methods of primary induction for text and discourse analysis and expressed my observations in standard linguistic terminology. On the other hand, secondary induction allowed me to select my most significant observations and decide on the modes and strategies of interpreting and presenting them.

As any exploratory investigation, my study was iterative and cyclical (Brown, 2004). It went through a series of working hypotheses and involved multiple theoretical perspectives and analytic

methods. The development of the framework was long and arduous. It was not before a few failed attempts to make sense of my materials and some fruitful encounters with reports of similar studies and methodologies that I developed a sense of what kind of data my work had turned up and what I should focus on in the written account of my results.

In the course of the study I had to abandon the lines of inquiry that involved searching for unique markers of argumentative meanings and statistical analysis. The search for unique markers involved attempts to draw direct links between lexemes or connectives to text spans of the type that Swales (1990, 2004) calls argumentative moves and Teufel (1999), argumentative zones. Statistical analysis consisted in trying to establish correlations between text semantics and distributions of isolated lexico-grammatical features.

A pilot study following these lines of investigation brought forth some positive results, which, however, turned out too trivial given the objectives that I pursued. In spite of the mixed results (or thanks to them), the pilot helped me to notice a number of text characteristics that set me on a more productive course.

At the next stage of my study I worked through the corpus looking for recurrent linguistic patterns that indexed minimal elements of argumentative organization. I marked in the texts, recorded, and classified all syntactic units with such patterns in order to correlate and describe them. At the end of this stage I surveyed my materials for two kinds of correspondences: (1) linguistic patterns correlated with argumentative meanings and (2) their typical clusterings and distributions in the texts. The former allowed me to see if my semantic designations could be confirmed with linguistic patterning; the latter helped me to start organizing the patterns into functional categories. The specific questions that guided my analysis of the linguistic features of the units were, first, whether or not the textual semantic categories could be recognized in isolation from the texts, based on their internal linguistic configurations alone, and, second, whether such configurations were pronounced enough to claim the status of distinct categories for the meanings that I had identified.

With a preliminary set of semantic categories and a tentative understanding of their linguistic signals, I let the corpus lay fallow for a month and then worked through it for a third time. Two major objectives motivated this stage. On the one hand, I wanted to test my designations for consistency. Since a month had elapsed from my first annotation, I viewed my ability to match my earlier designations as an equivalent of inter-annotator agreement in collaborative research, which allowed me to test the soundness of my preliminary classification. On the other hand, I wanted to see if the recurrent textual units that I had found might be elements of larger patterns in and across the texts. At this time I started tabulating and comparing the annotation results. I resolved ambiguous cases, merged the categories that were not sufficiently distinct, and divided those where I found irreconcilable linguistic patterns.

Once the classification of the topoi was complete, I classified the linguistic features associated with them. In NLP such classifications of features are called ontologies. Their purpose is to formalize "the internal structure" of the annotations (Ide & Romary, 2004, p. 223). Ontologies are not unheard of in other domains as well. For example, Bazerman (1985) mentions a structured

lexicon that he developed for his inquiry into physicists' reading strategies. He explains that the terms from this lexicon point to "domains of organized knowledge" and are linked to the experts' reading schemata (p. 7).

The systemic description of the linguistic features provided in this chapter lacks the rigour of formal ontologies. In my investigation this catalogue played the role of a 'transcendental hypothesis', allowing me to formulate generalizable findings and at the same time to verify my list of topoi against a set of theoretically sound criteria. It also allowed me to relate my observations to the existing theory and thus translate my results into the categories of current linguistic and epistemic discourse.

At the last stage of my study, I turned to the state of knowledge of the field. A literature review and environmental scan helped me to select and interpret my observations in the light of other authors' insights and findings and present them in a way that would address the issues underrepresented in the literature.

The selection and organization of materials

I surveyed a total of sixty articles on normal-tension glaucoma (NTG), but my close analysis was restricted to a smaller corpus of clinical studies that I identified within the 'large' corpus. I acquired the papers from MEDLINE (PubMed). The subject of normal-tension glaucoma was of interest to me due to a combination of circumstances. On the one hand, I hoped to capitalize on my limited background in nursing and on my earlier exposure to the analysis of eye-care discourse (Schryer et al., 2007). Thanks to this earlier encounter I learned about the social facets of glaucoma, which provided motivation for my pursuit. I was also motivated to persist by the history of glaucoma in my own family. Such keen amateurishness surely sets me up as something of a meddling stakeholder in relation to the domain. Some of the obvious limitations of this approach are possible misinterpretations of the materials and artificial grafting of theories and methodologies from my 'home' domains onto the materials. Yet I hoped that my tabula-rasa perspective would have its rewards given my dependence on analytic induction. In spite of the well-known benefits of domain expertise (e.g. Moravcsik & Murugesan, 1975, p. 87), there are also clear benefits to etic investigations since "outsiders often have sharper vision than insiders" (Harris, 1993, p. 267, n. 4) and are less affected by disciplinary doctrines.

Apart from maintaining my stance of an impartial observer, I had to reduce the corpus to a manageable size without biasing it with my subjective preferences. My exact search terms were

> glaucoma[Title] AND (normal[Title] OR low[Title]) AND (pressure[Title] OR tension[Title] OR IOP[Title] OR I.O.P.[Title]) AND ("loattrfull text"[sb] AND English[lang]).

This search generated a corpus of 290 English publications on the subject that were available online in full text. To reduce the size of this corpus, I used a combination of three methods. First, where possible, I selected only free full-text papers in English with abstracts. This brought the number to

papers down to sixty.

Next, I divided this broad corpus into two parts based on statistical criteria. Of the sixty articles, forty-three were published between 1995 and 2007 and seventeen between 1959 and 1994. The pre-1995 period had from one to five publications a year, whereas the post-1994 period showed a significant increase of published research on the topic: from ten publications a year in 1995-97 to thirty-six publications in 2006. I conjectured that such a difference in interest levels and available literature should reflect on the stability of theoretical concepts, research procedures, and reasoning patterns in the domain. The stabilization of inquiry practices should in turn result in greater homogeneity of the subject matter and textual forms. That is, in Kuhn's (1962) terms, the statistical difference might indicate the normalization / normal science watershed. Based on this conjecture I applied additional limits to narrow the post-1994 part of the corpus from 273 publications down to forty-three. The selection criteria for this period included, in addition to an English full-text version, availability of an abstract and access to free full text:

> glaucoma[Title] AND (normal[Title] OR low[Title]) AND (pressure[Title] OR tension[Title] OR IOP[Title] OR I.O.P.[Title]) AND ("loattrfree full text"[sb] AND hasabstract[text] AND English[lang]) AND ("1995/01/01"[EDAT] : "2007/12/31"[EDAT]).

Another factor that motivated the two-tiered structure of the study was the representation of the broad corpus in the narrower sets. For each year after 1994 the narrow set represents on average 85% of the broad corpus: from 42% for 1995 to 130% for 2007. To compare, the application of the same selection criteria to the pre-1995 part of the broad corpus would have resulted in a reduction from eighteen to one publication, retaining only 6% of the original set. Moreover, both parts of the abridged corpus represent comparable percentages of all English publications on the subject: 12% for the pre-1995 period and 13.5% for the post-1994 period.

To sum up, the abridged corpus (sixty publications) consists of all full-text English articles published by 1994 and all free full-text English articles with abstracts published after 1994, which amounts to about 13% of all English publications on normal-tension glaucoma indexed in MEDLINE.

On closer examination of this part of the corpus, I found important formatting and substantive differences among the papers. Two papers were published in a no-copy format, making their processing impossible. They were excluded from the corpus. I also excluded three papers that were written on topics other than normal-tension glaucoma. Among the remaining fifty-five papers I found several research types, such as case studies, literature reviews, methodological inquires, as well as clinical, experimental, and laboratory investigations (cf. Adams Smith, 1984; Salager-Meyer, 1992). Most of them used the IMRD structure but varied in terms of what van Dijk (1980) calls superstructures. That is, their textual profiles point to substantially different research and reasoning procedures. I decided to focus on the clinical subset, the largest in the corpus. This left me with seventeen papers (a 45,599-word corpus) whose topics and study designs seemed similar enough for generalizations about their recurrent rhetorical and linguistic features. I stripped the texts of figures,

tables, end-of-text citations, front- and end-matter. Parenthetical citations were replaced with ellipses.

My work with the corpus consisted of a survey of the 'large' set followed with close reading of the literature reviews and manual annotation of the 'small' clinical set. The survey familiarized me with the nature of NTG, the conceptual and methodological tools of the research, and the rhetorical features of the papers. The literature reviews introduced me to the insiders' perspectives on the state of the art. Finally, the annotation allowed me to identify, describe, and classify the most prominent and significant argumentative patterns in the clinical studies and identify their linguistic manifestations.

The NTG corpus at a glance

Like the field of epistemic studies, NTG studies can be described in terms 'spontaneous order' (Butos & Koppl, 2003; Forstater, 2003). The papers in my 'large' NPG corpus come from thirteen journals. The titles of the journals lend themselves to the same type of classification as the epistemic journals that I surveyed in the second chapter. There are nine scholarly titles, one interdisciplinary, one empirical, and two professional. (Interestingly enough, the two segments of my corpus do not overlap in terms of the publication venues; i.e. none of the journals from the pre-1995 segment of the corpus appear in the post-1995 group, and vice versa.) The largest number of papers, twenty-six, appeared in the *British Journal of Ophthalmology*; the rest of the journals are represented with one to five publications. The field accommodates a very diverse community, which is apparent already from the range of disciplines featured in the journal titles (including ophthalmology, genetics, visual science, molecular biomedicine, and medicine):

Pre-1995 publications:

BMC [BioMed Central] Ophthalmology
British Journal of Ophthalmology
Investigative Ophthalmology & Visual Science
Journal of Medical Genetics
Korean Journal of Ophthalmology
Molecular Vision
Tohoku Journal of Experimental Medicine

Post-1995 publications:

Documenta Ophthalmologica
Graefe's Archive for Clinical and Experimental Ophthalmology
International Ophthalmology
International Ophthalmology Clinics
Proceedings of the Royal Society of Medicine
Survey of Ophthalmology

The domain of NTG studies turned out to be an international enterprise with research contributions from Europe, Asia, and North America, with most papers written by groups of co-authors. While the sense of field cohesion comes from the thematic unity of the papers (cf. Gilbert, 1976), the heterogeneity of the domain is apparent from the diverse research modes and evidence types represented in the corpus. It is also quite diverse in genre, including literature reviews, case studies, experimental reports, clinical studies, and even one meeting script. Despite very similar textual structures, the papers differ in the types of data they use, the evidence they generate, and the findings they produce. In terms of their 'knowledge claim' types, they range from empirical reports, on one end of the spectrum, to methodological and theoretical investigations, on the other. The type of investigation is often apparent from the title of the paper (cf. Busch-Lauer, 2000, pp. 87, 90). Reports are represented as purely observational investigations of reproducible phenomena:

> The effect of Ca2(+) -antagonist on visual field in low-tension glaucoma
>
> The visual response to increased ocular blood flow in normal pressure glaucoma
>
> Altitudinal visual field asymmetry is coupled with altered retinal circulation in patients with normal pressure glaucoma

Methodological and theoretical investigations, in contrast, introduce or discuss conceptions, classifications, techniques, and methods (underlined in the examples):

> Spectrometric investigations in ocular hypertension and early stages of primary open angle glaucoma and of low tension glaucoma--multisubstance analysis
>
> Measurement of retinal nerve fibre layer by scanning laser polarimetry and high pass resolution perimetry in normal tension glaucoma with relatively high or low intraocular pressure
>
> Central corneal thickness measurements in patients with normal tension glaucoma, primary open angle glaucoma, pseudoexfoliation glaucoma, or ocular hypertension

Many empirical, methodological and theoretical titles have references to the major analytic method of the field, comparison:

> Ocular pulse amplitude in patients with open angle glaucoma, normal tension glaucoma, and ocular hypertension
>
> Focal ischaemic normal pressure glaucoma versus high pressure glaucoma

Case reports and clinical studies are often directly announced in the title:

> Pulsatile ocular blood flow: the effect of the Valsalva manoeuvre in open angle and normal tension glaucoma: a case report and prospective study
>
> A case of normal tension glaucoma associated with Buerger's disease
>
> The effect of latanoprost on intraocular pressure during 12 months of treatment for normal-tension glaucoma
>
> Effects of glaucoma drugs on ocular hemodynamics in normal tension glaucoma: a randomized trial comparing bimatoprost and latanoprost with dorzolamide

Genetic studies, on the other hand, are usually indicated with specialized concepts specific to this type of research:

Normal tension glaucoma is not associated with the common apolipoprotein E gene polymorphisms

Investigation of the association between normal-tension glaucoma and single nucleotide polymorphisms in natriuretic peptide gene

But titles without generic identity, such as "Optic Nerve Compression by Carotid Arteries in Low-tension Glaucoma" or "Diffuse Nerve Fiber Layer Loss in Normal Tension Glaucoma," are also quite frequent in this group. Other categories also have titles that offer no insight into the genres of the publications. For example, "Peripapillary retinal blood flow in normal tension glaucoma" names the general topic but has no indication of the authors' methodological pursuit.

To sum up, the identification of the genres is no easy matter in biomedical research. While the divisions between the genres may seem intuitively clear, the multitude of possible combinations of the evidence types and uses, as well as the inherent fluidity of rhetorical genres, makes the classification of papers a difficult matter. It is perhaps this abundance of combinations that makes many authors wary of explicitly labelling the genres of their papers, even as they carefully introduce the minute details of their study designs in their methods sections. The preferred lexicalized self-reference in the corpus is the generic *this study*; the other, much less popular option is *this paper*. Explicit indications of research types, such as "a retrospective clinical study" (G21), are quite rare. There is an expected preference, in other words, for the activity of research to be distinctly foregrounded over the activity of writing and arguing.

For my annotations I chose reports on clinical studies with or without medical or surgical interventions. To identify this type of papers, I relied on the authors' designations of their study types in the titles and introductions, as well as on the textual evidence. I found that some of the papers were based on medical record reviews, long-term observations or clinical trials; others on one-time tests or examinations. My linguistic analysis does not cover any papers involving experimental, morphological, genetic, or molecular research. I looked at the clinical reports that focused on NTG and its treatment rather than on the general theory of the disease or new tools and methods of investigation. This selection criterion allowed me to compile a sample of papers with a reasonably consistent set of epistemic topoi and to limit my sample to a manageable size for manual annotation.

Insights from the pilot study

Distribution analysis of linguistic features

It has been demonstrated that argumentative meanings can be signalled with lexical, grammatical, and syntactic features, so from the start of my investigation I looked for the correlations between these features and the units of argumentative organization. No type of linguistic organization, taken in isolation from others, could be used as a marker of the recurrent argumentative meanings in my corpus. Of course this is not to say that certain lexemes, grammatical forms, or syntactic constructions have no statistical links with the IMRD structure (Bondi, 2006; Crismore &

Farnsworth, 1989; Mercer & DiMarco, 2004; Salager-Meyer, 1994).

Let us take the distributions of Hylandian metadiscourse, for example. In my corpus the density of metadiscourse is invariably higher in introductions and discussions. Here is the text of the shortest paper from the corpus (E10) with the interactive and interactional metadiscourse (Hyland, 2005, pp. 218-224) marked with blue and yellow highlights, respectively:

Introduction

Normal-Tension Glaucoma (NTG) refers to a clinical entity of glaucomatous optic disc change and visual field defect without elevated intraocular pressure (IOP)... Evidence is accumulating that NTG may be quite distinct from primary open-angle glaucoma (POAG)...[30] Recently, Yamazaki et al. reported that patients with NTG show more localized retinal nerve fiber layer (RNFL) loss than diffuse loss compared to POAG patients when matched for visual field loss... The difference in pattern of morphological changes suggested a hypothesis that non pressure-related factor may contribute to optic nerve damage in glaucoma.

However, histopathological study of NTG demonstrated that axons in the laminar zone were mechanically overstreched by the backward bowing of the lamina cribrosa…, these findings agree with Quigley's report in POAG... If the pattern of RNFL loss in NTG has relationship with IOP, the mechanisms of optic nerve damage in NTG might be similar to its in POAG. The purpose of this study is to determine the relationship between IOP and RNFL loss and to address the question as to whether the optic nerve in patients with NTG is susceptible to normal IOP levels that are nondamaging to most eyes.

Materials and methods

The diagnostic criteria for NTG were:

- maximum IOP of 23 mmHg or less including diurnal tension curve; and
- the presence of typical glaucomatous field defects associated with glaucomatous disc changes not attributable to other ocular or systemic pathology.

According the above criteria, the 30 eyes of 30 patients with NTG were selected and they were classified into two groups, 14 eyes with the maximum IOP ≥ 19 mmHg and 16 eyes with the maximum IOP < 19 mmHg. Visual acuity in all eyes was 20/20 or better. Both groups had a reproducible classic localized visual field defects, confined to either the upper or lower hemifield, detected by Goldmann or Humphrey Perimetry.

RNFL photographs were taken with the previously described technique, and evaluated using a computerized digital image analysis system… The reproducibility of this system has been reported… RNFL analysis was carried out to the RNFL areas corresponded to the spared visual hemifield (Fig. 1).

RNFL analysis

Two parameters, intensity decrease and intensity variance, were determined for the evaluation of RNFL using red-free fundus photograph; They were derived from the image intensity obtained along the semicircular scanning line around the optic disc. The scanning line had a radius of two-fifth of the distance between the optic disc and the fovea. The value of intensity decrease is calculated as the arthmetic mean of the differences in the intensity between individual measurement values and the normal values stored in the analysis system (Fig. 2). The value of intensity decrease is increased by any kind of RNFL loss, but in contrast with intensity variance, relative small by localized loss and very much by diffuse RNFL loss. The value of intensity variance is more sensitive to localized loss. It becomes large value in the presence of real localized RNFL loss.

Results

[30] The ellipses in samples and examples stand for omitted parenthetical citations.

The average of the maximum IOP for 30 patients with NTG was 18.6 ± 2.2 (± S.D.) mmHg. It was 20.6 ± 1.3mmHg for 14 patients with the maximum lOP ≥ 19 mmHg, and 17.0 ± 1.1 mmHg for 16 patients with the maximum lOP < 19 mmHg. Nine of 14 patients (64%) with the maximum IOP ≥ 19 mmHg and 10 of 16 patients (63%) with the maximum lOP < 19 mmHg were women. The mean age of patients with the maximum IOP ≥ 19 mmHg was 59.1 ± 11.6 years; patients with the maximum IOP < 19mmHg had a mean age of 52.4 ± 4.4 years. These differences were not statistically significant. Assessment of the spared hemivisual field showed no difference between the two groups either in the mean deviation (the maximum IOP≥ 19 mmHg: -2.55 ± 2.50dB; the maximum IOP < 19 mmHg: - 2.21 ± 2.12 dB) or in the pattern standard deviation (the maximum IOP- 19mmHg: 3.04 ± 1.52dB; the maximum IOP <19 mmHg: 2.75 ± 1.30 dB).

The average of the intensity decrease of the spared RNFL area in patients with the maximum IOP ≥ 19mmHg was -13.7± 13.1 (± S.D.); in patients with the maximum IOP< 19mmHg, it was -6.8 ± 7.0. The difference was statistically significant (P = 0.04). The mean intensity variance was 6.5 + 5.5 in the maximum IOP ≥ 19mmHg group and 4.1± 4.8 in the maximum IOP< 19 mmHg. The difference was not statistically significant.

The relationship between the intensity decrease and the intensity variance was examined to determine the difference between the pattern of RNFL loss in the two groups (Fig. 3). A comparison of the slopes of the regression lines of the intensity variance on the intensity decrease revealed that NTG patients with the maximum IOP ≥ 19 mmHg show a significantly gently slope than those with the maximum IOP< 19mmHg (P= 0.03).

Discussion

In selected NTG patients who have classic localized visual field defects confined to one hemifield, we analyzed the characteristics of the spared RNFL area in the two groups of NTG patients which were classified depending on the average of the maximum lOP. There is more diffuse RNFL loss in the RNFL area corresponded to the spared visual hemifield in patients with the maximum lOP ≥ 19 mmHg as compared to those with the maximum IOP < 19 mmHg. A significantly gentle slope was found using linear regression analysis for intensity variance on intensity decrease in the maximum IOP ≥ 19 mmHg group.

The intensity decrease was an index for the diffuse retinal damage, whereas the intensity variance indicated an index for estimating the localized retinal damage... Diffuse damage has been postulated to be pressure-induced and should therefore occur frequently in eyes with high IOP...

This finding suggests that IOP is a causative factor for optic nerve damage in patients with NTG, whereas it is not elevated above the statistically normal IOP range. Although most authors agree that elevated IOP produces glaucomatous optic nerve damage, they do not agree that optic nerve damage in NTG may be directly related to IOP. Recently, Cartwright et al. reported that glaucomatous cupping and field loss was greater in the eyes with high lOP than in those with low lOP in 12 of 14 NTG patients with the asymmetric IOP and suggested that, even in NTG, IOP play an important role in damaging optic nerve... Subsequently, Crichton et al. confirmed the same issue... The most interesting question is whether the optic nerve damage in NTG is directly produced due to the IOP-related mechanical damage. A new concept has been proposed by Davanger, who accounted for the prevalence of NTG on the basis of the overlapping distribution of IOP in population and the pressure vulnerability of the optic nerve head... The present study showed that NTG patients with relatively higher lOP revealed diffuse RNFL loss with purely localized damage, it suggests a relationship between IOP and RNFL loss in NTG patients. If our hypothesis is correct, IOP reduction might be helpful in the treatment of all types of glaucoma.

Figure 5.1. The distribution of interactive (blue highlights) and interactional (yellow highlights) metadiscourse in a sample research paper (E10).

It is clear at a glance that the authors are more explicit about their reasoning operations at the edges of the text than in the body, and there is also more metadiscourse in the methods section than the results.[31] Here are the absolute and relative distribution rates of the signals across the sections:

	Interactive			**Interactional**		
	Total	/Sentence	/Word	Total	/Sentence	/Word
Introduction	5	71.42%	2.64%	12	171.42%	6.35%
Materials and methods	10	83.33%	3.05%	13	108.33%	4.41%
Results	4	33.33%	1.26%	4	33.33%	1.26%
Discussion	10	76.92%	2.75%	30	231.80%	8.26%

Table 5.1. Distribution rates of interactive and interactional metadiscourse in a sample paper (E10).

The most frequent metadiscursive signal in E10 is *and*, with three instances in the introduction, eight in methodology, four in the results, and five in the discussion. In proportion to the word counts, the density of *and*s is the highest in "Materials and methods."

I could keep the numbers coming, and many of them would be interesting for some kind of comparative analysis of the corpus. Yet the metadiscourse distributions are of little help in deciphering the semantic make-up of this specific text. Let us take the five sentences where *and* is the only metadiscursive signal:

3.1.a. Normal-Tension Glaucoma (NTG) refers to a clinical entity of glaucomatous optic disc change and visual field defect without elevated intraocular pressure (IOP)...

b. The scanning line had a radius of two-fifth of the distance between the optic disc and the fovea.

c. It was 20.6 ± 1.3mmHg for 14 patients with the maximum IOP ≥ 19 mmHg, and 17.0 ± 1.1 mmHg for 16 patients with the maximum IOP < 19 mmHg.

d. The mean intensity variance was 6.5 + 5.5 in the maximum IOP ≥ 19mmHg group and 4.1± 4.8 in the maximum IOP< 19 mmHg.

e. A new concept has been proposed by Davanger, who accounted for the prevalence of NTG on the basis of the overlapping distribution of IOP in population and the pressure vulnerability of the optic nerve head...

No reference to the co-text is necessary to understand where the sentences belong in the argument. The disorder definition (3.1.a) is part of the introduction, the technical details (3.1.b) come from the

[31] Crismore and Farnsworth's (1989) observation that "[t]heoretical writing… requires a great deal of metadiscourse, though applied scientific writing may require less" (p. 109) explains the low frequencies of epistemic lexis in the results sections.

methodology, the numeric data (3.1.c & d) from the results, and the theoretical reference (3.1.e) looks like part of the discussion. The use of *and* offers little indication of these diverse meanings, no matter if it links propositions or their elements.[32] Moreover, from the table above it is clear that not every sentence in the text has interactive metadiscourse, and that at least a third of the results section has no metadiscourse at all. To be exact, five sentences in the methodology and six in the results sections are devoid of explicit interactive or interactional authorial commentary. Here are the methods sentences:

3.2.a. Visual acuity in all eyes was 20/20 or better.

b. Both groups had a reproducible classic localized visual field defects, confined to either the upper or lower hemifield, detected by Goldmann or Humphrey Perimetry.

c. They were derived from the image intensity obtained along the semicircular scanning line around the optic disc.

d. The value of intensity variance is more sensitive to localized loss.

e. It becomes large value in the presence of real *localized RNFL loss.*

And these are the results sentences without explicit interactive or interactional metadiscourse:

3.3.a. The average of the maximum IOP for 30 patients with NTG was 18.6 ± 2.2 (± S.D.) mmHg.

b. The mean age of patients with the maximum IOP ≥ 19 mmHg was 59.1 ± 11.6 years; patients with the maximum IOP < 19mmHg had a mean age of 52.4 ± 4.4 years.

c. These differences were not statistically significant.

d. The average of the intensity decrease of the spared RNFL area in patients with the maximum IOP ≥ 19mmHg was -13.7± 13.1 (± S.D.); in patients with the maximum IOP< 19mmHg, it was -6.8 ± 7.0.

e. The difference was statistically significant (P = 0.04).

f. The difference was not statistically significant.

If metadiscourse is not helpful, may there be other markers of the textual identities of these sentences? Judging by this set, verb tenses are strongly correlated with the IMRD structure. In the sentences from the results section all verbs are in the past tense, while two of the methods sentences have present-tense verbs. Numerals are also much more frequent in the results. Such propensities are significant for statistical analyses, and they have been reported in earlier research into the linguistic features of research articles, such as Malcolm's 1987 analysis of tenses in science and technology articles, Channell's 1990 inquiry into the uses of quantifiers in economics, Paice's 1990 study into the role of linguistic cues in information extraction, Liddy's 1991 inquiry into the semantics of medical abstracts, Myers's 1992 investigation of "self-referential introductory statements," and

[32] Hyland (2005) explains that the functions of connectives like *and* should be identified by the type of content they link. Metadiscursive connectives link propositions, whereas the rest link content within propositions.

Salager-Meyer's 1992 analysis of tenses and modalities in medical abstracts. Yet taken in isolation from other features, verbal tenses – like lexical markers – have little connection with the elements of argumentative organization beyond statistical links.

Probabilities can be useful for identifying IMRD sections but not statements. There have been attempts in natural language processing to apply statistical approaches for smaller semantic units than IMRD sections, such as Teufel's (1999) 'argumentative zones' or Biber, Csomay, Jones, and Keck's (2004) 'Vocabulary-based Discourse Units'. Yet based on Biber and his colleagues' work, the smallest units that can be identified statistically are a hundred words long (p. 57), which is larger than an average sentence in my corpus by an order of magnitude.

Linguistic configurations

Textual and schematic organization

My initial lack of progress in identifying the argumentative meanings of statements based on their linguistic features was a result of my attempts to load too much semantic weight on isolated linguistic signals. Another major block was the assumption that semantic meanings can be mapped onto a predetermined sequence of ideas in texts and sentences. For example, I was tempted to link literature reviews to text introductions, methods and results to bodies, and discussions to conclusions since such is the order of the IMRD sections in most research fields. Yet the recent tendency in some domains to conclude research papers with methods sections (e.g. Wilbur, Rzhetsky, & Shatkay, 2006) shows that the association between the text structure and argumentative organization is incidental, rather than essential. Similarly, topoi are not hardwired to 'rhetorical moves' (Swales, 1986, 1990, 2004), which are identified based on their linguistic characteristics, as well as on their fixed order in the structure of the text. The links between the order of moves and the statement types that realize them is of statistical nature. Here, for example, is a selection of sentence fragments from Swales's (1990), which perform the function of introductory "centrality claims" in his corpus of research articles:

3.4.a. Recently, there has been a spate of interest in how to…
b. In recent years, applied researchers have become increasingly interested in…
c. The possibility … has generated interest in…
d. Recently, there has been wide interest in…
e. The time development… is a classic problem in fluid mechanics.
f. The explication of the relationship between… is a classic problem of…
g. The well-known… phenomena… have been favourite topics for analysis both in…
h. Knowledge of… has a great importance for…
i. The study of… has become an important aspect of…
j. The theory that… has led to hope that…

k. The effect of… has been studied extensively in recent years.
l. Many investigators have recently tuned to…
m. The relationship between… has been studied by many authors.
n. A central issue in… is the validity of… (p. 144)

Most readers with any degree of exposure to academic literature would likely agree with Swales's designation, but such agreement rides not only on the linguistic properties of the statements but also on the shared communicative expertise between the author and readers. People familiar with academic genres know that such statements are typically used to claim the relevance of the subject matter. However, the homogeneity of function does not translate into the homogeneity of form, and that is why automatic identification of rhetorical moves is likely to pose a problem. As Swales explains, the lexical features of centrality claims offer different variations on the idea of centrality:

> They can claim interest [as do 3.4.a – 3.4.d] or importance [as do 3.4.h and 3.4.i]; they can refer to the classic, favourite or central character of the issue [as do 3.4.e – 3.4.g and 3.4.n]; they can claim that there are many other investigators active in the area [as do 3.4.k – 3.4.m]. (p. 144)

The diversity of the form creates potential for various interpretations. This means that some of the statements can be potentially used in other rhetorical roles than centrality claims. For example, having stated that certain *phenomena have been favourite topics* in the literature (3.4.g), the authors may proceed to explain that the pursuit of these topics never lived up to the expectations. In that case the statement will function as a "problematization" statement (Barton, 1993).

Swales's examples show that rhetorical moves and steps have statistical links with linguistic features. His list has three configurations of features that can be recognized regardless of the contexts of the statements. Here is one such configuration:

Recently, there has been a spate of interest in how to… (3.4.a)
In recent years, applied researchers have become increasingly interested in… (3.4.b)
The possibility … has generated interest in… (3.4.c)
Recently, there has been wide interest in… (3.4.d)
The study of… has become an important aspect of… (3.4.i)
The theory that… has led to hope that… (3.4.j)
The effect of… has been studied extensively in recent years. (3.4.k)
Many investigators have recently tuned to… (3.4.l)

All these statements evoke recent developments in the field. In some of them the idea is made explicit with the lexeme *recent(ly)*. In others it is communicated with a combination of the present perfect tense and evaluative diction: interest, potency, prominence, or popularity expressions.

When combined with the present indefinite tense, the same diction creates a different configuration:

The time development… is a classic problem in fluid mechanics. (3.4.e)
The explication of the relationship between… is a classic problem of… (3.4.f)
Knowledge of… has a great importance for… (3.4.h)

A central issue in… is the validity of… (3.4.n)

Such statements evoke timeless or long-standing issues that are endowed with the status of disciplinary touchstones.

The third group of statements may initially appear similar to the first, but it lacks the climactic thrust of the statements where the present indefinite tense is combined with evaluative diction:

> The well-known… phenomena… have been favourite topics for analysis both in… (3.4.g)
>
> The relationship between… has been studied by many authors. (3.4.m)

Favourite topics or *many authors* does not necessarily suggest a universally *interesting subject matter*, so the present perfect tense in such statements may imply the exclusive *up till now*, as distinct from to the inclusive *recent(ly)* of the first pattern. The fact that three different types of statements perform the same rhetorical function in Swales's corpus helps in identifying them but obscures the fact that these types can potentially carry different meanings depending on their specific linguistic makeups and relations with other statements.

Of course whether or not the position of a statement in the text should be used as its definitive feature is a methodological issue. In fact some IR systems identify statements exclusively based on their position in the linear structure of the texts (Frants, Shapiro, & Voiskunski, 2010, pp. 196-197; cf. Teufel, 1999). However, in NLP there seems to be a tendency toward greater attention to the linguistic features of statements, as distinct from their linear arrangement. For example, Wilbur, Rzhetsky, and Shatkay (2006) note that

> [i]n contrast to zone-based annotation schemes, we note that not every sentence appearing in a Methodology section discusses methodology, and not every sentence discussing methodology appears in the Methodology section. (p. 362)

From Aristotle's analysis in *Rhetoric* we know that topoi are signalled linguistically and are loosely associated with certain oration parts but do not necessarily have a fixed order. This is also known to modern linguists. For example, van Dijk (1980, 1981) points to the distinction between sequential and semantic text organization, and Halliday and Hasan (1976) usefully observe that meaning is communicated at the interface between conceptual entities, on the one hand, and their co-textual relations. Such relations, called 'texture', are realized through the formal properties of the discourse, but are subject to a different "kind of STRUCTURAL integration" than clauses and sentences (Halliday & Hasan, 1976, p. 2; capitalization in the original). Texture manifests itself as a network of semantic links in the discourse and is autonomous from syntax (p. 8).

Nowadays NLP is dominated by quantitative approaches, and so lexical items (i.e. words and contiguous word clusters) are viewed as the major medium of discourse semantics. Accordingly, lexical coding is a major analytic tool in computer-assisted text and discourse analysis across the disciplines (Gee & Light, 2002; Hersh, 2003; Starsk & Brown Trinidad, 2007). Lexical cues are most often described in terms of their distributions. However, there is evidence that combinations of linguistic features have a role in discourse semantics. For example, Stirling, Fletcher, Mushin, and

Wales's (2001) results suggest that the perceived salience of the 'dialogue acts' is proportional to the number of different linguistic tokens signalling them (pp. 126-127). Similarly, Litman (1996) found that combinations of features identify meanings more reliably than isolated features.

Multidimensional approaches have expanded analysis beyond distributions of isolated lexical markers. For example, Rouveyrol and colleagues' (2005) paper describes some typical communicative strategies in terms of the distributions of lexical and grammatical features. A number of studies have used linguistic collocations as a second dimension added to distribution analysis. Such is Mercer and DiMarco's (2004) work, which looks into the semantics of citations by analyzing combinations of lexical cues. Biber et al. (2007) find that bundles of lexical features signal topical shifts in academic discourse. Schryer et al. (2007) describe decision-making processes based on the distributions and discursive environments of modal words and expressions.

Taboada (2009) takes the idea of linguistic configurations even further by suggesting that not only relations between text segments but also relations between clauses "are all explicit," even though they are not necessarily marked with connectives (p. 130). The relations she has in mind are the cohesive links postulated in Mann and Thompson's (1988) Rhetorical Structure Theory. Following Mann and Thompson, Taboada concedes that "there is probably no one-to-one mapping between a relation and any given marking" (p. 135). Nonetheless, she expresses an intriguing idea that "[i]f people truly interpret different types of relations with relative ease, they must be using signals to guide that interpretation" (p. 130). Among the likely signals she lists morphological, syntactic, semantic, and pragmatic "discourse markers" (p. 129). Linguistic configurations have already demonstrated their utility in health informatics. For example, Hersh (2003) reports that lexical configurations are used as signals of argumentative organization in KM and IR systems involving clinical narratives. For example, a sentence can be classified as a CLINICAL FINDING when it states that the application of a METHOD to a LOCUS lead to a RESULT (p. 406).

Visual annotation

How can we pin down the evasive signals of topical organization along with the meanings that they communicate? Situated research is a powerful test to the limits of traditional analysis methods due to the limited human ability to perceive and accommodate for the multiple facets and parameters of fragmented phenomena. One technique that helps researchers to stretch the limits of their analytic capacities is information visualization. It has numerous benefits since it is better oriented towards natural human perception and thus characterized as 'pre-attentive' (Shipley, 1993). According to Grinstein and Ward (2002), visualization works better than quantitative analysis for overview of complex datasets and synthesis of fragmented data (p. 21).

In the context of linguistic analysis, Shipley's (1993) idea "of meaning as the 'perception of order from disorder' (or texture)" (p. 126) promises more fine-grained analysis by shifting the onus from mere distribution or collocation of linguistic features to their patterning. He insists that some patterns can convey meanings regardless of the specific arrangement of their elements due to the

quality of gnomicity, a kind of flexible coherence. An important type of gnomic patterning is style: "what constitutes style in writing… is in part the texture of it. Style means how it appears to the eye… and how it sounds to the ear" (p. 126). Shipley explains that, for the human patterning faculties, visual information is generally a better match than typographic or linguistic. To illustrate this idea, he shows how the visual message dominates the orthographic message in statements like ~~*THIS MESSAGE IS CLEAR*~~ (pp. 126-127). Two of Shipley's conclusions are particularly relevant for the visualization of linguistic information: that "[i]t is quite possible to put linguistic messages into pure spatial form" and that "[c]ertain physiological arousal processes of textural clustering can be shown to take visual precedence over cultural or linguistic coding" (p. 127). This means that formatting notations of language data can in some cases be more accessible for manual processing than symbolic or orthographic tags that are traditionally used in annotation.

This study owes much to the ideas of pattern recognition. I looked into the role of patterning in the communication and attribution of argumentative meanings. So it only made sense for me to use visual annotation as a way to link the perceived semantic categories to the configurations of linguistic features in them. This parallelism between the visual and discoursal textures was quite productive. As I worked through the corpus, the gradual emergence of the annotation replicated the process by which novices grasp their disciplinary heuristic schemata. Visualization allowed me to convert my linguistic annotations into multidimensional data that were easily accessible both for 'holistic' observations and for semi-automated processing.

In my study visual annotation consisted in matching MS Word's typographical formatting features to the linguistic features. For a demonstration of how the method can help in the analysis of linguistic configurations, let us compare the THEME/PURPOSE[33] statements from two sample papers (E10 and G16):

3. a. The purpose of this study is to determine the relationship between IOP and RNFL loss and to address the question as to whether the optic nerve in patients with NTG is susceptible to normal IOP levels that are nondamaging to most eyes.
   b. This study was conducted to determine the longer term effect of latanoprost on the IOP of patients with newly diagnosed NTG.

The linguistic features that are prominently present in both statements are the phrase *this study* and the infinitive *to determine*, but it would be naïve to assume that all other statements of this type will contain the same combination of words without first looking at the whole set of these statements and comparing it to statements of other types that have similar linguistic features. THEME/ PURPOSE statements can be found not only in introductions but also in discussions, and as it turns out, the occurrence of *to determine* is incidental in our sample introductions, and so is the occurrence of *study*. The common feature of all the statements in the set is self-referential deixis (*this*, *the present*)

[33] Refer to Chapter 6 for a detailed analysis of the topoi represented in my corpus and to Appendix F for their taxonomy.

combined with either *study* or *paper*. In this topos, such combinations always occur in the first half of the statement:

- The main question in this study is: is a filtering procedure in low tension glaucoma patients effective in halting or slowing the progression of visual field loss. (E15)
- The purpose of this study is to determine the relationship between IOP and RNFL loss and to address the question as to whether the optic nerve in patients with NTG is susceptible to normal IOP levels that are nondamaging to most eyes. (E10)
- This study is aimed at assessing the effects of therapy on POBF and functional parameters in patients with NTG. (E3)
- In this study, we estimated the relevance of interocular asymmetry of optic disc size to the level of IOP, and the degree of optic disc and visual field changes in normal-tension glaucoma. (E1)
- In this study, we investigated the visual prognosis of fellow eyes of NTG patients with unilateral field loss. (G36)
- The purpose of this paper was to review the results of fistulising surgery in its ability to achieve and maintain a target IOP reduction and to see what complications occur. (G35)
- In this study, we examined retinal microcirculation in patients with NPG and the correlation with altitudinal asymmetric visual field loss. (G34)
- The purpose of this study was to compare the frequency and site of visual field progression and changes in visual acuity in NPG patients with and without pre-existing visual field loss that comes close to fixation. (G33)
- This paper reports on the incidence of visual field progression in a series of patients with NPG who were largely untreated before progression and followed for a median of 7 years. (G33)
- The purpose of this study was to investigate the relation between the use of adjunctive antiproliferatives, IOP reduction after filtering surgery, and visual field progression in NPG using a measure of current IOP. (G31)
- This paper reports on the incidence of visual field progression in a similar group of NTG patients who have undergone fistulising surgery. (G31)
- The aim of this study was to investigate and compare the effect on POBF after treatment with latanoprost 0.005% (Xalatan; Pharmacia and Upjohn, Uppsala, Sweden) or brimonidine tartrate 0.2% (Alphagan; Allergan Inc, Irvine, CA, USA) on NTG patients. (G24)
- This study was conducted to determine the longer term effect of latanoprost on the IOP of patients with newly diagnosed NTG. (G16)
- In this study, we therefore wanted to investigate a possible coincidence between NTG and progressive sensorineural hearing loss (PSHL) and the association to APSA. (G14)
- The purpose of this study was to examine in more detail whether the compression of the optic nerve by the ICA can be a possible causative factor of NTG. (G12)

- The purpose of the present study was to classify patients with untreated NTG by the degree of nocturnal BP reduction; to study BP, IOP, and MOPP parameters in each classification; and to investigate predictor variables of circadian MOPP fluctuation (CMF). We also evaluated the relationships between CMF and the severity of glaucoma at initial presentation. (G5)

Yet we will be sorely disappointed if we assume that the combination *this*/ *the present study*/ *paper* is a definitive feature of the THEME/ PURPOSE topos since many KEY FINDINGS statements in the corpus start in absolutely the same way:

- In this study the glaucoma patients had a mean IOP of 22 mmHg without therapy and 18 mmHg with therapy. (E15)
- In this study with a median follow-up period of three years evidence is presented that a filtering procedure in low tension glaucoma can slow the progression of the disease. (E15)
- The present study showed that NTG patients with relatively higher IOP revealed diffuse RNFL loss with purely localized damage, it suggests a relationship between IOP and RNFL loss in NTG patients. (E10)
- In this study, we found no significant interocular differences when eyes were grouped according to disc size, except for larger cup volume and vertical cup-to-disc ratio and smaller R/D in the LaDA eye, which was assumed to depend on the difference in disc area. (E1)
- In the presented study, the retinal arteriovenous passage (AVP) time of NPG patients is almost doubled compared with healthy subject data, indicating a severe attenuation of retinal circulation. (G34)

Clearly then, we have to find what other features complete the linguistic configuration of the THEME/ PURPOSE topos and make it distinct from other statement types. On closer examination of the two sets, we can notice that they are differently oriented towards the study. While the THEME/ PURPOSE statements state the research objectives, the KEY FINDINGS statements talk about the outcomes. We may assume that both these meanings should be somehow expressed in the surface features of the topoi. Indeed, in the THEME/ PURPOSE set we can see frequent purpose or volition expressions (such as *aim at*, *purpose*, *want to*) and examination, analysis, or research lexis. All statements in the KEY FINDINGS set have some kind of results expressions: observation abstractions (such as *reduction* or *time*) and numeric or non-numeric quantifiers. To put this conjecture to test, we need to annotate all the statements for these two types of expressions:

THEME/ PURPOSE:

- The main question in this study is: is a filtering procedure in low tension glaucoma patients effective in halting or slowing the progression of visual field loss. (E15)

- The purpose of this study is to determine the relationship between IOP and RNFL loss and to address the question as to whether the optic nerve in patients with NTG is susceptible to normal IOP levels that are nondamaging to most eyes. (E10)
- This study is aimed at assessing the effects of therapy on POBF and functional parameters in patients with NTG. (E3)
- In this study, we estimated the relevance of interocular asymmetry of optic disc size to the level of IOP, and the degree of optic disc and visual field changes in normal-tension glaucoma. (E1)
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- The purpose of this study was to compare the frequency and site of visual field progression and changes in visual acuity in NPG patients with and without pre-existing visual field loss that comes close to fixation. (G33)
- This paper reports on the incidence of visual field progression in a series of patients with NPG who were largely untreated before progression and followed for a median of 7 years. (G33)
- The purpose of this study was to investigate the relation between the use of adjunctive antiproliferatives, IOP reduction after filtering surgery, and visual field progression in NPG using a measure of current IOP. (G31)
- This paper reports on the incidence of visual field progression in a similar group of NTG patients who have undergone fistulising surgery. (G31)
- The aim of this study was to investigate and compare the effect on POBF after treatment with latanoprost 0.005% (Xalatan; Pharmacia and Upjohn, Uppsala, Sweden) or brimonidine tartrate 0.2% (Alphagan; Allergan Inc, Irvine, CA, USA) on NTG patients. (G24)
- This study was conducted to determine the longer term effect of latanoprost on the IOP of patients with newly diagnosed NTG. (G16)
- In this study, we therefore wanted to investigate a possible coincidence between NTG and progressive sensorineural hearing loss (PSHL) and the association to APSA. (G14)
- The purpose of this study was to examine in more detail whether the compression of the optic nerve by the ICA can be a possible causative factor of NTG. (G12)

KEY FINDINGS:

- In this study the glaucoma patients had a mean IOP of 22 mmHg without therapy and 18 mmHg with therapy. (E15)
- In this study with a median follow-up period of three years evidence is presented that a filtering procedure in low tension glaucoma can slow the progression of the disease. (E15)
- The present study showed that NTG patients with relatively higher IOP revealed diffuse RNFL loss with purely localized damage, it suggests a relationship between IOP and RNFL loss in NTG patients. (E10)
- In this study, we found no significant interocular differences when eyes were grouped according to disc size, except for larger cup volume and vertical cup-to-disc ratio and smaller R/D in the LaDA eye, which was assumed to depend on the difference in disc area. (E1)

- In the presented study, the retinal arteriovenous passage (AVP) time of NPG patients is almost doubled compared with healthy subject data, indicating a severe attenuation of retinal circulation. (G34)

Figure 5.2. Annotated THEME/ PURPOSE and KEY FINDINGS statements from the NTG corpus. (Annotation scheme: observation abstractions, quantifiers, purpose or volition expressions, and examination, analysis, or research lexis.)

The annotation brings forth mixed results. On the one hand, there are significant overlaps between the configurations of the two topoi. For example, we find high instances of observation abstractions in both sets. There are statements with quantifiers in the THEME/ PURPOSE set, and, contrary to our expectations, a number of statements in this category do not have purpose or volition expressions. The good news is that the examination, analysis, or research lexis is exclusive to the THEME/ PURPOSE set. The latter does not mean that the distinction of THEME/ PURPOSE from all other topoi rides on this feature alone since there are other statement types in my corpus that also have examination, analysis, or research lexis. Rather, the distinction of the topos depends on a combination of features including autoreferential deixis, observation, reasoning, or research abstractions, and examination, analysis, or research lexis.

This analysis was meant to demonstrate a few ideas regarding epistemic topoi and their analysis. First, it is linguistic configurations, rather than isolated linguistic markers, that can provide insight into argumentative organization. Second, topoi have no fixed order within the text parts that they are associated with. Nor do their linguistic configurations have any fixed types of components; rather, they seem to work as clusters of features providing communicators with 'reasons' to interpret them in a certain way. Finally, the linguistic configurations of the topoi can be established with contrastive analysis, and visual annotation is an effective method for such analysis.

Analytic framework

Units of argumentative organization

How large is a topos and what is it made of? It is well understood that the linguistic organization of scientific discourse is "inextricably connected with the praxis of science, [and] reflects, expresses, and represents the inner dynamics of that praxis itself" (Krips, McGuire, and Melia, 1995, xviii). So, to grasp the nature of epistemic topoi, we need to turn to the research practices of the domain. Let us consider the manifestations of the idea of STUDY DESIGN in the corpus. As a metalinguistic tag, it has only two instances in the corpus, both in the same paper:

3.7.a. We cannot directly compare our results with the previous data, because our work has a different study design[34] based on the subgroup comparison within patients with

[34] In all examples the emphases are mine.

NTG. (G5)

b. Our study design was not based on the comparison between the case and control groups, but based on the comparison of subgroups in patients with NTG. (G5)

These examples show that the tag does not necessarily index the topos – not even when *study design* is a sentence topic. In both sentences the idea is part of a more complex topos: the distinction of the study from other similar investigations. The authors go beyond simply stating what they did ("comparison of subgroups in patients with NTG"); they also emphasize what they did *not* do. Here is the textual environment of 3.7.b:

> Sehi et al… reported that a significant difference was observed in the MOPP pattern between POAG and normal controls. Riccadonna et al… showed that they did not confirm a different pattern of circadian BP fluctuation in NTG subjects compared with HTG and control groups. However, subgroup analysis based on nocturnal BP reduction was not performed in these studies. Our study design was not based on the comparison between the case and control groups, but based on the comparison of subgroups in patients with NTG.[35] In our study, we classified patients with NTG into three groups based on different nocturnal BP reduction level and found that CMF was larger in overdippers of patients with NTG. (G5)

By emphasizing the distinctiveness of their study design, the authors explain that their findings are incomparable with those of the previous studies. They find a disparity between earlier findings, but rather than generating new data that would warrant siding with one party or the other, they propose a novel approach that circumvents the contradiction. In contrast to such a complex invocation of the study design, here is a straightforward STUDY DESIGN statement form the same paper:

3.7.c. The purpose of the present study was to classify patients with untreated NTG by the degree of nocturnal BP reduction; to study BP, IOP, and MOPP parameters in each classification; and to investigate predictor variables of circadian MOPP fluctuation (CMF). (G5)

Unlike 3.7.b, this sentence has no explicit reference to its own topos, but it names the objectives and methods of the investigation as well as the cohort type – a set of semantic elements that amount to the idea of a study design. Here are two other statements of this type, both communicating some combination of the same semantic elements:

3.7.d. This is a retrospective review of a large number of NPG patients referred to a single hospital based glaucoma service. (G33)

e. In this study, we tried to evaluate the difference in nerve fibre layer (NFL) defects between NTG and POAG through analysis of RNFL photographs. (G21)

For comparison, let us consider an account of what the authors of another paper (E1) identify as their *Analysis design*:

[35] Emphasis mine.

Analysis design
Taking into account the absolute interocular difference in disc area and mean lOP in each patient (Table 1), we made five analysis designs as follows:
1. Denote the two eyes as larger disc area (LaDA) and smaller disc area (SmDA), if there was any difference, and compare them.
2. Denote the two eyes as higher mean IOP (HiI) and lower mean IOP (LoI), if there was any difference, and compare them.
3. Classify patients according to whether the difference in disc area between the two eyes was equal to or less than the median value of 0.28 mm 2 (group with symmetrical discs) or exceeded 0.28 mm 2 (group with asymmetrical discs). Further, denote the eyes as the LaDA and the SmDA side and make comparisons between the two groups and within each group.
4. Classify patients according to whether the mean IOP difference was equal to or less than the median value of 0.7 mmHg (group with symmetrical IOPs) or exceeded 0.7 mmHg (group with asymmetrical IOPs). Further, denote the eyes as the HiI and the LoI side and make comparisons between the two groups and within each group.
5. Classify patients according to whether LaDA was on the LoI side (dissociated group) or the HiI side eye (associated group). Make comparisons between the two groups and within each group.

Figure 5.3. The *Analysis design* subsection from E1.

Even though this excerpt presents us with a narrower set of ideas than a fully fledged STUDY DESIGN statement, it can also be broken down into semantic blocks related to the selection of information and the generation, processing, and analysis of data.

What are we to make of these examples? First, they should once again remind us of the distinction between semantic organization and syntagmatic, sequential organization. Epistemic topoi are elements of the semantic organization of arguments, referred to as schemata. Topoi themselves are also made up of semantic elements that manifest themselves through linguistic configurations. Moreover, metalanguage referring to topoi can in some cases be part of such configurations. That is why the sizes of the linguistic units that can be mapped to epistemic topoi vary between a lexical unit, such as *study design*, and a series of clauses, such as this:

> 3.7.e. In this study, we evaluated the IOP-lowering effect of latanoprost in NTG over a 12-month treatment period. The relationship between pre-treatment IOP levels and the efficacy of latanoprost was also assessed. The medical records of 63 patients diagnosed with NTG who were treated with 0.005% latanoprost alone were reviewed retrospectively. (G6)

The indirect relations between topoi and syntagmatic units pose a problem for analysis. Analysts need to decide how to go about overlapping topoi. They also need to stipulate the size of the units for their analysis. Such methodological decisions must be made with an eye to the anticipated outcomes and effects of the analysis (cf. Crawshay-Williams, 1957).

This project is aimed at producing a taxonomy that would be useful in information retrieval and knowledge management. The common practice in these fields is to extract information rather

than abstract it[36] (Edmundson, 1969; Hirsh, 2003; Teufel, 1999). In other words, IR and KM systems typically lift whole sentences from texts, rather than summarize elemental ideas into synthetic content. That is why in this project my minimal unit of analysis was the sentence or, when the sentence boundaries were ambiguous, the clause.

Linguistic attributes of topoi

The comparative procedure that I described in the previous section is very similar to the one that Aristotle recommended for inductive reasoning in *Posterior Analytics*:

> We should look at what are similar and undifferentiated, and seek, first, what they all have that is the same; next, we should do this again for other things which are of the same genus as the first set and of the same species as one another but of a different species from those. And when we have grasped what all these have that is the same, and similarly for the others, then we must again inquire if what we have grasped have anything that is the same—until we come to a single account; for this will be the definition of the object. And if we come not to one but to two or more accounts, it is clear that what we are seeking is not a single thing but several. (II.13.97b16-97b24)

The procedure is very well known to modern linguists. Here, for example, is Wierzbicka's (1992) description of the method for discovering semantic configurations of lexical meanings:

> The meaning of a word is, so to speak, a configuration of semantic primitives; therefore it doesn't depend on the meaning of other words in the lexicon. The meanings of different words can overlap (as ***abc*** overlaps with ***bcd),*** and the meaning of one of the overlapping words can change without a concomitant change affecting the other (e.g., ***abc*** may change to ***acd,*** with ***bcd*** remaining as it was). But although the meaning of a word does not depend on the meanings of other words, to establish what the meaning of a word is one has to compare it with the meanings of other, intuitively related words. By comparing a word to other words that intuitively are felt to be related to it, we can establish what each of these words really means; having done this, we can compare them again, this time more precisely, being able to identify the elements that are different. (p. 210)

What Aristotle sees as definienda and Wierzbicka as semantic primitives are pretty homogeneous systems of features which organize semantic and linguistic species into watertight genera. Similarly, the Saussurean theory of *langue* posits various levels of linguistic organization: phonemes, morphemes, words, phrases, clauses, sentences, and texts. Not only are the structural units well known and well described – they subsume one another in a system of admirable clarity and coherence. Phonemes are distinct thanks to a system of contrastive articulation features; they make up morphemes, creating differences between them through binary oppositions of phonological

[36] Refer to Hovy (1993) for a review of alternative, dynamic, approaches used in artificial intelligence.

features; morphemes make up words, which in turn make up phrases, and so on. At least we get this impression of a closed hierarchical system from dictionaries and grammars, and the study of language is partitioned along the same lines. The rhetoric and argumentation theory have a less rigorous hierarchy of concepts, yet they, too, are prone to regard communication through the prism of simple correlations[37] and binary oppositions.[38] Such is the nature of systematic knowledge, which, according to Aristotle, provides us with well organized categories that people can learn through demonstration, memorize, and recall for specific applications. Yet anyone who has tried to find clarity of organization in actual communication knows how much "inspired tinkering" this takes (Scriven, 1987, pp. 16-17).[39]

Topical schemata do have elements of dichotomous organization, but, generally speaking, they are more like networks of patterns than oppositions and pyramids of attributes. The features forming their distinctive configurations are far from uniform. I have already named a few: deixis, lexico-grammatical and semantic relations. Two more types of features that I found useful in my analysis are syntactical constructions and co-reference. It usually takes two or three categories to identify each topos. The divides between the attribute categories are quite fluid. To illustrate this idea, I will briefly revisit two of the THEME/ PURPOSE statements analysed in the previous section:

3.6.a. This study is aimed at assessing the effects of therapy on POBF and functional parameters in patients with NTG. (E3)

b. This study was conducted *to* determine the longer term effect of latanoprost on the IOP of patients with newly diagnosed NTG. (G16)

Both statements have expressions of purpose, but while in 3.6.a the idea is communicated with a metalinguistic tag, *aimed*, in 3.6.b it is communicated syntactically, with the adverbial modifier (or adjunct) of purpose *to determine*.

Similarly, the idea of possibility, ability, or potency may be expressed either explicitly, with the metalinguistic tag *possible*, or with a modal verb, such as *can*, or even with the suffix *–ible*/ *-able*. The idea of identity can be conveyed with identity lexis (e.g. *characteristic*, *subtype*) or with the help of a linking verb that establishes a relationship of identity between the subject and predicative (e.g. *Phospholipids are constituents of all membranes*). Finally, comparison can be expressed metalinguistically (*compar-*), lexically (e.g. *different*, *similar*), with comparative grammatical forms or comparative syntactic constructions.

We know that grammar and lexis communicate different types of meanings. However, in topical analysis we need to account for the fact that synonymy can traverse the boundaries between

[37] See, for example, Aristotle's discussion in the *Rhetoric* of the links between the genres of oratory and temporal categories.

[38] Refer to Chapter 2 for a discussion of two of these popular oppositions, material vs. formal and common vs. special topoi.

[39] Scriven's "inspired tinkering" is the process of adapting theoretical knowledge to practical tasks. It is distinct from Knorr's (1979) "constructive tinkering": the process of finding applications for scientific discoveries. Both of them involve decision-making. Yet whereas the former proceeds from problem to decision, the latter starts with a purported decision and seeks out a problem.

levels of linguistic organization.

Catalogue of linguistic features

The systematic description of the linguistic features of epistemic topoi provided in this section has two major purposes. On the one hand, for my readers this catalogue can serve as a reference for the descriptions of topoi in the next chapter and in Appendix E. On the other hand, practitioners may find this catalogue useful for the development of more exacting ontologies for their specific tasks in informatics and knowledge management.

The first part of this section lists the lexical categories that were found to be variously correlated with topical organization. Also discussed in the first subsection are the role of morphology and the relations between lexical and grammatical meanings as signals of argumentative meanings. The second part of the catalogue outlines the interaction between syntactic and lexico-grammatical features, as well as deixis, in communicating different types of observational and methodological content in the corpus.

Lexical and morphological categories

I explained above that the distribution of lexis within the texts in my corpus is loosely linked to the IMRD structure. The framing sections of the text, the introduction and discussion, tend to contain multiple references to the social, medical, and theoretical background, whose aims are demonstrate the relevance of the study to the readers and incorporate it into the theory of the field. Two other important argumentative procedures are the formulation of the purpose or topic in the introduction and the interpretation of findings in the discussion. I found all these motifs to have regular associations with several categories of expressions. Some of these categories are related to the researchers' activities:

1. Deontic modality (e.g. *have to*, *need*, *must*, *should*)
2. Potency and possibility (e.g. *able*, *can*, *easy*, *likely*, *may*, *natural*, *possible*, *potent*)
3. Research (e.g. *address*, *investigate*, *literature*, *paper*, *publish*, *question*, *report*)
4. Reasoning (e.g. *conclude*, *consider*, *know*, *propose*, *suggest*, *support*)

Others refer to the phenomenal reality:

5. Appearance or indexing (e.g. *appearance*, *indicator*, *manifestation*, *reflect*, *sign*)
6. Association (e.g. *associated*, *correlated*, *involve*, *linked*, *more likely*, *predictor*, *risk* [*factor*], *role*), causation (e.g. *cause*, *contribute*, *effect*, *influence*, *lead to*, *mechanism*, *pathogenesis*, *susceptible*), and affect (e.g. *affect*, *improve*, *increase*, *reduce*)
7. Congruity or consistency (e.g. *agreement*, *comparable*, *confirm*, *consistent*, *similar*, *surprising*) and incongruity or variation (e.g. *vary*, *ranging*, *asymmetric*)
8. Diminution or negation (e.g. *few*, *hardly*, *not*, *small*)
9. Distribution (e.g. *incidence*, *population*, *prevalence*, *total*)

10. Identity (e.g. *characteristic, distinct, form, normal, reliable, reproducible, subset, typical*)

Two prominent categories occurring mostly at the edges are related to the structure of the domain's discourse:

11. Evaluation (e.g. *advantage, ideal, successful*)
12. Time and aspect (e.g. *further, future, recent, new, no longer, potential, remain, today's*)

In the methodology sections, the major motif is the organization of the study. It is associated with the ideas of

13. Analysis (e.g. *assess, calculate, classify, determine, define, divide*)
14. Designation (e.g. *according to, based on, calculate/ define/ record/ take as, classify as/ in*[*to*], *consider as/ to be, criteria, exclude, include, judge*)
15. Examination (e.g. [*de*]*note, examine, measure, monitor, record, test*)
16. Objectivity, detachment, or separation (e.g. *external, separately, masked, without knowledge*)

The results sections have high frequencies of numerals, as well as participation (e.g. *drop out, enroll, withdraw*) and generalization lexis (e.g. *average, maximum, mean, median*). Finally, I found a number of free-ranging lexical categories that were not associated with any specific part of the text:

17. Circumscription (e.g. *at least, only, or better*, ≥)
18. Clinical practice (e.g. *apply, follow-up, operate, surgery, therapy, wash-out*)
19. Demographics (e.g. *age, Asians, white, women*)
20. Discovery or presentation (e.g. *find, present, reveal, show*)
21. Emphasis (e.g. *important, significance/ significant*)
22. Participants (e.g. *controls, eye, patients, subjects*)
23. Summarization (e.g. *all, both, each, majority, most, none*)

Lexical features are very important for argumentative organization, but the distributions of the lexical categories across the IMRD sections are only a minor concern in my study. It is collocations, not distributions, that signal the epistemic topoi. For example, the typical lexical attributes of the INTERVENTION DATA topos include clinical practice or examination lexis combined with numerals or summarization lexis and participant lexis or *group*:

- All patients had a general ophthalmological examination.[40] (E15)
- In 10 eyes an argon laser trabeculoplasty had been performed. (E15)
- Of the remaining 83 patients, 28 had fixation threatening field defects and were started on treatment. (G16)

Most configurations include at least two types of lexical elements. However, the lexical meanings themselves turned out to be less stable and determinate than I had first assumed. A few lexical features in my corpus defied my attempts to classify them. For example, the word *group* is a definitive feature of a number of topoi (such as INTERVENTION DATA above) but has no clear links

[40] Emphasis mine.

with any lexical category. It is typically associated with participant lexis, but it also communicates the idea of organization, so some topoi have participant lexis with no mention of groups.

In contrast to the lexical categories involved in multiple topoi, I found a few lexical categories restricted to single argumentative meanings, such as copyright information combined with the phrase *obtain from* in the RELEVANT LITERATURE/ COMPANION PUBLICATIONS topos. Somewhat similar to such unique signals, six configurations were found to include specialized lexis that is used as a kind of topical jargon drawn from one or more lexical categories. Such, for example, are words like *clinical*, *retrospective*, *review*, or *trial* signalling the RESEARCH TYPE topos or are words like *figure* and *table* signalling the DATA PRESENTATION topos.

To complicate matters even more, some lexemes take on various meanings and participate in various configurations depending on their morphological forms. For example, the word *typical* communicates the meaning of identity, in the same way as *characterize* or *normal*. Compare the meanings of the underscored terms in these excerpts:

- The disorder characterized by the presence of optic disk cupping together with visual field loss in eyes with normal intraocular pressure (IOP) and open angles, in which there are no other possible causes of damage, is known as low or normal tension glaucoma (NTG). (E3)
- The diagnosis of NTG was established by typical optic disc and visual field damage. (G14)

The adverb *typically*, on the other hand, belongs with potency and possibility lexis, like *can* and *usually*:

- Descending neuropathies (for example, retinitis pigmentosa) are typically associated with reduction of vessel diameters attributed to a metabolic downregulation. (G34)
- The prostaglandin $F_{2\alpha}$ can cause vasoconstriction in isolated bovine retinal arterioles… (G24)
- Compressive optic neuropathy is usually related to aneurysms, meningiomas, or other types of tumours… (G12)

Such distinctions between the meanings of related adjectives and adverbs are rare in my corpus, but the semantic distinctions between abstract nouns and other morphological categories turned out to play an important part in the organization of arguments. In many cases the distinction is purely a matter of syntactic organization. For example, many linguists point to the differences in the density of information in oppositions like Quirk et al.'s (1985):

In the morning, they *quarrelled* over pay.

The *quarrel* over pay was the reason for his resignation. (p. 1288)

According to Quirk and his colleagues *quarrel* "has systematic correspondence with a clause structure" (p. 1288). Other authors (e.g. Yongsheng, 2008) have also commented on the ability of derivation and conversion to compress ideas. Indeed, this effect is quite prominent in my corpus. For many ideas that are consistently present in the corpus both as nouns and in other morphological and grammatical forms, the level of their abstraction in the statements matters. Witness this statement of

the OBSERVATION DATA type:

- Thirty four patients (63%) were women. (G36)

The sentence concerns the sex of the patients, and the idea is communicated with a concrete noun (if we agree that *women* is concrete, that is). Such statements are exceptionally rare in my corpus, and most of them are found in the results section. When the authors analyze observations, more abstract ideas come into play. Such is this ASSOCIATIONS/CORRELATIONS statement from the discussion section of the same paper where *sex* is a condensed reiteration of the idea that the majority of patients were women:

- Analysis using Cox univariate and multivariate regression techniques revealed strong evidence of independent associations between time to onset of field loss and both the sex of the patient and the severity of field loss of the fellow eye (AGIS score) at presentation (Table 1). (G36)

In other statements, the abstraction allows the authors to reify the idea from its context and relate it to other researchers' observations:

- NTG is known to affect women more frequently than men…; however, a *sex* related difference in the rate of progression of NTG has not been previously reported in studies investigating field progression over time… (G36)

Observational abstractions, like *sex*, *age*, or *increase*, are the most frequent of all abstract nouns in my corpus. Not all of them have concrete counterparts. For example, *age* can be matched with the noun *year* and the adjective *old* in the papers. On the other hand, *increase* corresponds with a set of verbs, including *to grow, to increase*, and *to rise*, as well as with comparative degrees and comparative syntactic constructions. However, there are no concrete nouns in this set.[41]

Abstractions referring to the researchers' activities also have regular correspondences with their morphological and grammatical counterparts:

- Analysis (e.g. *analysis*, *assessment*, *classification*, *comparison*, *correction*, *criteria*, *formula*, *model*, *variability*)
- Clinical practice (e.g. *clinical practice*, *management*, *substances*, *therapy*, *treatment*)
- Examination (e.g. *examination*, *imaging*, *measurement*, *test*)
- Reasoning (e.g. *data*, *evidence*, *method*, *outcome*, *parameter*, *result*, *technique*, *significance*)
- Research (e.g. *approach*, *investigation*, *literature*, *studies*, *theory*, *understanding*)

As with observational abstractions, the reification of these ideas is significant in terms of the topical schemata. Depending on their levels of abstraction, they may differently contribute to argumentative organization. For example, the presence of *results* in "It should be noted that the results presented here come from a retrospective analysis of data" (G35) does not mean that the sentence presents the

[41] Of course the distinction of abstract nouns is not as obvious as it may seem. There is no clear boundary between the terms referring to what is seen as natural phenomena and collectives (e.g. *border*, *disease*, *patients*), on the one hand, and abstraction, on the other. Technically speaking, any noun or pronoun is a result of some kind of abstraction, which turns an idea into a conceptual thing (cf. Nuyts, 2004).

study results but rather that it comments on them. Not only does the statement contain no results; it occurs outside the results section, and this mismatch reflects a pattern. In the sections labelled "Results" the relative frequency of the term *results* is unexpectedly low. It is about the same as in other sections and almost seven times lower than in discussions.

The disparity is due to the fact that nouns and noun phrases communicate meanings differently from statements. They label references, semantic entities represented as static semantic objects, and this is why they are often used as headings. Throughout my corpus, headings provide metalinguistic tags for the IMRD sections. In some papers the authors also title subsections, and some of the subheadings approximate epistemic topoi, such as *Analysis Design* or *Definitions*. In oral communication, the counterpart of such metadiscourse would involve characteristic intonation and body language, such as the announcement of guests by a butler. In research literature, the function is signalled typographically. Yet in both contexts, to announce the discussion of the study background or the arrival of Sir Lovejoy amounts to a speech act that is distinct from mentioning either of them in text or conversation.

Statements, on the other hand, are dynamic symbolic processes, which turn references along with other types of ideas into acts and activities. Topoi are the typical semantic profiles of these acts and activities, and that is why their metalinguistic tags are seldom part of their linguistic configurations. For example, a sentence like "The result of the present study was that angle α was smaller in the NTG group than in the POAG group and that angle β was larger in the NTG group than in the POAG group" (G21) will strike most readers as unusual precisely because it names its own topos.

The fact that ideas can freely traverse the divides between morphological categories and levels of linguistic organization is significant for argumentative organization. One of the ideas with diverse linguistic manifestations that I touched on earlier in this chapter is comparison.[42] Comparison is in fact more than an idea. It is a reasoning method indispensable both in primary and secondary induction. Witness this series of COMPARISON statements from one results section:

- The percentage of eyes with compression of the optic nerve was significantly higher in the eyes with NTG than that in the control group (x2=4.4, p=0.035; fig 2). The percentage of eyes with grade 2 compression was not significantly higher in the NTG group than that in the control group (x2=1.6, p=0.20; fig 2)… The prevalence of bilateral optic nerve compression was significantly higher in NTG group than that in the control group (x2=4.74, p =0.029, table 2). (G12)

As we can see from these examples, in such statements the comparison lexis is not indispensable. The idea can manifest itself implicitly, through grammatical forms of adjectives and adverbs as well as relationships between phrases or clauses. Where it takes on the form of explicit metalinguistic tags, like *different*, *vary*, or *comparison*, it presents opportunities for more complex statements where comparison is a subject matter in its own right:

[42] Aristotle's *Rhetoric* names comparison among common topics.

- Our analysis varies from previous studies in that we looked at IOP updated for each 6 month period postoperatively as a risk factor for visual field progression (G31)
- Comparisons between baseline and after treatment were performed with paired Student's *t* test. (G24)
- The significant evidence of differences in NTG and POAG would imply pathogenic differences of optic nerve damage between NTG and POAG. (G21)
- The higher percentage of eyes with C/D ratio <0.7 who showed compression was statistically different from eyes with C/D ratio <0.7 (x2=5.7, p =0, 017; and x2=4.1, p =0, 042 with Yates's correction). (G12)

This is a diverse selection of statements: G31 exemplifies the METHODOLOGICAL CONSISTENCY type; G24 is of the DATA PROCESSING/ ANALYSIS TOOLS type; G21is a HYPOTHESIS; and G12 a GENERALIZATION. One of the essential resources that allows the authors to communicate the topical identities of such statements is the shifting of the idea of comparison between the levels of linguistic organization. In COMPARISON statements it is often expressed with combinations of grammatical and syntactic features, in SUMMATED OBSERVATIONS and CONSISTENCY statements with verbs and adjectives, and in methodological topoi and commentary the idea is often expressed with abstract nouns.

If we can learn anything from such examples, it should be to resist the temptation of relying on binary oppositions and simple one-to-one correlations. The semantic profiles of the topoi are too complex to split them between the levels of discourse and metadiscourse since there are more than two levels of organization here (cf. Crismore & Farnsworth, 1989; Mao, 1993) with no simple ways to link them to the levels of linguistic organization.

Content types

It is convenient to divide the elements of the topoi into propositional and modal elements. The division of discourse into propositional and modal contents is one of the oldest conceptions in logic and linguistics, which to this day remains a subject of numerous animated debates. In this study we do not need to concern ourselves with the fine detail of the debates. Suffice it to say that the proposition/modus distinction is useful for explanations (Hyland & Tse, 2004), and in some sentences it is quite clear. For example, the difference between *Iris contraction does not affect the IOP* and *Iris contraction may affect the IOP* is in the modus (*does not* vs. *may*), while the propositional contents of the two statements are similar (*Iris contraction* [*affect*] *the IOP*). However, in most cases the distinction between the modus and proposition is far from obvious (Mao, 1993). For my analysis, I will use the term *propositional content* for recurrent lexicalized ideas, and *modality* for their modes of presentation.[43]

[43] Cf. Halliday (1994, Ch. 4) on *Residue* and *Mood*.

Another helpful distinction for my purposes is that between the subject matter and methodological commentary, which is assumed in numerous studies on research genres (e.g. Crismore & Farnsworth, 1989; Swales, 2004). Note, however, that like the modus/proposition distinction, the distinction between observations and methodology will be used as an explanatory, rather than analytic, conception.

Observational information

Five recurrent types of content in the corpus allow the authors to write about phenomena and relations among them:

- **Instances and precedents**: e.g. Of the 20[44] patients in this study 9 had LTG plus myopia, 8 unclassified LTG, 2 senile sclerotic LTG and one focal ischemic LTG. (E15)
- **Relations**: e.g. Vascular risk factors include migraine, blood transfusion, Raynaud's phenomenon, and nocturnal blood pressure (BP) reduction… (G5)
- **Causality**: e.g. This shift is the beginning of the apoptotic mechanism and leads to cell destruction and ischaemia in endothelial cells… (G14)
- **Signs and indicators**: e.g. Thus, AVP measurements representing the passage through from the artery passing the capillary formation to the vein are an indicator of the integrity and regulation of a vascular segment. (G34)

Let us take a closer look at these categories to understand their linguistic signals the semantic differences between them. In the **instances and precedents** statement the local character of the proposition is typically signalled with quantifiers – in this case, numerals. The phrase *risk factors* in the **relations** statement marks it up as information about the details of patients' medical histories that are typically associated with the disease. The **causality** statement is signalled with *mechanism* and *leads to*. In the **signs and indicators** statement the idea that *AVP measurements* are indexical of *the integrity and regulation of a vascular segment* is communicated with two lexemes: *representing* and *indicator*. All these statements are shaped as simple assertive sentences. That is to say, they present the propositions as received or obvious information whose reliability or certainty the readers are not expected to question.

Similar content can be presented as less certain, less general, or more specific with the help of certain types of syntactic constructions, modal expressions, and reporting verbs (underlined in the examples below). Such modalizations (Halliday, 1994, pp. 88-92) can limit the scope or force of the statement or project the authors' or community's uncertainty about the propositions. For example, we can distinguish between broad generalizations that the authors represent as attributable to all similar cases, on the one hand, and more narrow statements that cover a limited range of cases and circumstances, on the other. Here is what the latter type of assertions looks like:

[44] In all examples the emphases are mine.

- **Instances and precedents**: e.g. All other parameters assessed by CDI measurements in the central retinal artery, short and long posterior ciliary arteries and ophthalmic artery appeared to be stable. (G10)
- **Relations**: e.g. The time to development of a visual field defect in the "second eye" seems to be related to the severity of the defect in the "first eye". (G36)
- **Causality**: e.g. Small vessel disease could be a major risk factor. Levels of IOP, which are normally well tolerated, may produce damage to the optic nerve. (E15)
- **Signs and indicators**: e.g. This may be indicative of an active (IgM) and persistent (IgG) autoimmune process. (G14)

A third type of observational statements presents propositions as current knowledge, as distinct from 'timeless' assertions. Such statements tend to have reporting verbs in the present perfect or present indefinite tense and other finite verbs, if any, in the present indefinite:

- **Instances and precedents**: e.g. It has been shown that in patients with ocular hypertension, with IOPs between 21 and 30 mmHg, the change of developing glaucomatous damage is low (less than 1% per year). (E15)
- **Relations**: e.g. Accumulating evidence indicates that intraocular pressure (IOP), even within the normal range, is a major risk factor for normal tension glaucoma (NTG)… (G24)
- **Causality**: e.g. In normal subjects a higher IOP is associated with a higher degree of myopic refraction, and myopia is more prevalent in patients with primary open-angle glaucoma or NTG than in normal subjects… (E1)
- **Signs and indicators**: e.g. … pulsatility index (PI) and resistive index (RI) are calculated automatically by the CDI software. (G10)

Even though such statements may contain parenthetical citations, in their agent roles they feature indefinite or vague references and thus represent the propositional content as general knowledge, something that the field experts are expected to be aware of or at least have heard about (cf. O'Keefe, 2004). In contrast, recent or notable developments in the field are shaped as more specific statements; similarly marked up are the authors' own methodological assumptions, stipulations, and findings. The specificity of the proposition can be communicated with the past indefinite tense of the main clause and with references to particular studies:

- **Instances and precedents**: e.g. The proportion of patients developing field loss, reported in these studies, varied from 15 to 29% up to 43% during a follow up period of 5–7 years. (G36)
- **Relations**: e.g. Both of these studies found that the patients with higher initial IOPs showed greater IOP reductions. (G6)
- **Causality**: e.g. In contrast, brinzolamide did not to alter ocular perfusion… (G10)
- **Signs and indicators**: e.g. The intensity decrease was an index for the diffuse retinal damage, whereas the intensity variance indicated an index for estimating the localized retinal damage... (E10)

Such statements stand out against the background of what goes without saying in the field. On the one hand, they communicate the less certain part of the knowledge; on the other, they are often used to foreground the part of the knowledge that is of special interest or relevance for the study. Witness how the shift from the present perfect to the past indefinite tense can signal a shift from the general background to the issue at hand:

- Many researchers have suggested a difference in pathogenesis between normal tension glaucoma (NTG) and primary open angle glaucoma (POAG). Among the evidence supporting this theory were the different patterns of visual field defect… and optic nerve head configuration… The frequent occurrence of optic disc haemorrhage and the high incidence of systemic diseases… in patients with NTG also suggested that a damaging mechanism other than high intraocular pressure contributed to the glaucomatous damage… (G21)

Having set up the issue in relation to the field theory, the authors formulate the problem and study objectives:

- Although retinal nerve fibre layer (RNFL) evaluation has become important in detecting glaucomatous nerve damage, quantitative comparison of RNFL photographs between NTG and POAG has been rare.

  In this study, we tried to evaluate the difference in nerve fibre layer (NFL) defects between NTG and POAG through analysis of RNFL photographs. (G21)

Many of the statements discussed above have the form of complex sentences. Such syntax provides the writers with a flexible stratified system for signalling their stances on the propositions and the field's theory in general. The most obvious signal here is the choice of the reporting verb (cf. Thomas & Hawes, 1994). For example, *reported* projects a greater degree of acquiescence in the proposition than *suggested*. The choice of the reporting verb may also signal differences in the nature of the borrowed content. For example, *reported*, along with *observed* or *discovered*, is likely to introduce the results of another study, while verbs like *suggested*, *hypothesized*, or *proposed* are more suitable for extrapolations and recommendations.

Besides the lexical choices, the status and nature of the propositions can be signalled by grammatical means. For example, complex sentences with coordinated tenses in the main and subordinate clauses is the norm in English, and like any deviation from the norm, lack of coordination may have semantic significance (cf. Halliday, 2002, Ch. 3). Thus a combination of a past-tense verb in the main clause (the modus) and a present-tense verb in the subordinate clause (the proposition) may communicate the authors' view that the proposition can be extrapolated from its original context. For example, in the statement *Both of these studies found that the patients with higher initial IOPs showed greater IOP reductions* (G6), the past-tense verb in the proposition (*showed*) communicates a somewhat lower degree of assent with the source than its less standard version would: *Both of these studies found that the patients with higher initial IOPs show greater IOP reductions.* (G6)

So far we have found that modal distinctions signal the epistemic status and the nature of the borrowed content, as well as the authors' attitude to it. For an etic analyst it is hard to say which distinctions are relevant for the community, but the distinctions between original and borrowed observations and interpretations seem especially relevant for the purposes of knowledge extraction. For example, the authors' observational inferences tend to be some of the most modalized topoi, and the patterns of modalization make them distinct from other cited inferences. In my corpus I found two major types of original inferences. One type conveys the authors' findings and explanations; the other is used to propose theoretical extrapolations. Here are examples of the former type:

- Although a significant increase was identified in our study, the 10.4% increase after brimonidine treatment may not be attributable to drug effects. (G24)
- Interestingly, a higher prevalence of antiphosphatidylserine antibodies of the IgG class was seen in NTG patients with hearing loss in comparison to NTG patients with normacusis. (G14)

And here is what extrapolations look like:

- This finding suggests that IOP is a causative factor for optic nerve damage in patients with NTG, whereas it is not elevated above the statistically normal IOP range. (E10)
- This indicates that agents may have variable impact on ocular haemodynamics even with the same IOP lowering effect. (G24)
- It is also possible that eyes with a more advanced, fixation threatening disease are more resistant to latanoprost. (G16)
- These findings may be interpreted as a sign for a generalized disease. (G14)

All reporting or reasoning verbs in both types of statements are used in present tenses (*may not be attributable, suggests, indicates, is… possible, may be interpreted*), which marks them up as original, rather than borrowed, inferences. The difference between them is in the projected specificity of the propositional content. The more obvious specificity signal is the use of deictics pointing to either the local or general nature of the propositions: e.g. *our study* as opposed to *a sign for a generalized disease*. The verbal tenses in the proposition are more subtle but more consistent and reliable. In findings and explanations the verbs are typically used in past tenses (*was seen*), which represents them as strictly local, tied to their specific contexts. In extrapolations, the propositional verbs tend to be in present tenses (*is, may have, are*), which shows that the authors expand the range of the propositions outside the original contexts.

What I hoped to achieve with this survey of the most salient types of subject matter in my corpus is to show how argumentative meanings depend on the interplay between the communicated propositional content and various types of modalizations.

Methodological information

When it comes to the clinical procedures and the research terminology, avenues, and methods, the text turns from observations to activities and actions:

- **Clinical practice**: e.g. Lumigan® contains 0.3 mg/ml bimatoprost. (G10)
- **Knowledge and research**: e.g. As indicated in the formula, IOP and BP parameters affect theoretical MOPP value at each point of measurement. (G5)
- **Concepts and classifications**: e.g. The remaining individuals are classified as either nondippers or overdippers… (G5)

These examples demonstrate some of the characteristic features of their semantic categories: medication names in the **clinical practice** statement, multiple analysis and research terms in the **knowledge and research** statement, and a designation term in **concepts and classifications** statement.

As with the observational information, modalities often communicate the certainty and generality of methodological information. Such are the functions of the underlined modal expressions in this series of **concepts and classifications** statements:

- Evidence is accumulating that NTG may be quite distinct from primary open-angle glaucoma (POAG)... (E10)
- Differences between the means are considered to be significant at the $P < 0.05$ level. (E1)
- Compressive optic neuropathy and atypical glaucoma are two conditions with clinical profiles that have overlapping characteristics in some of the reported patients… (G12)

Another important type of modus that methodological statements share with observational information is the state of the art:

- **Clinical practice**: e.g. Today's noninvasive methods for measuring ocular blood flow have contributed greatly toward the research carried out in this area. (E3)
- **Knowledge and research**: e.g. Many researchers have studied the structural and functional differences between NTG and POAG. The targets were optic nerve head, visual field, and RNFL. (G21)
- **Concepts and classifications**: e.g. Some authors have identified two distinct categories within this nosological form: a non-progressive and a progressive form. (E3)

But generally speaking, the methodological information presents us with a rather more complex system of meanings in the modus. Here are the most prominent and stable mark-ups on methodological content in my corpus, which are somewhat similar to Halliday's (1994) modulations (pp. 88-92):

Desirability and advisability:

- **Clinical practice**: e.g. In the light of changes in visual acuity noted here, surgery needs to be justified. (G35)
- **Knowledge and research**: e.g. If an ischaemic change is thought to be causative… the knowledge of the microcirculation may be important. (G34)
- **Concepts and classifications**: e.g. Hence, our suggestion that NTG may be subgrouped should be confirmed by further investigations on a larger number of subjects. (E1)

Availability, potency, and feasibility:

- **Clinical practice**: e.g. This may be accomplished by filteration surgery. (E15)
- **Knowledge and research**: e.g. The scanning laser ophthalmoscope allows the choice of automatic video gain control, which is confounding for dye dilution curve analysis. (G34)
- **Concepts and classifications**: e.g. It might be possible to distinguish between diffuse and focal progression in these patients by determining the pattern of this progression… (G31)

Selection, stipulation, and designation:

- **Clinical practice**: e.g. Our standard management has been to withhold treatment until or unless visual field progression occurs. (G33)
- **Knowledge and research**: e.g. This specific time point was chosen due to organizational reasons. (G10)
- **Concepts and classifications**: e.g. The diagnosis of NTG was established by typical optic disc and visual field damage. (G14)

Modalities are typically associated with well defined lexico-grammatical categories: tense, mood, and modal expressions such as *can*, *must*, *should*, *likely*, *able*, etc. (Halliday, 1994). Indeed, the verbal forms, the tense, mood, and voice, play an important role in the communication of modalities. But apart from such well known modal mark-ups, I found in my corpus elements of modus that are not typically recognized in the literature as modality expressions. For example, desirability and advisability may not only be communicated with deontic modality (*need*, *should*) but also with evaluative lexis (*important*).

To sum up, the meanings and rhetorical functions of statements in many cases hinge on the interfaces between their moduses and propositions. In addition to superimposing modal meanings on the propositional content, the modus variously marks up the roles that the authors attribute to the content in their own arguments, in the arguments of their sources, and in the theory of the field (cf. Butler, 2003; Nuyts, 2001; Schryer et al., 2007).

Summary

One point that the discussion of my study design, analytic procedures, methods, and system of linguistic features in this chapter should have demonstrated is that inductive analyses of topoi tend to be circular and iterative and therefore need to rely on a flexible and versatile system of concepts and methods. It also helps to have a clear set of objectives to resolve the indeterminacy of the units of text and discourse organization. Above all, the researchers have to continuously adjust their methodological and theoretical assumptions and to keep learning in the course of the study.

Apart from these methodological principles, some properties of epistemic topoi should also be clear by now. It is futile to look for singular lexical markers for most of them. Their distinctive features are composite semantic profiles realized through linguistic configurations. The elements of these configurations are far from uniform. In my corpus they include deixis, syntax, co-reference,

lexico-grammatical and semantic relations. Topoi and schemata manifest themselves through ‘texture’, as networks of non-contiguous and overlapping patterns and ideas. This means that their identification requires a combination of observations and methodological choices. Visual annotation and pattern recognition are tractable enough to capture such intricate organization and thus present analysts with a viable alternative to the conventional combination of tagging and statistical analysis.

Chapter 6: On argumentative practices in clinical research of normal pressure glaucoma

> Only connect.
>
> E. M. Forster

> An ethic that is based on conformity to principles or to duty will not make quantitative distinctions between acts, as will an ethic that is based on the importance of the consequences.
>
> Ch. Perelman

For my exploratory analysis I formulated three major questions:

- What are the recurrent elements of argumentative organization in the corpus?
- What are their linguistic realizations?
- What metalanguage designates these elements?

I arrived at the answers to these questions by the method of analytic induction discussed in the previous chapter. The method combines observation with conceptual and methodological analysis. Such a combination was necessary because of the indeterminacy of the size of the topoi and the flexibility of their linguistic configurations.

Like the identification of the topoi, their classification was a result of observations and methodological choices. On the one hand, it emerged from juxtaposition and analysis of the rhetorical functions and linguistic configurations of the topoi, as well as their clustering and distribution in the texts. On the other hand, I developed the classification with special attention to those facets of argumentation that I found to be underrepresented in the literature. My literature review discussed in the third chapter suggested that two important parts of argumentation theory that do not receive sufficient coverage are situated knowledge and learning. So in my discussion of the topoi and their categories I will foreground these facets of argumentation while giving less attention to the popular themes of suasion and demonstration.

My choice of terms for the categories was also a result of a methodological decision. Where both a meta-theoretical and local epistemic terms for a topos or a class of topoi were available, I opted for the local term. To introduce some of the metalanguage used by the domain experts, I will begin this chapter with an ethnomethodological survey of the local epistemic lexicon, which will be followed with an outline of the argumentative superstructure identified in the corpus. This superstructure will then be evaluated in terms of the decision-making issues that it foregrounds and suppresses.

The NTG theory and meta-theory

A good place to start an investigation into the meta-knowledge of a research domain is its literature reviews. The NTG corpus is bounded with two reviews: Levene's 1980 "Low tension glaucoma: a critical review and new material" and Krupin's 2007 "Special considerations in low-tension glaucoma." If the number of citations is any indication of success, Levene's review has made it big. He is cited in seventeen out of the fifty-eight papers in the corpus, and the citation frequency has not been much lower over the past decade than in the decade following the publication. This makes Levene's paper an essential source of background information, warranting a closer look at its content and organization.

Levene's review is the first comprehensive and systematic publication on NTG in my corpus and its most extensive and sophisticated paper offering helpful insights into the domain's theory and argumentative practices. The review involves two levels of argumentation addressing not only the subject matter, NTG, but also the field's theory and discourse. The author's purposes are many. Primarily, he pools available observations from various studies for a comprehensive description of the disease. He finds the received theory and practice to be uncertain on the definitive and distinctive features of NTG. Like other types of glaucoma, Levene explains, NTG produces a characteristic damage to the optic disc, which results in visual field loss. NTG also shares excavation of the optic disc and retinal degeneration with other types of glaucoma. Yet, unlike other types of glaucoma, NTG damages the eye in absence of elevated intraocular pressure (IOP), which raises the question of the cut-off line between elevated and normal pressure. It is also unclear why in NTG relatively low pressure causes the disc excavation and retinal degeneration.

In search of answers, Levene is especially alert to recurrent combinations and correlations of features and factors. He finds two major combinations of clinical characteristics of NTG, which, he says, suggest different etiologies and thus call for different therapies. Levene also undertakes a careful comparative analysis of the causal accounts of the disease. He reviews what is seen as typical signs and risk factors of NTG, as well as the known treatment effects. In the light of this analysis, he compares the major NTG theories that tend to foreground one of its likely etiologies: (1) the stress from intraocular pressure, (2) the low optic disc resistance to such stress, or (3) the vascular factors which can either weaken the resistance or cause additional stress. He concludes that the major contributing factor of glaucomatous damage in NTG is the stress on the optic disc from vascular changes caused by factors other than IOP. But he also reconciles the competing theories by proposing a new conception of the mechanisms of glaucomatous damage. Different parts of the visual field, he suggests, are susceptible to different stress factors, so the differential diagnosis of NTG should take into account the location and shape of the glaucomatous damage. Moreover, he says, in view of available evidence, the diagnostic criteria of NTG must be reconsidered.

Apart from his inquiry into the phenomenal aspects of NTG, Levene performs a careful analysis of the field's epistemic practices and attendant lexicon. He finds manifold differences across

the literature in the examination procedures and instruments, analytical methods, and concepts. These themes are an essential part of any paper in the corpus, yet Levene's approach is more systematic than the other authors'. He shows how disagreement can be used in the process of secondary induction. Any methodological and terminological distinctions for him are a source of insight into different possible explanations of NTG. He uses distinctions a system of theoretical 'refractive lenses' that call for interpretation rather than resolution. He carefully defines his key terms and compares them to the definitions provided by his sources (p. 627 ff.). This move allows him to convert disparate measurements into the units of his study, which in turn enables him to draw on the research data from across the field. His view of NTG is distinct from many of the more rigid conceptions that he reviews. Where his sources look for a singular set of signs and diagnostic criteria, Levene prefers a systematic but not necessarily coherent theory – in part because he does not regard NTG as a fully self-contained syndrome. He considers NTG to be a cluster of interrelated conditions and causal chains. Phenomenal complexity calls for epistemic open-mindedness, and Levene achieves such open-mindedness by approaching epistemic categories as theoretical entities, rather than designations for 'objective' phenomena.

Levene supplements his review with an elaborate outline (Appendix E). In a paper the size of Levene's review, the outline, attached at the end of his paper, may be seen as a usability feature, a table of contents. Yet there are no page numbers, which suggests that the author intended it as a projection of the field's knowledge organization. The outline is written in the field's jargon: a mix of specialized terms (*visual field*, *optic disc*, *congenital defects*, etc.) and epistemic metalanguage (*definitions*, *criteria*, *characteristics*, *summary*, etc.). This mixture allows the author to represent a birds-eye view of what he sees as the optimal conceptual and procedural organization for NTG research. The methodology section (I – V) includes definitions of all relevant concepts and other terminology (II & III), as well as relations between the concepts (IV & V). The latter two subsections provide the lexicon for discussing the disease in terms of its definitive features (IV), its distinctions from similar and overlapping conditions (V), as well as of its interaction mechanisms with the factors that are believed to be its causes, effects, risk factors, and treatments (VII - IX). The methodology informs the research practices and reasoning procedures, but it is also continuously reviewed for fit with the evidence that it helps to bring forth (VI – X). All factors must be accounted for: the social context (VI), the organization and contingencies of the study (VII.A & VII.B), its circumstances, results, and effects (VII.C – VII.P). All associations between the factors must be analysed with statistical methods (VIII) and scrutinized for significant and accidental interactions (IX). Finally, the analysis and discussion must proceed from raw data to conclusions and recommendations through a system of successive generalizations and syntheses (VII.J.7, VII.Q, VIII.A.8, IX.H, & X).

Most other publications in my corpus are different from Levene's paper in that they focus on the phenomenal and technical matters, making only occasional recourse to epistemic aspects of the research. Besides, an average article in the corpus is a few pages long, in contrast to Levene's forty-three-page opus. This volume gives Levene enough space to make meta-theory a prominent part of his argument. Yet, distinctions aside, his paper is essentially representative of the field's

argumentative practices. It confirms Johnson and Connelly's (1980) insight that two major operations of medical reasoning are problem-solving and decision-making, or primary and secondary induction, to use the terms of the philosophy of science (Kneale, 1949).

Annotation and analysis results

Communication is inextricable from agency; therefore it is important for argumentation analysts to recognize the objects of their investigations as integral elements of purposeful and organized human activities, and communicators as members of communities of practice (Clarke, 2004; Kimble & Hildreth, 2004). Activity theory offers a convenient concept for inquiries into the organization of human activities, called activity system (Artemeva, 2004; Engeström, 1999; Flower, 2002; Miller, 1984; Schryer et al., 2007; Varpio, 2006; Vygotsky, 1962a). According to Flower (2002), an activity system includes

> … not only the actors, the object of action, and the community which shares those objects, but also divisions of labor or power, the rules and conventions, and the material or symbolic tools that mediate the activity. (p. 242, emphasis added)

This may appear as an intimidating set of analytic entities, but it can shed light on many of the features of text and discourse organization in research literature. In fact, without reference to the notions of agency and activity, it is hard to understand what sustains the complexity of natural argumentation.

How do the elements of the activity system of the field play out in the discourse and individual texts? The object of the research activities is the theory of the field; that is, the transcendental hypothesis of the disease. The theory is a complex conceptual system involving phenomenal and technical knowledge. The phenomenal knowledge includes the description of NTG in terms of causes, effects, and risk factors, signs and symptoms, types and distinctions from other similar diseases, diagnosis protocols, treatment methods and their effects. It also accounts for interactions among these factors and the ways that the disease affects lives and societies. The technical knowledge (*techne*, in the categories of ancient Greek methodology) concerns decisions and actions required in specific situations as well as activities called for by the state of the field, the epidemiology of the disease, and the available resources. The community involved in the construction of the theory, the types of actor roles in the community, and its divisions of labour were addressed in the survey of the corpus in the previous chapter. The major epistemic conventions were introduced above in the digest of Levene's literature reviews. For insight into the research tools used for the construction of the theory we now will turn to the organization of argumentation at the textual level.

In addition to problem-solving and decision-making topoi that are prominently featured in medical metatheory, I identified in my corpus a significant number of topoi associated with the projected interpersonal relations between the authors and readers (cf. Hyland, 2005). Each of the three argumentation modes performs a number of functions in the texts. Primary induction is aimed

at the solutions of specific problems that the authors set up for their investigations. Secondary induction allows them to make decisions, interpret findings, and propose recommendations. Interpersonal argumentation is used to demonstrate the significance of the studies, to make the arguments reader-friendly, and to engage the readers in the integration of the findings into the field's theory.

I found the distinctions between primary and secondary induction to be closely linked with the conventional IMRD structure of the papers. The methods and results sections mostly deal with primary induction, while introductions and discussions are dominated by secondary induction. In addition, the topical makeups of introductions and discussions turned out to be more diverse than the methods and results sections. This means that, like secondary induction, interpersonal argumentation tends to gravitate towards introductions and discussions.

Problem-solving and decision-making topoi

Problem-solving and decision-making form two distinct yet closely interconnected modes of argumentation in the papers. Problem- solving is a comparatively straightforward argumentation mode based on a set of highly standardized procedures, such as statistical analysis and comparison. The relative simplicity of primary induction operations means that, outside their methodological choices, the authors have little influence on their outcomes. Decision-making is by far more complex than primary induction. It also has distinct aspectual features. While problem-solving is reported on, decision-making unfolds before the readers' eyes, as it were. The degree of the authors' involvement in the outcomes of decision-making is quite high compared to problem-solving. While the generation of primary results is a matter of technique, decision-making involves numerous choices. To a great extent, these choices set up the theoretical and methodological frameworks for problem-solving. Three more important functions of decision-making are the selection, interpretation, and evaluation of major findings and their synthesis with those of other researchers. Finally, it allows the authors to produce broader conclusions than problem-solving alone affords. Thus problem-solving and decision-making are interdependent yet at the same time autonomous in their objectives, materials, and results. The fact that some projects precipitate multiple publications (e.g. G31 and G35) bears out the distinction between these two argumentation modes.

Problem-solving topoi

The problem-solving topoi are divided between the methods and results narratives depending whether they deal with methodological or observational content. The methods narratives, mostly found in the methods sections, communicate information about the researchers' actions, stipulations, and decisions. The following basic topoi are used to convey these meanings:

COHORT SCREENING

INTERVENTIONS

INFORMATION
DATA HANDLING
INSTRUMENTS
DATA PROCESSING / ANALYSIS TOOLS
STIPULATED CONCEPTS / CLASSIFICATIONS

In the results narratives the authors present observational information in the form of quantified data of various levels of specificity. This part of clinical argumentation relies on a small number of topoi:

INTERVENTION DATA
PARTICIPATION DATA
OBSERVATION DATA
DEMOGRAPHICS

The outcomes of primary induction, drawn from the information communicated in the methods and results narratives, can take the following forms:

SUMMATED OBSERVATIONS
COMPARISON
STATISTICAL SIGNIFICANCE
FOUND ASSOCIATIONS / CORRELATIONS
FOUND CAUSES/ EFFECTS

Content-wise the problem-solving accounts are dominated by data, methodological and observational. Methodological data describe study designs and thus are important for the credibility of the results and their reproducibility (Thompson, 1993). The authors also use them as premises in their own arguments. For example, a recurrent type of inferences in the results sections concerns the statistical significance of the results. Such judgments are impossible unless the authors stipulate the threshold of significance in the methods section (e.g. *A new defect was considered significant if it had a least three locations with a reduced sensitivity of 5 dB or more and one location of 10 dB or more.*). Similarly, most primary inferences in the results sections are based on the definitions or classification criteria that are set up among the methods (e.g. *Progression was thought to be present when a defect of at least three locations showed a change of 5 dB or more, or if such a change occurred contiguous to a defect.*). Results statements sometimes have explicit references to stipulated parameters, as in *Thirty eight patients failed to maintain 25% IOP reduction as defined above*[45] (G35). The stipulated and selected values and parameters are even more important for secondary induction. In order to compare and synthesize findings from diverse studies, the authors often have to analyse their methodological similarities and distinctions.

As with most empirical research publications, in NTG papers the methods sections tend to

[45] Emphases in all examples are mine.

have less numeric information than results sections. Yet this tendency reflects not so much the difference in the rank of the content (i.e. observations vs. commentary) as the distinction of the stipulations and screening results from study results. Besides, since the results follow the methods, they tend to contain both premises and inferences, while the methods narratives mostly deal with premises. The two sections in the papers from my corpus are quite uniform in terms of their organization patterning. They are written in the past tense and organized into narrative sequences, which communicates the idea that primary induction is reported on rather than performed at the time of writing.

Methodological narratives

The methods narratives are constructed as matter-of-fact accounts of procedures and techniques that are expected to be familiar to the readers. Figure 6.1 shows an example of such a narrative:

PATIENTS AND METHODS

[1] NTG patients with progressive optic disc cupping/visual field defects not associated with other disease, new disc haemorrhage, or glaucomatous field defects that threatened fixation were recruited between November 2000 and September 2001. Diagnosis of NTG is based on reproducible field defects of a retinal nerve fibre type (Humphrey visual field analyser, program…), corresponding disc findings, open angles, and normal IOP. IOP was <22 mm Hg on multiple measurements including one diurnal phasing (every 2 hours from 8 am to 8 pm). Exclusion criteria were corneal abnormality, a history of corneal surgery, other diseases that might cause field defects, ocular trauma, ocular laser/surgery within 12 months, advanced glaucoma with impaired visual acuity, or severe systemic disease.

[2] Patients taking glaucoma medication before the study underwent a washout period of 4 weeks for topical β blockers and latanoprost, 2 weeks for topical adrenergic agonists, and 1 week for cholinergic agents and carbonic anhydrase inhibitors… Topical lubricant (Artelac; Dr Mann Pharma, Berlin, Germany) was given during the washout period. **[3]** Patients were then randomly allocated to two groups. **[4]** Group 1 received latanoprost once daily at 9 pm for 4 weeks, lubricant for 4 weeks, and then brimonidine twice daily at 9 am and 9 pm for 4 weeks. Group 2 followed the same schedule but with the two active regimens in reverse order.

Patients were examined on day 1, week 4, week 8, and week 12. One masked ophthalmologist measured POBF at 8 am, 12 noon, and 4 pm at each visit. On each occasion, POBF was measured three times with one OBF tonometer (Paradigm Medical Industries, Inc, UT, USA). **[5]** Institutional review board approval was obtained, and verbal and written consent was obtained from all subjects.

[6] The eye with more advanced glaucoma was selected for analysis if both eyes of one patient were eligible. **[7]** Data were analysed using the statistical software STATA (Stata Corporation, College station, TX, USA). The normality of data distribution was checked with the Shapiro-Wilk test. Comparisons between baseline and after treatment were performed with paired Student's *t* test. Multivariate linear regression with generalised estimation equation was used to adjust the effects of IOP on POBF… Treatment effect comparisons between two regimens were assessed with a crossover designed analysis of variance (ANOVA). **[8]** A p value of less than 0.05 was considered as statistically significant.

Figure 6.1. The study design and research procedures narrative from a methods section (G24).

The section has highly standardized terminology, few references, and little commentary. The arrangement of the topoi in it is also quite typical:

1) COHORT SCREENING
2) INTERVENTIONS
3) INFORMATION
4) INTERVENTIONS
5) RESEARCH ETHICS
6) INFORMATION
7) DATA PROCESSING /ANALYSIS TOOLS
8) STIPULATED CONCEPTS/CLASSIFICATIONS.

The authors first talk of their patients (COHORT SCREENING[46]), then about the organization of the study (INTERVENTIONS and INFORMATION), and, finally, about the ways they processed and analysed the data (DATA PROCESSING /ANALYSIS TOOLS and STIPULATED CONCEPTS/CLASSIFICATIONS). (The RESEARCH ETHICS topos conveys information on standard research practices rather than on original know-how. Thus I deal with in the section on artistic topoi.) Most methods sections in my corpus use similar topical arrangements. The linguistic patterns signalling the topoi are also quite well defined. The COHORT SCREENING[47] topos describes the study participants in general terms. Here are more statements of the same type from across the corpus:

- They all fulfilled the following criteria: peak IOP lower than 26 mmHg as measured in a diurnal curve without medication, the presence of glaucomatous field defects associated with glaucomatous disc changes, and an open chamber angle. (E15)
- Eyes were excluded where diagnoses other than glaucoma, which might affect the visual field or visual acuity, had been made. (G33)
- The diagnosis of NTG was established by typical optic disc and visual field damage. (G14)

Like all methodological narrative topoi, COHORT SCREENING statements have past tense verbs in the main clause. They are shaped after the **knowledge and research** model and are marked up with identity lexis (*typical*), circumscription (*or better*, ≥), or designation (*criteria*, *excluded*) expressions. They also contain numerous abstractions referring to observations, examinations, or clinical procedures (*IOP*, *medication*, *defects*, *changes*, *angle*, *diagnoses*, *field*, *acuity*, *damage*).

The topoi dealing with the organization of the study are more diverse than the participant topoi:

[46] I mostly use small caps for the names of the topoi. However, each first description of a topos in this chapter will be marked with its all-caps name.
[47] Cf. Trawiński's (1989) "preliminary activities" and Liddy's (1991) "subjects."

INTERVENTIONS[48]:

- Isolated peaks of 26 mmHg were allowed in a diurnal IOP curve without therapy. (E15)
- IOP was measured in our hospital for at least 3 days at different times during day and night. (G14)
- The patients underwent CDI measurements of ocular perfusion of the right eye by CDI shortly before and 3 to 5 weeks after initiation a local therapy with either latanoprost or bimatoprost. Both eye drops were applied once a day between 6 p.m. and 8 p.m. (G10)

The INTERVENTIONS topos is the most general in this class, with mixed **clinical practice** and **knowledge and research** information. The writers use it to explain how they managed the disease, how they scheduled and performed examinations, tests, and measurements, what kinds of interventions they used, and how they distributed them among the participants. Few statements of this type in my corpus have just one of these types of information, like E15 or G14 above. More often they contain a mixture of information, as in G10. The topos is signalled with clinical practice or examination lexis (*therapy*, *measured*, *hospital*, *measurements*, *applied*). Most sentences in this category have past passive verbs; many have ordinal or cardinal numerals, and time expressions.

The INFORMATION statements are used to explain how the authors collected and organized the data, so they refer to the **knowledge and research** type of content.

INFORMATION[49]:

- The relationship between the intensity decrease and the intensity variance was examined to determine the difference between the pattern of RNFL loss in the two groups (Fig. 3). (E10)
- The mean value of the three diurnal IOP measurements (mean IOP), the highest value of the measurements (max IOP), and the lowest value of the measurements (min IOP) were used as IOP parameters. (E1)
- Of the patients and controls in whom both eyes were considered, we used the mean value of the two eyes. In those in whom only one eye was considered, we used the IOP, PA and POBF values of the single eye. (E3)
- For each patient the relative NRR area was calculated. (G36)

Like the INTERVENTIONS topos, these statements deal with the researchers' actions and thus are a diverse category. Yet in INTERVENTIONS statements the researchers' actions are directed at patients, clinical procedures, or medical data, while in INFORMATION statements, the researchers' actions are directed at analytical entities and materials. That is why apart from analytic, examination, or reasoning lexis (*examined*, *determine*, *used*, *considered*, *relative*, *calculated*), their recurrent features include abstractions (e.g. *relationship*, *intensity*, *decrease*, *variance*, *value*, *measurements*, *parameters*, *area*). They often mention *patients* or *controls*, but they can also contain a synechdocal

[48] Cf. Trawiński's (1989) "schedule of testing method," "place where testing was carried out," "time of testing," and "specification of procedures employed in testing," and Salager-Meyer's (1994) "describe the process which led to the obtaining of the data."

[49] Cf. Trawiński's (1989) "specification of objects used in testing."

reference to the participants, *eyes*. Also typical of this category are summarization lexis (*both*, *each*) or small natural numbers, often with the definite article (e.g. *the two*). Comparison lexis (*difference*), parallelism and repetition (e.g. *both eyes were considered… only one eye was considered*) are also frequent in INFORMATION statements:

The DATA HANDLING and INSTRUMENTS topoi also communicate content of the **knowledge and research** type. The purpose of DATA HANDLING statements is to explain how the researchers controlled their biases and ensured the reliability of their results:

DATA HANDLING[50]:

- The visual fields were analyzed by an external observer. (E15)
- Each factor was entered in the model separately. (G36)
- The measurements of IOP were made by one of two observers masked to the treatment status of the patient (authors AA and MAR). (G16)

They tend to have diction communicating the ideas of objectivity, detachment, or separation, such as *external*, *separately*, and *masked*. Like most other study design topoi, DATA HANDLING statements have passive predicates in the main clause. Yet they also tend to have a *by*-agent (e.g. *by an… observer*). Their lexical features are somewhat similar to those of the INFORMATION statements since they, too, tend to have analysis terms (*analyzed*, *entered*) and analysis, observation, examination, or reasoning abstractions (*factor*, *model*, *measurements*, *treatment*, *status*, *area*).

INSTRUMENTS statements are also predominantly passive categories. Yet where DATA HANDLING statements have *by*-agents, this topos usually has instruments: the names of standard equipment linked to the verb with the word *using* or a preposition: *with (the aid of)* or *on*:

INSTRUMENTS[51]:

- Stereophotographs of the optic discs were taken with the simultaneous stereo fundus camera (Topcon TRC-SS2), using Kodak Ektachrome 100 HC film. (E1)
- Blood pressure and heart rate were measured with an automatic device (Dinap Criticare Vital Daten Monitor, Criticare, Tampa, FL, USA). (G34)
- Visual field examinations were performed with the 24-2 full-threshold program on the Humphrey field analyzer (HFA; Carl Zeiss Meditec, Inc., Dublin, CA). (G5)

The next class of methodological topoi refers to the processing and analysis of data. The category of DATA PROCESSING/ANALYSIS TOOLS statements continues the list of predominantly passive categories with content of the **knowledge and research** type. It shares many features with the INSTRUMENTS topos, which is expected, since analysis relies on instrumentation at least as much as does direct experimentation. However, in the instrument slot this topos has analysis lexis combined with names of computer software, models, templates, or formulae instead of examination and measurement equipment:

DATA PROCESSING/ANALYSIS TOOLS[52]:

[50] Cf. Trawiński's (1989) "data reductions, calculations" and Salager-Meyer's (1994) "describe the process of manipulating the data obtained during the experimental stage."
[51] Cf. Trawiński's (1989) "specification of equipment used."

- All calculations were performed using SAS, version 8.2 (SAS institute Inc, Cary, NC, USA). (G16)
- Student's t-test for paired data was used. (G10)
- In an a-priori-power-analysis the sample size was calculated. (G10)
- Statistical analyses were performed using SAS/STAT software 8.1. (G6)

The STIPULATED CONCEPTS/CLASSIFICATIONS topos refers to the terms that the researchers adopt for their studies. It communicates **concepts and classifications** information:

STIPULATED CONCEPTS/CLASSIFICATIONS[53]:

- The intensity decrease was an index for the diffuse retinal damage, whereas the intensity variance indicated an index for estimating the localized retinal damage... (E10)
- The median of the IOPs in the 2 years before surgery for each patient was taken as the preoperative baseline. (G35)
- POAG was defined to meet the same criteria of NTG except for intraocular pressure greater than 21 mm Hg in an eye without antiglaucoma medication… (G21)
- Differences reaching $P < 0.05$ were considered statistically significant. (G5)

I found indexing (*indicated*, *index*) and designation expressions (*criteria*, *defined*, *differences*, *considered*) or compound nominal predicates to be the most reliable signals of such statements in my corpus. Their other characteristic feature is frequent abstractions.

Methodological narratives are compact, well organized, and cast in highly standardized terminology. Yet despite the transparency of their coding, they seem to play an important part in the community's discourse. Detailed accounts of study designs are present in each paper, which suggests that readers appreciate this information and use it in their own analyses. It is no surprise that an average methods section in NTG papers is almost as long as a discussion, twice as long as a results section and thrice as long as an introduction.

Results narratives

In the results sections the authors develop their arguments from 'raw' data to primary inferences. The data for the most part represent quantified information about clinical interventions and their effects. Clinical interventions involve simple observations, examinations and measurements, or clinical procedures, such as medical treatments or surgeries. The investigators may choose to analyze observations that have been recorded over a certain period of time or more focused examination results of selected groups of patients, or cohorts. Decisions about the selection and presentation of the data are based on the purposes of the study as well as on the availability of certain types of information. Primary inferences derived from the data include simple generalization, comparative

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[52] Cf. Trawiński's (1989) "model used."

[53] Cf. Aristotle's "definition" (Huseman, 1994), Trawiński's (1989) "evaluation criteria used," Liddy's (1991) "new terms defined," and Swales's (2004) "definitional clarifications."

statements, statements about found associations, correlations, and intervention effects, as well as evaluations of the statistical significance of such inferences.

Results sections are more straightforward than the methods sections. They rely on a limited number of standardized reasoning methods and procedures:

> RESULTS
>
> APSA concentrations were significantly higher in NTG patients compared to healthy controls (fig 1). Interestingly, the frequency of elevated IgG APSA concentrations in the NTG patients with hearing loss was significantly increased as compared to NTG patients with normacusis and healthy controls (table 1).
>
> Twenty three NTG patients (68%) had hearing loss, mostly affecting the high (41%) and the middle frequencies (32%). After excluding presbyacusis in 12 (35%) NTG patients, 11 NTG patients (32%) had a pathological hearing loss and 11 NTG patients (32%) had normacusis defined by age matched controls… Twenty seven NTG patients (79%) showed reproducible levels of transitory otoacoustic emissions indicating normal outer hair cell function. No reproducible transitory otoacoustic emissions were found in seven patients (20%).
>
> Six NTG patients (18%) had a positive history of thromboembolic disease, four of these patients had a pathological hearing loss and two presbyacusis or normacusis.
>
> In NTG patients, in the group with presbyacusis and normacusis, levels of IgM APSA concentrations were significantly higher ($p<0.05$) as in healthy controls, whereas no significant differences of IgM APSA concentrations between NTG patients with normacusis, PSHL, and presbyacusis were found (fig 2).
>
> Levels of IgG APSA concentrations were significantly increased in the NTG subgroup with PSHL ($p<0.05$) compared to healthy controls.
>
> Levels of anti-β2 glycoprotein were in the normal range and not significantly different between patients and controls.

Figure 6.2. A sample of primary induction from a results section (G14).

The middle part of the results section shown in Fig. 6.2 (specifically, its second and third paragraphs) is dominated by plain data: basic **instances and precedents** information. All statements here refer to the category of OBSERVATION DATA.[54] The edges (the first and the last three paragraphs) are less uniform. They are composed of processed data: comparisons (CLUSTERS COMPARED), as well as generalizations and assessments of observations and comparisons in terms of statistical significance (COMPOSITE DATA[55]). Note that the explication of all the data that inform these inferences would take up too much volume, so the authors refer the readers to a figure with detailed information.

The conventional development pattern typical of primary induction (data – analysis – inference) is scrambled in this section. In fact no part of it is 'pure' data, analysis, or inferences. Rather, plain and processed examination results are mingled in the section. Yet we recognize them by their linguistic configurations. The whole section is written in the past indefinite tense, which

[54] Cf. Aristotle's "simple consequences" (Huseman, 1994) and Trawiński's (1989) "presentation of raw data obtained"; refer to Appendix F for descriptions of the linguistic configurations of the topoi.

[55] This topos will be discussed in more detail below, under "Indeterminate and composite statement types."

identifies its content as strictly local, confined to the study. In the OBSERVATION DATA paragraphs all sentence subjects are modified with quantifiers, and all but one of the quantifiers are numerals. The predicates convey the idea of observation or discovery. Where the subject is *patients*, the predicate is *had* or *showed*. The other predicate option is *was found*. Regardless of the predicate, every sentence has the term *patients*. Another typical element of OBSERVATION DATA is observation abstractions like *loss*, *age*, *levels*, and *function*.

In the data processing and inferencing paragraphs, we find numerous juxtapositions and comparisons of *patients* with *controls*. The operation of comparison is expressed with the metalinguistic tag *compared* and other comparison lexis, such as *different*. In this sample we also find grammatical signals of comparison: comparative degrees and comparative syntactical structures. Typographical comparison symbols, such as <, are frequently used as shorthand for comparison diction in the corpus. The operation of generalization is signalled with the summarization adjective *normal*.

The section given in Figure 6.2 comes from a short paper that reports on a series of examinations conducted over three days specifically for the purposes of the study. More extended arguments in my corpus have a wider range of topoi. Apart from the intervention and effects topoi, most longitudinal studies also take into account the changing circumstances. For example, the researchers may note the numbers of participants that were enrolled and that stayed until the end of the study, as well as of the reasons of their withdrawals (PARTICIPATION DATA).

In summary, primary induction manifests itself in my corpus as a system of statement types that present qualitative and quantitative information about the study, its participants and effects. In the methods sections the authors describe study designs and stipulate concepts. The results sections report on the outcomes of the analytic and reasoning procedures used to convert plain data into primary inferences. The major reasoning operations of primary induction are division, selection, deduction, quantitative analysis, comparison, correlation and association. (Refer to Appendix F for a complete list of these topoi.)

Decision-making topoi

The divide between the methods and results, on the one hand, and introductions and discussions, on the other, is informed by the distinction between problem-solving and decision-making. Decision-making argumentation, or secondary induction, creates a frame and foundation for problem-solving. It allows the authors to formulate their study objectives, to interpret their results in practical terms, and to make their findings meaningful for their readers. Another important type of interpretations that result from secondary induction is new hypotheses and commentaries on existing theory and practice. Such interpretations[56] do not and cannot follow directly from primary results. To arrive at them, the

[56] Cf. Trawiński's (1989) "explanation of results obtained."

authors juxtapose their results with relevant findings by other authors. In the process of juxtaposition distinctions and disparities are explained, analysed, and often used for higher-level analysis.

Much of decision-making figures in the papers as background reviews, mostly occurring in introductions, and syntheses of primary and secondary evidence, typically found in discussion sections. These parts of the argument are realized with the following set of topoi:

OPEN ISSUES
DISPARITY / UNCERTAINTY
AVAILABLE TREATMENT / RESEARCH
NEW APPROACHES
KNOWN CAUSES/ EFFECTS
KNOWN ASSOCIATIONS / CORRELATIONS
AVAILABLE CONCEPTS / CLASSIFICATIONS
PREVIOUS FINDINGS

Another set allows the authors to explain the conceptions of their studies, as well as to comment on their methodological choices and findings:

THEME/ PURPOSE
HYPOTHESIS
LOCAL FACTORS
QUALIFICATIONS
RESULTS CONSISTENCY
METHODOLOGICAL CONSISTENCY
RESULTS RELIABILITY

The outcomes of secondary induction can take the form of the following types of interpretations and conclusions:

EXTRAPOLATIONS
RECOMMENDATIONS
NEW/ REMAINING ISSUES
FUTURE RESEARCH
KEY FINDINGS

The decision-making topoi form a system of reasoning circuits in the texts that allow the authors to generate study findings through the appraisal and interpretation of primary results and their synthesis with the theory of field. Decision-making topoi also provide epistemic resources for the integration of findings into current practice and discourse.

Relations between problem-solving and decision-making

Problem-solving and decision-making are interdependent in terms of their materials and results. Secondary induction builds on the results of primary induction; however, it does not encapsulate or replicate it.

Autonomy of secondary induction

Primary inferences form a distinct set of topoi from secondary inferences. For example, the meaning of the terms *significant* and *significance* can vary depending on the context. Here is a statement combining two different meanings of this term:

- We noted a statistically significant but clinically insignificant reduction in mean blood pressure (3.4 (7.2) mm Hg) and pulse rate (2.1 (4.2) beats/minute) after brimonidine treatment, findings in accordance with several reports… (G24)

STATISTICAL SIGNIFICANCE[57], a purely quantitative category, is a recurrent topos in primary induction, while clinical or functional significance[58] is occasionally brought up in secondary induction. One type of significance does not necessarily entail the other. Assessment of clinical or functional significance involves appraisal of results against contextual factors and is typically based on complex criteria (Fethney, 2010).

Alternatively, study results can be appraised by probing into the study design, as in the following statements:

- A significant difference was observed between the two eyes because of the selection criteria. (E1)
- Although this is not statistically significant it may also be expected since in this model the effect of adjunct group has been adjusted for the effect IOP. (G31)

Both these statements cast doubt on the practical value of the statistical significance of results. In the first the authors tag the statistical significance as a study design artefact; in the second the authors suggest that their statistical analysis was not discerning enough to capture an obvious effect.

Besides circumscribing the value of statistical significance, these examples demonstrate one more facet of the autonomy of primary and secondary induction. Not only the primary inferences but also any information about the study (such as the study design) can be invoked in discussions. In fact an important part of secondary induction is the identification of major outcomes of the study. As such outcomes, the authors often present results of any level of abstraction, from plain data to causative inferences:

[57] Cf. Trawiński's (1989) "statistical analysis of results" and Salager-Meyer's (1994) "make limited claims about the statistical tests."

[58] Cf. Harmsze and Kircz's (1998) "qualitative interpretation" and "quantitative interpretation."

KEY FINDINGS[59]:

- In this study, latanoprost 0.005% administered once daily significantly reduced the IOP in NTG patients, and maintained this IOP reduction for up to 12 months. (G6)
- In conclusion, a high percentage of patients with NTG had marked nocturnal BP reduction. (G5)

The G6 statement points to the significance of a precedent (positive and sustained effects of treatment with *latanoprost 0.005% administered once daily*), while G5 stresses the importance of a discovered association (between *NTG* and *nocturnal BP reduction*). Despite the diverse subject matter, both statements perform the same argumentative function. They formulate important conclusions, which is signalled with end-of-text metadiscourse (*in conclusion*) and autoreferential deixis (in *this* study).

It takes a community to develop a theory, and that is why references and appeals to the community are an essential part of the arguments in the corpus. The authors frequently appeal to their readers to advance the theory of the field in specific ways or directions. These appeals combine **relations**, **causality**, or **signs and indicators** with **knowledge and research** information:

NEW/REMAINING ISSUES[60]:

- Although filtration surgery may alter the aqueous humour dynamics of the fellow unoperated eye… and uniocular application of topical β blockers may reduce the IOP of the contralateral eye…, we do not know whether treatment given to one eye may influence the natural course of the disease of the contralateral eye. (G36)
- However, the primary cause remains unclear when visual field integrity does not necessarily reflect nerve fibre health… (G34)
- Whether an increase in POBF is beneficial to the optic disc remains debatable. (G24)

FUTURE RESEARCH[61]:

- Hence, our suggestion that NTG may be subgrouped should be confirmed by further investigations on a larger number of subjects. (E1)
- Further studies are needed to investigate longitudinal progression of the glaucomatous damage with different levels of CMF. Risk factors that make overdippers susceptible to the development of glaucoma should also be investigated. (G5)

The NEW/REMAINING ISSUES statements[62] tend to have present tense verbs and to contain expressions of disparity, inadequate knowledge or lacking clarity (e.g. *unclear*, *not necessarily*). Autoreferential

[59] Cf. Harmsze and Kircz's (1998) "findings" and Swales's (2004) "announcing principal outcomes."
[60] Cf. Trawiński's (1989) "new problems encountered during research" and Harmsze and Kircz's (1998) "new problems."
[61] Cf. Trawiński's (1989) "possible ways of improving solution," Liddy's (1991) "future research needs," Thompson's (1993) "calls for further research in the results section," and Salager-Meyer's (1994) "propose further questions."
[62] This topos shares some features with the statements of OPEN ISSUES and DISPARITIES/UNCERTAINTIES discussed in the next subsection.

deixis (*we*) or the verb *remain* indexes it as part of the conclusions. FUTURE RESEARCH statements are typically signalled with research and reasoning lexis (*suggestion, confirmed, investigations, studies, investigate*), deontic modality (*should, needed*), and continuity diction (*further*).

Appraisal and interpretation of primary results

Most papers in my corpus have two levels of generalizations. Local generalizations are typically drawn up in the results sections based on the quantitative analysis of the observations. Higher-level generalizations are typically formulated in the discussion sections by relating original observations to the field's theory. In some papers such generalizations take the form of commentary on the consistency of the study results and methods with the field's practice and theory. In this class of statements I found two forms of combined **relations** and **knowledge and research** information:

RESULTS CONSISTENCY[63]:

- Concerning the postoperative complications, our data are consistent with those of others... (E15)
- This is a considerably larger value than has been mentioned in previous reports of disc size in normal and NTG eyes… (E1)
- This is not surprising because antiphospholipid antibodies increase with age. (G14)

These statements explain how well the study results fit in with existing knowledge. We can recognize this category by epistemic lexis (*consistent, surprising*) or comparison expressions (*larger… than…*). Not only do the authors comment on the consistency of their findings with the theory but also on the METHODOLOGICAL CONSISTENCY of their studies with the field's practices:

- Diagnostic criteria for NPG were very similar to that of previous studies… (G33)
- Our analysis varies from previous studies in that we looked at IOP updated for each 6 month period postoperatively as a risk factor for visual field progression. (G31)
- In the present study, we modified the standard for classification of nondippers, dippers, and overdippers, which was adopted in a previous study… (G5)

This topos is very similar to RESULTS CONSISTENCY. Yet while in RESULTS CONSISTENCY statements the comparison is applied to analytic or research abstractions (*data, value*), in METHODOLOGICAL CONSISTENCY statements the objects of comparison shifts to research and reasoning abstractions (*criteria, analysis, standard, classification*).

Many authors go beyond simple comparison of results and designs. They also use statistical methods and combine multiple analytic methods to probe their RESULTS RELIABILITY[64]:

- After adjusting for the factor of IOP, the increase of mean POBF associated with both regimens no longer reached statistical significance ($p = 0.424$ and $p = 0.345$,

[63] Cf. Aristotle's "proportional results" and "identical results" (Huseman, 1994), Trawiński's (1989) "comparison with results obtained by other authors," and Thompson's (1993) "statements citing external consistency."

[64] Cf. Trawiński's (1989) "evaluation of data precision" and Liddy's (1991) "reliability."

respectively). To avoid the possible effects of systemic cardiovascular medication on POBF, data were further analysed after excluding patients with such medications. The results remained similar. (G24)

- Fifteen pairs of repeated IOP measurements were compared for the calculation of limits of agreement between the two observers. The mean difference of the measurements was 0.3 mm Hg and the 95% confidence interval was 20.2 mm Hg to 0.7 mm Hg. The limits of agreement were 21.3 mm Hg to 1.7 mm Hg. (G16)
- Age, gender, ocular laterality, lens status, and the time of day of IOP measurement were evaluated as potential confounding factors, but were not found to be significantly associated with IOP reduction. (G6)

This topos, which combines **causation** or **relation** with **knowledge and research** information, often takes the form of multi-clause sequences explaining how the authors tested their results for possible errors and artefacts. Such probing may involve adjusting analysis parameters and values or inquiring into assumed procedures. RESULTS RELIABILITY statements feature a distinctive system of metalinguistic tags, such as *adjust for… factor/difference/ disparity/ etc.*, *significant(ly)/ significance*, *avoid… effects*, *limits of agreement*, *confidence interval*, *evaluate errors/ confounding factors*. The probing may also involve comparison of results obtained by various methods. This semantic element can be signalled either with concession or disjunction expressions (*but*) or with aspect diction (*no longer*, *further*, *remained*) combined with comparison expressions (*similar*, *compared*).

So far we have seen how contingencies get acknowledged, analysed, and reckoned with. But in clinical research contingencies can also work as a type of evidence, so some authors take them into account when interpreting their results. Such interpretations take the form of LOCAL FACTORS statements:

LOCAL FACTORS:

- A significant difference was observed between the two eyes because of the selection criteria. (E1)
- Although we have looked for the effect of potential confounding factors, unexpected confounding factors cannot be excluded which might provide an alternative explanation for the data. (G35)
- As it is widely known that nocturnal BP reduction can cause various end-organ damage…, glaucomatous optic neuropathy in NTG may have been caused by large CMF in similar mechanism. (G5)

This topos refers to **causality** statements that are signalled with causal expressions (*because*, *factors*, *effect*). In some cases they are used to point to study design artefacts, like the E1 and G35 examples, but they can also express tentative theoretical propositions, like G5. Apart from the idea of causation, such statements signal the attribution of the observations to the circumstances of the study with explicit metalinguistic tags, such as *selection criteria* and *confounding factors*, perfective infinitives

in compound modal predicates ([*may*] *have been*), or past tense simple predicates[65] (*was observed*). This is the most tentative type of inferences in the papers.

Generally speaking, when it comes to causal inferences, the authors in my corpus are quite cautious. Primary data can occasionally be used for primary inferences[66] of the FOUND CAUSES/ EFFECTS[67] type:

- In agreement with other authors… we also found that medical treatment and argon laser trabeculoplasty (ATP) only slightly reduced the IOP (13%) in eyes with low tension glaucoma. (E15)
- Interestingly, age of patient had a significant effect on response to latanoprost. (G16)
- In accordance with previous reports dorzolamide led to an increase of blood flow velocity in systole. (G10)

In two of these statements, E15 and G10, the authors compare their findings with those of earlier studies, and such comparisons are highly typical. When authors seek to relate the observed links to underlying causal mechanisms, they have to transcend the boundaries of their studies. A cause-to-effect observation has the status of an accidental regularity until it gets corroborated by other studies. That is why original inferences about causal mechanisms, signs, indicators, or diagnostic methods are always carefully hedged. Such theoretical inferences often take the form of EXTRAPOLATIONS:

- These findings suggest that there may be two different types of NTG, the affected eyes differing in optic disc size and in other ocular characteristics. (E1)
- These differences suggest that optic nerve compression by ICA may be one of the possible causes or may be a risk factor for optic nerve damage of NTG in some patients. (G12)

The hedging of these statements, both in the modus and proposition, shows that the EXTRAPOLATIONS do not follow directly from either primary or secondary evidence. (Nor *can* they follow, as Hume told us.)

Synthesis of primary and secondary induction

To incorporate their findings into the field's theory, researchers need to draw on the results of earlier studies. This is achieved by merging and synthesizing original observations with shared knowledge. Shared knowledge is present in the arguments as secondary evidence and references to the state of the art. The merging of primary and secondary evidence requires careful referencing. The two types of content are also signalled with distinctive linguistic features:

> **[1]** We noted a statistically significant but clinically insignificant reduction in mean blood pressure (3.4 (7.2) mm Hg) and pulse rate (2.1 (4.2) beats/minute) after

[65] Except in epistemic clauses, such as *unexpected confounding factors cannot be excluded which might provide an alternative explanation for the data*.
[66] Discussed above under "Problem-solving topoi."
[67] Cf. Aristotle's "cause to effect" (Huseman, 1994).

> brimonidine treatment, findings in accordance with several reports… **[2]** Treatment with 0.2% brimonidine may reduce the systolic blood pressure up to 7.1 mm Hg and decrease the pulse rate up to 3 beats/minute… **[3]** In a study on ocular normotensive subjects with implanted cardiac pacemakers, Trew *et al* found that the mean POBF increased by about 14% as the heart rate increased from 60–90 beats/minute… **[4]** Although the decreased pulse rate after brimonidine treatment may in itself reduce POBF, the effect is likely to be insignificant. (G24)

The first sentence in this passage communicates an assessment of the authors' own study results. We know that it is primary information from the combination of the simple past tense (*noted*) and autoreferential deixis (*we*). The next sentence corroborates this statement with secondary data on the effects of the same drug. We know that it is not an original result from the present tense predicate (*may reduce*). The authors use this sentence to juxtapose the results of earlier research with their own. The juxtaposition is communicated with parallelism and repetition:

> *reduction – reduce*
> *blood pressure… mm Hg… pulse rate… beats/minute – blood pressure… mm Hg… pulse rate… beats/minute*

The third sentence also communicates a statement about earlier findings. This time, however, the information is presented as an isolated instance or precedent. This effect is achieved by introducing and naming the source (*a study on ocular normotensive subjects with implanted cardiac pacemakers, Trew et al*) and using the past indefinite tense in both clauses (*found, increased*). The last sentence has two present tense predicates (*may reduce, is*), but, unlike in the second sentence, both propositions here are modalized (*may, likely*). These features suggest that the authors here present us with a synthesis of the primary and secondary evidence cited in the paragraph.

Primary results tend to shed a fair amount of specific details when restated or 'recycled' as evidence in secondary induction, compared to their first iteration in the results section. Witness these two statements from the same paper, one from the results section and the other from the discussion:

- The randomised latanoprost group had a statistically significantly lower mean AIOP and MIOP than the control group at follow up (1.5 mm Hg and 1.8 mm Hg respectively). (G16)
- Patients randomised to treatment appeared to respond better to latanoprost than non-randomised patients. (G16)

Both statements communicate the same content (comparison between the treatment effects in the randomized and non-randomized groups), and they both have the same type of comparison signals: comparative degrees and comparative constructions (*lower… than…*, *better…than…*). Thus they belong to the same type, CLUSTERS COMPARED. Yet the second statement is a much terser version of the first. The increased density of information is not the only change that the results statement undergoes in the discussion. Its tone shifts from reporting to selection and interpretation. In the discussion statement the authors signal this shift by substituting *appeared to respond better* for *had a statistically significantly lower mean AIOP and MIOP*.

In addition to merging primary and secondary materials, writers synthesize them. This is possible thanks to a technique that is specific to secondary induction. It consists in juxtaposition and analysis of study designs, contingencies, and results. Statements with such juxtaposition belong to the class of methodological information. They may concern the distinctive features, contingencies, benefits, and limitations of the studies:

QUALIFICATIONS[68]:

- Given the retrospective nature of our analysis and the small number of patients investigated, our results must be interpreted with caution. (G36)
- It should be noted that the results presented here come from a retrospective analysis of data. (G35)
- The influence of the tested compounds on perfusion of the entire eye cannot be answered by the present study. (G10)

This topos combines **knowledge and research** with **clinical practice** information. It is used to explicate the assumptions and methodological decisions which affect the study results and findings. Thus it delimits the scope of the conclusions or forestalls unwarranted interpretations. It may be signalled with explicit metalinguistic tags (*caution*, *noted*), but more often we can recognize it by more subtle signals, such as diminutive or negative diction (*small*, *not*) combined with deontic modality (*must*, *should*) or potency expressions (*cannot*). As a class of methodological information, such statements are also characterized by epistemic metalanguage (e.g. *interpreted*, *retrospective*, *tested*) with high frequencies of abstract nouns (e.g. *analysis*, *data*, *study*).

Contextual relevance and textual coherence

How do writers apply the decision-making procedures as they make their ways from research tasks and study objectives to conclusions? Much of the distance is covered with transformation and translation of ideas that allow researchers to integrate their studies and findings with the domain's discourse. The essential procedures of such integration are knowledge translation, as well as textual and discursive coherence and cohesion.

Knowledge translation

To a great extent, knowledge translation happens along the scales of specificity and time. This enables transition from the general tasks of the study to its specific objectives. The authors often make this transition by including into their introductions and discussions brief literature reviews with relevant information on the current treatment and research trends, as well as notable recent

[68] Cf. Trawiński's (1989) "evaluation of data completeness" and "analysis of possible errors" and Thompson's (1993) "evaluative comments on the quality of experimental data."

developments. AVAILABLE TREATMENT/RESEARCH[69] statements provide a summative outlook on these trends and developments:

- Treatment for NTG has therefore concentrated on lowering IOP. (G31)
- In recent years, the understanding of development and progression of glaucomatous optic nerve damage has changed. (G14)
- Studies have been conducted to investigate the relationship between nocturnal hypotension and glaucomatous optic neuropathy. (G5)

Prominent in this topos is the idea of cumulative development communicated with specific temporal expressions in the main clause: the present perfect tense or recency and currency adverbials (*in recent years*). In addition, the idea of a birds-eye-view of the field is expressed with abstract nouns related to clinical practice (*treatment*), reasoning and research (*understanding*, *studies*, *relationship*), and observation (*development and progression*, *damage*, *hypotension*, *neuropathy*). Statements of this type tend to convey either **knowledge and research** (G14, G5) or **clinical practice** information (G31).

AVAILABLE TREATMENT/RESEARCH statements are often used in introductions and elaborated with more detailed literature reviews. Besides fleshing out the authors' outlook on the state of the art, reviews work as a source of background information for the readers. Here we find various kinds of content related to the issue at hand, both of the observational and methodological types. In discussions background reviews convey the same types of content but play a somewhat different role. While at the start of the papers they provide theoretical background, in discussions they typically serve as a source of secondary evidence. This functional difference does not seem to produce significant distinctions in the form of the statements of which the reviews are composed. However, their cohesion with surrounding text is stronger in discussions. The borrowed content is incorporated into the text with a range of cohesive devices. Let us take a look at how these types of content are represented in one of the papers from the corpus (G6). Here is the background review from the introduction:

> Normal-tension glaucoma (NTG) is a clinical entity defined as a chronic progressive optic neuropathy resulting in characteristic optic nerve head changes, retinal nerve fiber layer defects, and visual field defects. In NTG, the intraocular pressure (IOP) values are lower than 22 mmHg, which differentiates it from primary open-angle glaucoma (POAG)…[70] Despite many controversies about the origin and pathogenesis of NTG, many reports have suggested that IOP reduction by filtering surgery… or medical treatment… has favorable effects on visual field progression and optic disc change in NTG. Thus, the current major treatment modalities for NTG are directed toward IOP reduction

Figure 6.3. A sample background review from an introduction (G6).

[69] Cf. Aristotle's "existing decisions" (Huseman, 1994) and Liddy's (1991) "relation to other research."
[70] The ellipses in the examples represent omitted in-text citations.

And here is its counterpart from the discussion:

> Treatment modalities for NTG are directed toward reducing IOP, which should prevent further deterioration of the visual field and further decay of the neuroretinal rim. It has been reported that reducing the IOP by 30% favorably influences NTG progression… Moreover, the findings that asymmetric NTG is often associated with asymmetric IOP…, and that there is an inverse correlation between IOP and the neural rim area of the optic disc among NTG patients…, suggest that the IOP, even when in the normal range, contributes to optic nerve damage.
>
> Latanoprost is a prostaglandin analogue and reduces IOP by stimulating uveoscleral outflow… Long-term studies have shown the efficacy of latanoprost in patients with open-angle glaucoma and ocular hypertension, the reduction of IOP achieved by monotherapy was between 27.8 and 33%... In addition, latanoprost was reported to maintain IOP reduction, especially during the night, and to increase pulsatile ocular blood flow by 21%, indicating a remarkable increase in choroidal blood flow…

Figure 6.4. A sample background review from a discussion (G6).

The first review passage (Fig. 6.3) coheres due to thematic development and repetition. However, all sentences in it are understandable on their own since none of them have connectives or pronominal cross-references. The inference that the authors draw from this material is a general statement about the AVAILABLE TREATMENT/RESEARCH: *Thus, the current major treatment modalities for NTG are directed toward IOP reduction*. The review passage from the discussion (Fig. 6.4) reiterates this AVAILABLE TREATMENT/RESEARCH statement almost to the word (*Treatment modalities for NTG are directed toward reducing IOP*), but otherwise it is quite different from the introductory review.

In fact the review from the discussion picks up where the introductory review left off. It is obviously more detailed and specific but also more cohesive. For example, its first paragraph is more than an outlook on the field. Its content provides support for the authors' argument, justifying their treatment method (which *should prevent further deterioration of the visual field and further decay of the neuroretinal rim*), stating its required effect (*reducing the IOP by 30%*), and justifying the requirement (in *NTG patients*, pressure *contributes to optic nerve damage* even *in the normal range*).

The second half of the paragraph is so closely linked with the first that it is not fully comprehensible on its own because of the anaphoric connective *moreover*. Besides, this second statement is quite complex, both structurally and conceptually. Here the authors cite two findings from the literature and draw their own inference from these findings, explicating the link between earlier research and their own study. This inference turns the statement into a transitional device between the preceding and following segments. The former talks about the links of optic nerve damage with intraocular pressure, and the latter about the effectiveness of the medication in reducing pressure. What links these 'argumentative zones' (Teufel, 1999) is a quasi-deductive combination of ideas: if IOP damages the optic nerve, and latanoprost reduces IOP, then the hypotensive effects of latanoprost warrant attention.

Generalizations about the state of knowledge and art

There is a special category of statements that link secondary and primary induction and thus create the internal coherence of the texts. Such statements are typically referred to as framing and transitional devices. In my corpus they also link the studies to the field's theory and social context. All papers have such statements, and in most cases authors make more than one reference to the field's exigencies in the course of their arguments. They typically take care to explain how their study designs address the general issues and to propose solutions.

The exigencies or opportunities that motivate the study are formulated quite early in introductions and discussions. They may figure as generalizations about the OPEN ISSUES of the domain:

- If IOP is assumed to influence such discs, the question arises of what rise in IOP will cause progression of glaucomatous damage. (E1)
- However, the correlation of the AVP to the degree of glaucomatous field damage has not yet been examined. (G34)
- The influence on POBF of brimonidine is still unknown. (G24)
- However, few reports are available upon the long-term IOP-lowering efficacy of latanoprost in NTG. (G6)
- To our knowledge, this is the first report to address the association between nocturnal BP reduction and CMF. (G5)

This topos usually merges **knowledge and research** with **relations** and **causality** information. It is used to point to lacking knowledge or insufficient literature on the issue pursued in the paper and is signalled with research or reasoning expressions (*assumed*, *question*, *examined*, *unknown*, *knowledge*, *report*, *address*) combined with causation or relation lexis (*influence*, *cause*, *correlation*, *efficacy*, *association*). The expressions of lack or insufficiency include negative diction (*not*, *unknown*, *few*), uniqueness expressions (*the first*), and indirect questions (*what rise in IOP will cause progression of glaucomatous damage*). Another characteristic feature of this category of statements is high frequencies of abstract nouns (e.g. *degree*, *influence*).

Like OPEN ISSUES, DISPARITY/UNCERTAINTY statements usually appear in the introduction or at the start of the discussion. They typically point to a contradiction within the field's theory that needs to be resolved:

DISPARITY/UNCERTAINTY[71]:

- The incidence of this pathology varies considerably in the studies that have been carried out, ranging from 5% of all types of glaucoma for some authors… to up to 15% of cases of POAG for other authors… (E3)
- Early glaucomatous visual field defects are often asymmetric showing either superior or inferior nerve fibre bundle defects. (G34)

[71] Cf. Salager-Meyer's (1994) "justify the reason for the investigation" and Swales's (2004) "indicating a gap."

Alternatively, the authors can point out a contradiction between the theory and the demands of clinical practice:

- A more important outcome after filtering surgery is the prevention of further visual field deterioration; however, the detection of "real" progression needs to be differentiated from the inherent "noise" in visual field testing. (G31)

The topos communicates various types of content. It manifests itself through expressions of variation, uncertainty, and incongruence (*varies*, *ranging*, *asymmetric*). Its other characteristic feature is juxtaposition signals, such as disjunctive and concessive connectives (*either… or*, *however*) and the syntactic and lexical cohesive links discussed in the previous subsection (*5% of all types… 15% of cases* and *for some authors… for other authors* in the E3 example, *superior… inferior* and *defects… defects* in G34, and *"real"… "noise"* in G31). Such juxtaposition signals may be combined with disparity, variation, and uncertainty lexis or act in its place. Compared to other topoi, the DISPARITY/UNCERTAINTY topos is more often expressed by means of syntax and texture, so it is typically superimposed on other meanings. For example, the last statement not only points to disparities but also talks about a challenge (*progression… needs to be differentiated from... noise*).

The OPEN ISSUES and DISPARITY/UNCERTAINTY topoi can be seen as a type of implicit negative motivation for research. In contrast, statements about NEW APPROACHES function as implicit positive motivation. They communicate a wide range of content types, both observational and methodological:

NEW APPROACHES:

- A new concept has been proposed by Davanger, who accounted for the prevalence of NTG on the basis of the overlapping distribution of IOP in population and the pressure vulnerability of the optic nerve head... (E10)
- Because of the risk of failure to achieve low normal IOP in the postoperative period guarded fistulising procedures with or without the use of adjunctive postoperative or perioperative 5-fluorouracil… or perioperative mitomycin C… have been proposed. (G35)
- Latanoprost is a "new generation" drug that has recently been evaluated as a potential therapy for patients with NTG in short term studies… (G16)

Such statements are somewhat similar to AVAILABLE TREATMENT/RESEARCH statements, discussed above, in that they typically have recency and currency adverbials and present perfect or present indefinite tense in the main clause. What makes them distinct is the expressions of novelty or promise (*new*, *proposed*, *potential*), which endows them with a more prominent affective appeal.

The OPEN ISSUES, DISPARITY/UNCERTAINTY, NEW APPROACHES, and AVAILABLE TREATMENT/RESEARCH topoi convey the authors' generalizations about the state of the art and formulate their general research tasks. That is why they are typically used to introduce or conclude literature review segments. This function makes them similar to transitional topoi discussed above. In fact framing and transitional statements are often used side by side, creating the 'movement' between

the general and specific information in introductions and discussions (cf. Hill, Soppelsa, & West, 1982). Here is one such sequence from an introduction:

> Patients with POAG frequently present with bilateral field loss at diagnosis. However, in the early stage of the disease visual field loss may be found in only one eye… Previous studies investigating the visual prognosis of fellow eyes of POAG patients with unilateral field loss have shown a much higher incidence of development of field loss in these patients than in ocular hypertensives… Therefore, POAG patients with uniocular field loss represent an ideal population in which to investigate factors influencing the onset of field loss over a period of time.
>
> In a retrospective longitudinal study we investigated the influence of several clinical variables on the temporal relation between time of presentation and onset of white on white perimetric defects in the fellow eyes of a group of NTG patients with unilateral field loss. (G36)

In this is passage the underlined NEW APPROACHES statement sums up the review and segues into a STUDY DESIGN statement, marked with double underscore, which in turn introduces the methods section.

From research objectives to findings

An important function of framing and transitional devices is the development of the arguments from general exigencies through specific study objectives to findings. In this category I found statements of different levels of abstraction. Such, for example, is the relationship between general exigencies and specific research objectives. While general exigencies are implied in the OPEN ISSUES, DISPARITY/UNCERTAINTY, NEW APPROACHES, and AVAILABLE TREATMENT/RESEARCH statements, specific objectives are explicitly formulated as statements of THEME/ PURPOSE[72]. They are typically derived from the reviews and occur at the end of introductions, right before the methods sections:

- This study is aimed at assessing the effects of therapy on POBF and functional parameters in patients with NTG. (E3)
- In this study, we therefore wanted to investigate a possible coincidence between NTG and progressive sensorineural hearing loss (PSHL) and the association to APSA. (G14)

Such **knowledge and research** statements contain frequent expressions of purpose or volition (*aimed at*, *wanted to*), examination, analysis, or research lexis (*study*, *assessing*, *investigate*), autoreferential dexis (*this*, *we*), and various abstract nouns (*effects*, *parameters*, *coincidence*, *association*). Such statements are typically used before the methods sections. By setting up a specific problem for the study, they link its design to the state of the art. Where the OPEN

[72]Cf. Trawiński's (1989) "idea of testing method," Liddy's (1991) "research questions" and "research topic," Myers's (1992) "self-referential introductory statements," and Swales's (2004) "announcing present research descriptively and/or purposively."

ISSUES/CHALLENGES and DISPARITY/UNCERTAINTY topoi state the general task, the THEME/PURPOSE topos shows how exactly the authors plan to go about this general task.

HYPOTHESIS[73] is another prominent topos that enables the general problem-solution development and at the same time creates textual coherence and cohesion. Such statements are typically viewed as a type of questions that motivate and organize inquiries (Stannard, 1965), and this, indeed, is the most typical function of this topos in my corpus. In this role they are similar to the THEME/PURPOSE statements. For example, *It is hypothesized that these compounds [latanoprost, bimatoprost, and dorzolamide] lead to changes in systolic and diastolic blood flow velocities within the short posterior cilary artery* (G10) is used in the introduction to the paper and thus formulates its major question. In fact the authors of this paper use a series of hypotheses to manage their evidence and to keep their argument on track. After the general hypothesis in the introduction, they come up with more elaborate questions in the methods section: *It was hypothesized that the tested compounds would influence peak systolic and end-diastolic blood flow velocities… in the short posterior ciliary artery...* In the discussion there is a third, the most general and abstract hypothesis, and this time it is directly linked to the aim of the study: *Aim of the present study was to focus on glaucoma patients and it is hypothesized that glaucoma is associated with a localized disturbance of ocular hemodynamics at the optic disc*. All the question-hypotheses of the paper are answered in the process of the discussion, gradually bringing the argument to conclusion. The authors explain that one of the three tested compounds, dorzolamide, produced positive results, leading *to an increase of blood flow velocity in systole* and improving *perfusion in the posterior ciliary arteries*. Yet the authors also state that there *is still a great demand for a pharmacological compound which significantly enhances perfusion of the optic nerve head*.

Now, HYPOTHESES consist of **relations** or **causality** information and are often signalled with metalinguistic tags (e.g. *hypothesized*, as in the examples above) but can also be expressed grammatically, with the help of conditional sentences and the subjunctive mood:

- If the pattern of RNFL loss in NTG has relationship with IOP, the mechanisms of optic nerve damage in NTG might be similar to its in POAG. (E10)
- If there is a simple correlation among IOP, optic disc size, and visual field loss, then in subjects with optic discs of equal size visual field loss would be expected to be more advanced in the eye with higher IOP. Furthermore, in eyes with similar IOPs the degree of visual field loss would be expected to be proportional to the size of the optic disc. (E1)

In addition to formulating study objectives, HYPOTHESES can be used to draw tentative conclusions at the end of the text. Here is one such statement:

> At this point certain hypotheses can be formulated:
>
> 1. Autoregulation exists and acts in a similar fashion in both groups, whatever the initial values of blood flow.

[73] Cf. Liddy's (1991) "hypothesis" and Swales's (2004) "presenting research questions or hypotheses."

2. Autoregulation of ciliary-retinal circulation is a supposition rather than a fact.
3. Autoregulation occurs for "physiological" values of IOP which in subjects with NTG are in any case lower than those in normal subjects.
4. In subjects with NTG there is no autoregulation at all. (E3)

In substance this conclusion is similar to extrapolations discussed above, but the tag *hypotheses* and the form of a list explicitly sets it up as a tentative programme for further investigations into the matter.

More typical in conclusions than HYPOTHESES are RECOMMENDATIONS related to **clinical practice**. Such framing statements formulate the practical implications of the research:

RECOMMENDATIONS[74]:

- In patients with progressive LTG the normal IOP is relatively too high and a reduction to lower levels by means of filtering surgery is in our opinion indicated to improve the capillary perfusion pressure, resulting in a better oxygenation of the optic nerve head. (E15)
- Circulatory changes should be considered in the treatment regimen when the cascade of events leading to loss of visual function is most amenable to being interrupted. (G34)

We can recognize such statements by their characteristic features: clinical practice (*filtering surgery*) and specialized lexis (*is indicated*) or deontic modality (*should*), as well as numerous abstractions (*reduction*, *levels*, *pressure*, *oxygenation*, *changes*, *treatment regimen*, *cascade of events*, *loss of visual function*).

Each category of conclusions closes one of the decision-making circuits in the paper. For example, the E15 conclusion above, which states that filtering surgery is a good way to improve the circulation, relates back to the introduction where authors complained about the dearth of methods to improve blood circulation at the optic disc (*the disease of the small vessels supplying the optic disc is till now hardly accessible for direct therapy*).

The framing topoi have one more common function, which manifests itself in their numerous cohesive ties with the titles of their papers. Such claims tend to contain terms from the titles, their synonyms, hyponyms, or hypernyms (cf. Halliday, 1994, Ch. 9). For example, every term from the title of the E15 paper ("Results of a filtering procedure in low tension glaucoma") is invoked at least once in the RECOMMENDATIONS statement quoted above: *LTG*, *reduction*, *filtering surgery*, *pressure*, *resulting*. From inquiries into reading strategies (e.g. Bazerman, 1985; Busch-Lauer, 2000; Dillon, Richardson, & McKnight, 1989) we know that paper titles tend to be the first thing about the papers that readers take note of when they decide on their relevance. The cohesive ties that the framing topoi have with titles direct the readers' attention from the 'main points' of the papers to the study designs and findings.

[74] Cf. Liddy's (1991) "practical applications" and Salager-Meyer's (1994) "make suggestions."

Such links between contextual relevance and textual coherence shed light on the dependency of the decision-making frames on their social contexts. The introductory and concluding topoi function as frames which introduce and interpret spans of primary and secondary materials. These frames are an essential coherence mechanism (cf. Bazerman, 1985). On the one hand, they create cohesion between the 'argumentative zones' in the text (Teufel, 1999); on the other, they demonstrate the relevance of the whole argument by linking it to authors' and readers' shared social contexts.

To sum up, secondary induction depends on a system of reasoning operations that create a decision-making framework for primary induction. Appraisal and interpretation of primary results often take the form of commentary on the circumstances and designs of the studies, as well as on the presentation of the data, which helps the readers to avoid erroneous interpretations of the results. Literature reviews allow authors to link their study designs to the current state of the art, as well as to interpret their primary and secondary evidence in terms of current theory and practice. Transformation and transition of ideas and evidence provides them with the means to make their results meaningful for their readers, synthesize them with the field's theory, and integrate them into the field's discourse.

Interpersonal topoi

Along with secondary induction, interpersonal argumentation (also referred to as entechnic proofs or persuasion) can be seen as a way of translating the writers' categories into those of the readers. This type of translation tends to be more subtle and abstract than the translation of secondary induction. It is convenient to divide interpersonal argumentation into affective and logical proofs (Spinoza, *Ethics*). Affective appeals allow the authors to set up their credibility, project their characters, establish relations with the readers, signal their memberships in various discourse communities, and express their concern with the patients' and other stakeholders' interests. With logical appeals the authors make their texts reader-friendly while at the same time directing the readers' perceptions of the content of their papers. This broad range of meanings and actions, which Aristotle calls artistic proofs, saturate and colour the whole text. For example, in the previous section I discussed the framing devices that tend to convey strong affective appeals. In interpersonal topoi, however, persuasion is more prominent than other functions.

Affective topoi link the authors' arguments to the social contexts:

NEGATIVE MOTIVATION

POSITIVE MOTIVATION

PREVALENCE /INCIDENCE

Logical topoi provide clarifications and address the readers' likely questions. In this way they make the authors' logic easy to follow and comprehend:

ASSUMED FACTS

RELEVANT DETAILS
ASSUMED CONCEPTS / CLASSIFICATIONS
RESEARCH TYPE
RESEARCH ETHICS
DATA PRESENTATION
RELEVANT LITERATURE / COMPANION PUBLICATIONS
MANUFACTURERS

Such topoi are distinct from inartistic proofs in that they have comparatively weak links with the problem-solving and decision-making operations. Rather, they seem to be brought in for the sake of communicating the results to the readers and engaging the community in their interpretation, dissemination, and integration into the theory of the field.

Affective argumentation

Rhetorical theory teaches us about the distinctive semantic features and textual functions of the three types of appeals. In my corpus, however, I found that, while the ethos and pathos were distinct from the logos, the two former types of appeals were not easy to tell apart. That is why I adopted the Spinozist model dividing artistic proofs into affective and logical.

I found most introductions and first paragraphs of discussions to contain statements with strong affective appeals. Some of these statements stress the significance of the studies in terms of research and clinical practice; others point to the social dimensions of the disease. In NEGATIVE and POSITIVE MOTIVATION[75] a common feature is the prevalence of the present indefinite tense, which marks them as generalizations drawn from a shared pool of facts:

NEGATIVE MOTIVATION:

- However, the disease of the small vessels supplying the optic disc is till now hardly accessible for direct therapy. (E15)
- The treatment of progressive NTG represents a therapeutic challenge. (G35)
- Potential side effects and high frequency of application (four times daily) has reduced the popularity of pilocarpine especially in the presence of newer generation glaucoma medications. (G16)

POSITIVE MOTIVATION:

- It seems therefore to be important to compare visual field behaviour of the operated eye and the non-operated eye in the same patient. (E15)
- These techniques are of fundamental importance in the study of pulse amplitude (PA) and the POBF. (E3)

[75] Cf. Aristotle's "the expediency or the harmfulness" (*Rhetoric*, I.3.1358b), Trawiński's (1989) "possible usage areas in practice" and "possible usage areas in science," Salager-Meyer's (1994) "motivate the study," and Swales's (2004) "stating the value of the present research."

- Therefore, POAG patients with uniocular field loss represent an ideal population in which to investigate factors influencing the onset of field loss over a period of time. (G36)
- Our analysis may be more easily extrapolated to clinical practice in that the risk of future visual field progression can be estimated from "current" IOP, taken as the median of readings done in the past 6 months. (G31)

A distinctive semantic characteristic of these affective topoi is the meaning of evaluation. Thus, NEGATIVE MOTIVATION is signalled with expressions with negative connotations (e.g. *hardly*, *difficult*, *side effects*) or potency expressions combined with negative diction (e.g. *may*, *can*). POSITIVE MOTIVATION, on the other hand, is signalled with emphasis or positive evaluative lexis (e.g. *important*, *ideal*), or with affirmative potency expressions (e.g. *may*, *can*). These differences point to the distinct rhetorical effects of the topoi. NEGATIVE MOTIVATION indicates problems; POSITIVE MOTIVATION shows the utility of solutions. This problem-solution trajectory explains why in my corpus negative affect is more frequent in the first half of the papers, and positive in the second. Such affective statements are marked up as **clinical practice** information with clinical practice lexis (e.g. *disease*, *therapy*, *treatment*, *clinical practice*). In addition, POSITIVE MOTIVATION statements can have research or reasoning lexis (e.g. *study*, *determining*).

In addition to their suasive function, the MOTIVATION topoi can also act as framing devices since they tend to have strong cohesive ties with the titles of the papers. In this sense they are not unlike the introductory topoi discussed above. Yet while their secondary induction counterparts formulate a specific theme or question for the study and thus segue from the major point into the particulars of the study, the MOTIVATION topoi segue outwards, to the field's general problems that the study responds to.

PREVALENCE/INCIDENCE statements are used for appeals to a broader social context than MOTIVATION statements:

- In Japan Shiose found a prevalence of NTG of about 2% of residents aged 40 years or older, accounting for about 57% of all types of glaucoma… (E3)
- Normal tension glaucoma (NTG) has a prevalence of 0.6% within white populations and is thought to account for 20–30% of primary open angle glaucoma… (G33)
- In the general population, approximately two thirds of individuals exhibit a 5% to 10% physiological nocturnal BP reduction. (G5)

Such statements convey **instances and precedents** content and are the only introductory topos with numeric information. Their other prominent feature is distribution diction, such as *prevalence* and *populations*. This combination of linguistic features gives PREVALENCE/INCIDENCE statements a semblance of substantive information. However, in all but two instances in my corpus (E3, G12), their function is to quantify the general relevance of the problem rather than provide any information related to the inductive argumentation. Such statements typically occur at the top of introductions,

which points to their abstract nature.[76] Yet neither their co-text nor the facts they cite provide any insight into the significance of PREVALENCE/INCIDENCE statements, so it is perhaps the quantification itself that accounts for their appeal. Unlike other framing topoi, these statements show few cohesive links with the titles, unless the titles mention NTG, its signs, or risk factors. Thus their major function seems to be linking the most general formulation of the study topics to their most general contexts.

Logical argumentation

The logical topoi allow the writers to walk the readers through the argument, as it were. Most of them provide commonplace information on theory, terminology, clinical procedures, and research techniques. The ASSUMED FACTS statements convey miscellaneous observational information:

- Complications of filtering surgery in LTG are not different from those reported for filtering surgery in POAG. (E15)
- The more severe the defect the earlier visual field loss develops in the "second eye". (G36)
- Systemic hypertension and diabetes are major causes of vascular dysfunction… (G12)

The RELEVANT DETAILS[77] topos provides all kinds of methodological information and, occasionally, information on **signs and indicators**:

- The change in POBF should exceed the variability resulting from measurement and physiological variation to be attributable to drug effects. (G24)
- Peak systolic velocity (PSV) and end diastolic velocity (EDV) can be determined directly and pulsatility index (PI) and resistive index (RI) are calculated automatically by the CDI software. (G10)
- As indicated in the formula, IOP and BP parameters affect theoretical MOPP value at each point of measurement. (G5)

The ASSUMED CONCEPTS/ CLASSIFICATIONS[78] topos is used to introduce **concepts and classifications**:

- Normal-Tension Glaucoma (NTG) refers to a clinical entity of glaucomatous optic disc change and visual field defect without elevated intraocular pressure (lOP)...[79] (E10)
- Normal tension glaucoma (NTG) is a subset of primary open angle glaucoma (POAG), with characteristic glaucomatous cupping and field loss, an open drainage angle, and an intraocular pressure (IOP) consistently within the normal range... (G36)
- The remaining individuals are classified as either nondippers or overdippers… (G5)

[76] Recall that the specific information about the study, such as THEME/PURPOSE statements, on the contrary, tend to occur at the and of introductions.
[77] Cf. Trawiński's (1989) "characteristics" content elements.
[78] Cf. Aristotle's "definition" (Huseman, 1994).
[79] The ellipses in the examples represent omitted parenthetical citations.

These three statement categories can be recognized by the present-tense verbs in their major clauses, which marks them up as reminders of what the readers likely know.

All common knowledge topoi are used as clarifications or interpretations addressing the readers' likely questions wherever these questions may be raised. They are not indispensable for the argument, but they make the authors' logic easy to follow and comprehend. Their distributions between the IMRD sections reflect the nature of the content that they communicate. ASSUMED CONCEPTS/ CLASSIFICATIONS statements mostly occur in introductions, ASSUMED FACTS are frequent in introductions and discussions, and RELEVANT DETAILS are typically provided in the methods sections. But these distributions are a propensity rather than a rule.

Two logical topoi provide clarifications related to the study designs:

RESEARCH TYPE:

- This was a retrospective clinical study. (G21)
- The study was designed as an interventional, randomized, prospective, institutional, single-blinded, controlled, clinical trial. (G10)

RESEARCH ETHICS:

- In every case, informed consent was obtained as to the type of therapeutic approach adopted. (E3)
- Institutional review board approval was obtained, and verbal and written consent was obtained from all subjects. (G24)
- The study was approved by the Norwich District ethics committee and all patients underwent informed consent. (G16)

The local nature of such **knowledge and research** information is communicated with the past tense of the main clause verbs.

The third class of logical topoi refers readers to additional sources of information in the texts and the literature:

DATA PRESENTATION:

- The morphometric characteristics of the optic discs are summarised in Table 2. (G36)
- Figure 2 shows the mean diurnal curves for both randomised groups at baseline and at follow up. (G16)
- All data are given as mean ± standard error of means (SEM). (G10)

RELEVANT LITERATURE/COMPANION PUBLICATIONS:

- The mode of progression of LTG patients has recently been described... (E15)
- The effect of such a lowering in IOP is to be addressed in a companion paper… (G35)
- The method has been presented in detail elsewhere… (G34)

MANUFACTURERS[80]:

- Latanoprost (50 μg/ml) was obtained from Pharmacia Pfizer (Karlsruhe, Germany) as Xalatan®. (G10)

[80] Cf. Trawiński's (1989) "source of objects" and "source of equipment."

- Dorzolamide was obtained in form of Trusopt® from MSD-Chibret, Munich, Germany. (G10)

Such references are rare in my corpus. They are somewhat more detailed than parenthetical citations but essentially perform the same function, acting as placeholders for the subject-matter or methodological information that the readers can obtain from the visuals or from the literature.

One interpersonal topos, METHOD/ DESIGN JUSTIFICATION,[81] communicates mixed rhetorical appeals. This category of statements explains the benefits of the chosen treatment, research methods, or equipment:

- This approach was chosen because a direct comparison of glaucomatous visual field defect and corresponding retinal microcirculation is possible. (G34)
- The decision to exclude all second eyes was made because some of the planned analyses were to be conducted on the group as a whole, rather than a comparison between adjunct groups, and inclusion of second eyes might overrepresent risk factors that may be common to both eyes. (G31)
- Analysis using microdensitometry and scanning laser polarimetry has the advantage of evaluating the severity of NFL defects in three dimensional mode by computer system. (G21)
- This was to ensure that the IOP measurements between the two observers were comparable. (G16)

These statements are a type of authorial commentary with high frequencies of abstractions related to reasoning, research, or clinical practice (e.g. *approach*, *comparison*). On the one hand, they offer substantive information of the **knowledge and research** type. On the other hand, the commentary is always positive. The meaning of positive assessment is seldom expressed with explicit lexis, such as *advantage*. Typically, it takes the form of potency expressions (*possible*, *comparable*) or diction that has positive or negative connotations in biomedical research and beyond (*direct comparison*, *overrepresent*, *ensure*).

Linguistic analysis has revealed eight predominantly persuasive topoi in my NTG corpus, which confirms numerous earlier findings about the prominent role of persuasion in research communication. Such statements have no obvious links with the primary or secondary induction but work as vehicles of knowledge translation and integration. The affective topoi link the authors' arguments to their social contexts, and the logical topoi make the papers reader-friendly. Both types of statements have implications for the authors' projected characters and credibility, as well as their relations with the readers (cf. Hyland, 2005). Their other important function is the foregrounding of the significance of the issues addressed in the papers. The writers use persuasive appeals to sustain the readers' attention to the arguments and motivate them to accept the findings as extensions or adjustments of the field's theory.

[81] Cf. Aristotle's "incentives and deterrents" (Huseman, 1994), Trawiński's (1989) "justification" content elements, and Thompson's (1993) "justifications for methodological selections."

It would be an exaggeration to say that persuasive topoi are indispensable for the authors' reasoning in my corpus. As we have seen, much clinical research takes place outside the writing of the papers, and significant portions of the papers report on this research. Yet it would also be naive to reduce all research to pursuit of pure facts and the writing to mere reporting. The research objectives and designs are imbued with the investigators' social contexts and circumstances, and these contexts and circumstances allow them to interpret their results for their colleagues working on similar or related problems. Moreover, the persuasive topoi allow the investigators to issue even broader appeals and make their arguments comprehensible to an even wider readership. Thus they have educational effects since they raise the profile of the domain within the discipline and communicate background information that audiences outside the narrow discourse communities may find helpful.

Indeterminate and composite statement types

Two major challenges for my analysis were sentences with loose cohesive links (connectives, as well as anaphoric pronouns, adverbs, and adjectives) and atypical or mixed sentences types. Quite predictably, cohesive links extending across sentence boundaries turned out to be frequent in some types of commentary, such as METHOD/ DESIGN JUSTIFICATION and RESULTS CONSISTENCY, and in causal interpretations, such as LOCAL FACTORS and EXTRAPOLATIONS. When extracted from the text, sentences with such links seem incomplete and can even be incomprehensible:

- The latter probably because the treatment with pilocarpine was ceased after surgery. (E15)
- This system has been shown to provide reproducible measurements of the optic nerve head… (G36)
- Patients were then randomly allocated to two groups. (G24)
- However, no statistically significant change in IOP range was found. (G16)

Unless the loose link was a recurrent feature of a topos, I considered linked series of sentences as composite statements similar to compound sentences.

Atypical sentence types mostly occur in cohesive passages that elaborate basic topoi. Consider this sequence:

- A possible limitation of our study is, that the follow-up period is variable. Progression may still occur in some patients with a relatively short follow-up. However, this limitation is to a certain extent compensated for by the comparison of the operated and non-operated contralateral eye of the same patient. (E15)

The first sentence here is of the QUALIFICATIONS type, and the last fits the RESULTS RELIABILITY pattern. The middle sentence makes a prediction about the data that the researchers might obtain later in the study, which may be labelled as a local extrapolation. In my corpus this function never occurs in independent statements, so it makes little sense identifying it as a separate topos. Interestingly enough, I found such indeterminate types to be exceptionally rare. Most statements have clear signs of membership in one or more recurrent semantic categories.

If loose cohesive links and atypical topoi were a logistical difficulty, mixed statement types presented me with a methodological challenge. Since the topoi are expressed with configurations of linguistic non-contiguous features, they can be identified at all levels of syntactic organization in the text, from phrases to paragraphs. Hence, I had to decide which configurations of features to count among the basic types, and which among composite types. My method consisted in treating as a basic topos any recurrent semantic statement type with an identifiable linguistic configuration. Combinations of the basic topoi were classified as composite categories. For example, in the previous chapter I touched on the composite topos STUDY DESIGN.[82] Its major semantic elements are the objectives and methods of the investigation and the cohort type. All of these meanings are present in my corpus as basic topoi dealing with the specific aspects of study designs (COHORT SCREENING, INTERVENTIONS, THEME/PURPOSE, etc.), each with its own typical configuration of linguistic features. So any element of the topos can be elaborated into an independent statement. That is why I classified the statements dealing with isolated aspects of study design as basic topoi, and statements dealing with more than one of these aspects, as the composite STUDY DESIGN topos.

Other recurrent composite sentence types in my corpus are GENERAL RELEVANCE, STATE OF THE ART, PRESENT SERIES, RESEARCH PROCEDURES, COMPOSITE DATA, COMPOSITE FINDINGS, COMPOSITE COMMENTARY, and DISPARITY/ SIMILARITY ANALYSIS.

GENERAL RELEVANCE statements are typically used to introduce the paper or its discussion section. They combine the topoi establishing the relevance of the research and motivating the readers to attend to the argument:

GENERAL RELEVANCE:

- The most interesting question is whether the optic nerve damage in NTG is directly produced due to the IOP-related mechanical damage. (E10)
- From existing data both a nonassociation or association of altered retinal circulation seems possible and the results could underline the significance of such measurement. (G34)
- Patients with compressive optic neuropathy show loss of central acuity associated with relative central and caecocentral scotomas. (G12)

The first statement in this series has the features of three topoi: OPEN ISSUES, POSITIVE MOTIVATION, and KNOWN CAUSALITY. The second combines the KNOWN RELATIONS, EXTRAPOLATIONS, and POSITIVE MOTIVATION topoi. The third talks about KNOWN RELATIONS and provides NEGATIVE MOTIVATION.

STATE OF THE ART statements are composed from the topoi introducing the readers to the field's theory and current research and clinical practices:

[82] Cf. Trawiński's (1989) "idea of testing method," Liddy's (1991) "research questions" and "research topic," and Swales's (2004) "announcing present research descriptively and/or purposively."

- Tomlinson and Phillips… and Armaly… supposed that a large optic disc is a risk factor for glaucomatous optic disc damage, being more easily affected by a rise in intraocular pressure (IOP). (E1)
- Pointwise linear regression analysis has been previously described in NTG… and shows favourable results compared to STATPAC-2… (G31)
- Derivatives of prostaglandins have become more and more popular for the treatment of glaucoma patients since they are very effective in lowering IOP and have to be applied only once a day… (G10)

These examples have various combinations of KNOWN RELATIONS, KNOWN CAUSALITY, RELEVANT LITERATURE/ COMPANION PUBLICATIONS, METHOD/DESIGN JUSTUFUCATION, and RELEVANT DETAILS topoi.

PRESENT SERIES is a category of self-reference statements whose propositional content is similar to that of STATE OF THE ART statements:

- In our own 10 year follow-up study we also reported some deterioration after filtering surgery… However, this deterioration occurred in the first postoperative years and was not clinically significant. (E15)
- We have already shown that the use of MMC is associated with a higher rate of both visual acuity loss and hypotonous complications in a larger group of similar patients… (G31)
- Recently, we… observed an increase of antibodies against APSA in NTG patients compared with POAG patients and healthy controls. (G14)

Like internal self-references (e.g. *in this study*), references to the authors' earlier research are marked up with specialized metalanguage (e.g. *series, paper, study*) and autoreferential deixis (e.g. *our, we*).

The topos RESEARCH PROCEDURES is used to provide mixed information on the techniques of intervention and data processing, analysis, and presentation:

- The values for the heart rate, systolic-diastolic brachial pressure, IOP, PA and POBF (mean value for the two eyes of the same patient) were compared with the age and sex-matched control group, using two-tailed Student's t-test and Bonferroni correction. (E3)
- The width of the measuring profile was 5 pixels and to generate subpixel accuracy the average of five repeated measurements is given. (G34)
- On a selected number of randomly chosen patients, IOP measurements were performed by both observers using the same handheld electronic tonometer. (G16)

The basic topoi represented in this series of statements are INFORMATION, DATA PROCESSING/ANALYSIS TOOLS, INTERVENTIONS, RELEVANT DETAILS, COHORT SCREENING, INSTRUMENTS, and DATA HANDLING.

COMPOSITE DATA statements convey quantitative information on the cohort, clinical interventions, study design and contingencies, research methods, and intervention effects:

- In 16 patients one eye was operated on and the contralateral eye served as control. Of these 16 patients that underwent surgery of one eye only, the eye that showed most progressive field loss was operated on. (E15)
- According the above criteria, the 30 eyes of 30 patients with NTG were selected and they were classified into two groups, 14 eyes with the maximum IOP ≥ 19 mmHg and 16 eyes with the maximum IOP < 19 mmHg. (E10)
- The ten patients that we studied represented 18 eyes; one patient was monocular and another was anisometropic with a 10D myopia. In these ten patients (five men and five women with a mean age of 66.9 ± 10.5 yrs), it was possible to obtain a complete clinical record before and after therapy was started. (E3)

This set of examples presents us with various combinations of the INTERVENTIONS, INTERVENTION DATA, OBSERVATION DATA, OBSERVATION DATA RANGE/AVERAGE, and QUALIFICATIONS topoi.

COMPOSITE FINDINGS are typically used in discussion sections to sum up or synthesize the most significant findings:

- Although it is difficult to know what was the cause of this visual loss, it does represent functionally significant morbidity. (G35)
- The treatment duration was for at least 6 months and averaged 11 months, indicating that the ocular hypotensive effect of latanoprost is sustained in NTG. (G16)
- The initial IOP reductions by latanoprost were maintained throughout the 12-month treatment period, and latanoprost was found to be more effective at higher baseline IOP levels. (G6)

Here the basic topoi are OPEN ISSUES, RESULTS RELIABILITY, INTERVENTIONS RANGE/AVERAGE, EXTRAPOLATIONS, and DISCOVERED RELATIONS.

COMPOSITE COMMENTARY combines various types of clarifications and qualifications related to the study designs, circumstances, and findings:

- Of all patients consecutive series of visual fields were available, which made a trend-analysis possible, thus avoiding problems of long term fluctuation that may occur if only a limited number of fields can be judged. (E15)
- Although we found no difference in the number of patients undergoing cataract extraction the time periods for the three groups are different and the numbers are too small to make survival analysis possible. (G31)
- The increase in POBF noted after brimonidine is within the range of long term variation and may not be attributable to the drug effect. (G24)

QUALIFICATIONS, METHOD/DESIGN JUSTIFICATION, and RELEVANT DETAILS are the basic topoi in these examples.

Finally, the DISPARITY/SIMILARITY ANALYSIS[83] topos allows the writers to turn the consistency or lack of such between their own and their sources' methods and findings into an object of scrutiny:

- The differences might be explained by the range of visual field data of the included patients; in other words, by including patients with severe field loss one would expect more pronounced narrowing of the vessel diameters. Those patients might be more affected by a downregulation as mentioned above. Thus, in this study with only moderate visual field loss, no significant alterations of vessel diameters were detected compared with the less affected hemifield. (G34)
- Our results are very similar to theirs despite the fact that our patients had a lower baseline IOP. (G24)
- Other investigators had achieved similar IOP reductions of 18–21.4% after shorter follow up periods… In the present study, 41% (21 of 51) of those treated achieved a minimum reduction of 20% in the AIOP but only 10% (five of 51) achieved a minimum reduction of 30%. Taking a 20% IOP reduction as a reasonable response, about four of 10 treated patients would achieve this target on treatment with latanoprost alone. (G16)

Based on its linguistic characteristics, this category can be classified as a kind of commentary, alongside the COMPOSITE COMMENTARY topos. However, it is distinct from other commentary categories in that it refers not only to the authors' own methods and findings but also to the methods and findings of their sources. Such juxtaposition helps the authors to explain why and how their findings are different (G34, G24) or resolve misalignments between their primary and secondary evidence (G16). These tactics typically call for a variety of observational and methodological content.

Analysis of indeterminate and composite topoi is instructive in terms of the analytic utility of linguistic configurations. For all the complexity of argumentative organization in the articles, it can be reduced to a limited number of meanings marked up with recurrent configurations of linguistic features. Of course, like any classification, such reduction inescapably does violence to the richness of the communication. That is why in rhetorical analysis and education it is likely to have a limited value. But in natural language processing it can be useful since it can potentially be converted into a code of topical meanings for knowledge extraction and discourse harvesting systems.

Summary

Activity theory presents us with a model of genres and research fields as systems of organized activities. The same approach can be applied to texts. Even with the limited view that rhetorical and

[83] Cf. Aristotle's "conflicting facts" (Huseman, 1994) and Thompson's (1993) "statements conceding quantitative discrepancies or admitting difficulty in interpreting results."

linguistic analysis offers of the papers from my NTG corpus, it is clear that complex argumentative organization provides researchers with meaningful ways for relating their observations and experiences to the theory of the field.

I identified forty-eight basic and nine composite topoi in the corpus:

BASIC TOPOI:

- Problem solving argumentation (primary induction):
  - Study design:
    - COHORT SCREENING
    - INTERVENTIONS
    - INFORMATION
    - DATA HANDLING
    - INSTRUMENTS
    - DATA PROCESSING / ANALYSIS TOOLS
    - STIPULATED CONCEPTS / CLASSIFICATIONS
  - Results:
    - INTERVENTION DATA
    - PARTICIPATION DATA
    - OBSERVATION DATA
    - DEMOGRAPHICS
    - SUMMATED OBSERVATIONS
    - COMPARISON
    - STATISTICAL SIGNIFICANCE
    - FOUND ASSOCIATIONS / CORRELATIONS
    - FOUND CAUSES/ EFFECTS
- Decision making argumentation (secondary induction):
  - State of the art:
    - OPEN ISSUES
    - DISPARITY / UNCERTAINTY
    - AVAILABLE TREATMENT / RESEARCH
    - NEW APPROACHES
    - KNOWN CAUSES/ EFFECTS
    - KNOWN ASSOCIATIONS / CORRELATIONS
    - AVAILABLE CONCEPTS / CLASSIFICATIONS
    - PREVIOUS FINDINGS
  - Present study:
    - THEME/ PURPOSE
    - HYPOTHESIS
    - LOCAL FACTORS
    - QUALIFICATIONS
    - RESULTS CONSISTENCY
    - METHODOLOGICAL CONSISTENCY
    - RESULTS RELIABILITY
  - Conclusions:
    - EXTRAPOLATIONS
    - RECOMMENDATIONS
    - NEW / REMAINING ISSUES

FUTURE RESEARCH
KEY FINDINGS

Interpersonal argumentation:

Affective appeals:

NEGATIVE MOTIVATION
POSITIVE MOTIVATION
PREVALENCE /INCIDENCE

Logical appeals:

ASSUMED FACTS
RELEVANT DETAILS
ASSUMED CONCEPTS / CLASSIFICATIONS
RESEARCH TYPE
RESEARCH ETHICS
DATA PRESENTATION
RELEVANT LITERATURE / COMPANION PUBLICATIONS
MANUFACTURERS

Commentary:

METHOD / DESIGN JUSTIFICATION

COMPOSITE TOPOI:

GENERAL RELEVANCE
STATE OF THE ART
PRESENT SERIES
STUDY DESIGN
RESEARCH PROCEDURES
COMPOSITE DATA
COMPOSITE FINDINGS
COMPOSITE COMMENTARY
DISPARITY/ SIMILARITY ANALYSIS

Figure 6.5. Basic and composite topoi from the NTG corpus.

The topoi, variously distributed across the texts, are associated with three modes of reasoning in the texts: (1) problem-solving, (2) decision-making, and (3) interpersonal relations between the authors and readers. Problem solving is focused on resolving the issues formulated for the study. In decision-making, the formulation of problems for primary induction, selection of methods and procedures, and interpretation of results take centre stage. Finally, interpersonal argumentation includes affect and logos, the former appealing to the readers' sensibilities, and the latter making the arguments reader-friendly and educational.

The authors' argumentative activities consist in communicating meanings through a system of relations between various types of content in the texts. By means of primary induction they establish relations between stipulations and conventional research methods, on the one hand, and observations, on the other. Through secondary induction they relate exigencies to decisions, and local

findings to the field's theory. Interpersonal argumentation allows them to relate their problem-solving and decision-making operations to the contexts of social action.

The induction topoi can be described as inartistic, or atechnic, proofs since the generation of their materials, the clinical data and secondary evidence, predates the writing process. The interpersonal, or artistic, topoi, are distinct from inartistic proofs in their relative autonomy from the inductive process. In a sense interpersonal argumentation is an antipode of primary induction. Whereas primary induction accounts for the standardized discovery process of regularities in the phenomenal world, the artistic topoi provide the motivation and means for the readers' engagement with the argument. Secondary induction, on the other hand, creates a middle ground, a space where diverse motivations are negotiated and findings appraised and synthesized.

The topoi shed light on the versatile epistemic toolbox of the field. The most prominent research procedures and reasoning operations of problem-solving were found to be division, selection, deduction, statistical analysis, juxtaposition, and comparison. Decision-making turned out to involve all the operations of problem-solving, which are, however, applied not only to observational but also to methodological information. Despite formal similarities, problem-solving and decision-making do not run as parallel lines of argumentation. Rather, they form a system of intertwined reasoning circuits. Decision-making depends on the results of problem solving as well as on knowledge contextualization, translation, and transformation. Finally, interpersonal argumentation involves some of the same operations as we find in primary and secondary induction, such as selection, contextualization, and translation.

The complex organization and multiple links between the topoi make their classification quite challenging. Yet the analysis of argumentation in terms of the reasoning modes that are realized with the topoi allows us to get a glimpse of the inventory of clinical research tools that researchers use for the construction of knowledge and practice. As Bazerman (1985) explains, the reception and perception of texts depend on interactions between the schemata and types of coherence that communities develop for modelling the phenomenal world. In Bazerman's terms, we can say that primary induction narratives and logical topoi make for the internal coherence of the papers, while secondary induction and affective topoi create discoursal coherence, "coherence with contextual knowledge" (p. 13). Of course internal coherence cannot be easily separated from external:

> If the new message cannot be meaningfully associated with what the reader knows, the reader finds it difficult to obtain the meaning from it… In reading, as in the rest of their work, [readers] are guided by the purpose of building up a picture of the actual world. If a statement does not fit in with the endeavor, it does not convey a significant meaning. (p. 13)

Thus it makes good sense to view the three modes of argumentation as a product of interaction between context and coherence types (Table 6.1). This classification harkens back to Aristotle's notion that discovery and persuasion are based on essentially the same patterns, such as his famous contention in the *Rhetoric* that examples are rhetorical counterparts of induction (I.2.1356b).

	Discovery context	Social context
Textual coherence	Primary induction	Interpersonal argumentation
Discoursal coherence	Secondary induction	

Table 6.1. Argumentation modes in relation to context and coherence types.

The classification also reminds us of the now-popular distinction between the contexts of discovery and of justification (e.g. Scriven, 1987, p. 24). For the readers, the text is the first phase of engagement with the study results, and for the authors it is its final stage. The argumentative activity system of the text allows it to work as a boundary object which mediates the two types of contexts.

Implications

How can analysis of the argumentative organization of clinical research publications benefit practitioners? They can be of use in education and policy research as a source of data for the appraisal of received argumentative practices. One obvious method for such appraisal is by comparing the argumentative superstructure of the domain to decision-making stasis discussed in the fifth chapter.

Prevalence of positivist reasoning

The studies in my corpus fit the profile of situated research. Their superstructure combines the elements of applied, empirical, and theoretical research. On the one hand, in their investigations the authors rely on the communal knowledge, the theory of the field; on the other hand, their clinical work contributes to such knowledge. Furthermore, they have to make numerous decisions related to the treatment of their patients and to their research. One may wonder if the clinical researchers treat all facets of their activities as equally significant. To see whether their decision-making procedures are fully accounted for in the papers, we will first match the identified topoi with the issues of the decision-making stasis (Table 6.2).

The distribution of the topoi between the stases provides us with a bird's-eye view of the issues that the community considers to be significant. It seems that facts and procedures draw the most attention. At the same time the issues of practical solutions (necessary actions, their expedience, and the availability of resources for them) and, especially, the anticipated outcomes of the solutions seem to draw little attention.

Content types	Issues	Epistemic topoi
Phenomena	Fact	Intervention data, Participation data, Observation data, Demographics, Summated observations, Comparison, Statistical significance, Found associations / correlations, Known associations / correlations, Previous findings, Assumed facts, Composite data
	Cause/ effect	Found causes/ effects, Known causes/ effects, Extrapolations, Local factors
	Value	Open issues, Disparity / uncertainty, Negative motivation, Positive motivation, Prevalence /incidence, General relevance, State of the art
Solutions	Action	Recommendations, Future research
	Expediency	Qualifications, New / remaining issues, Method / design justification
	Possibility	Available treatment / research, New approaches
Methods	Procedure	Cohort screening, Interventions, Information, Data handling, Instruments, Data processing / analysis tools, Theme/ purpose, Hypothesis, Relevant details, Research type, Data presentation, Relevant literature / companion publications, Manufacturers, Present series, Study design, Research procedures
	Definition	Stipulated concepts / classifications, Available concepts / classifications, Assumed concepts / classifications
Situational concerns	Appraisal	Results consistency, Methodological consistency, Results reliability, Key findings, Research ethics, Composite findings, Composite commentary, Disparity/ similarity analysis
	Outcome	

Table 6.2. The issues addressed in the NTG corpus.

What do these tendencies mean? The good news is that the community has more sophisticated meta-knowledge than most explanation and persuasion models would grant. The bad news is that not all authors take advantage of the full potential of the domain's argumentative toolbox. To my surprise, I found that many papers in the corpus hardly go beyond generalizations derived through unquestioning application of standardized tools and research procedures. One may wonder why this fact should raise any analytic brows. A cursory look at the OPEN ISSUES addressed in the papers through the years paints a picture of bustling activity in a domain with diverse pursuits:

- Because the IOPs are in the statistically normal range it has been questioned whether the IOP is the main cause of the glaucomatous damage in LTG. (E15)

- Not much is known from literature about the effect of filtering surgery on the visual field in low tension glaucoma... (E15)
- If IOP is assumed to influence such discs, the question arises of what rise in IOP will cause progression of glaucomatous damage. (E1)
- However, the correlation of the AVP to the degree of glaucomatous field damage has not yet been examined. (G34)
- What has not been established is whether the proximity to fixation of visual field loss relates to the likelihood of disease progression and the likelihood of deterioration in central visual function in NPG. (G33)
- The influence on POBF of brimonidine is still unknown. (G24)
- Thus, the role of compression of the optic nerve by the ICA in patients with NTG is still not certain. (G12)
- Only few studies have addressed the influence of prostaglandin analogues on ocular perfusion so far. (G10)
- However, few reports are available upon the long-term IOP-lowering efficacy of latanoprost in NTG. (G6)

The problem, however, is that the outcomes of this activity are very modest. What counts as meaningful findings in my corpus would strike an outsider as minor achievements: more statistically significant, reliable, and reproducible results compared to the results of earlier investigations or a correlation or association that has not been previously established. Even a failure to corroborate earlier results counts as a meaningful conclusion.

Such argumentative practices might suggest that the domain is in a state of "normal science" with a stable paradigm that meets the community's needs. However, the literature reviews tell a different story. Levene's paper found that before 1980 the disease was poorly understood and the community had few treatment options for it. Three decades later, new reviews cite new observations but state that little progress has been made in terms of understanding NTG (Orgül, Zawinka, Gugleta, & Flammer, 2005; Shields, 2008; Sowka 2005). The community is amassing information on risk factors, which in reviews takes the form of long lists of possible associations and correlations, but this information does not translate into progress in the treatment of the disease. Shields (2008) reveals a sense of apathy about the state of the art:

> [T]here is a rapidly growing list of factors that are involved in the complex cascade of events that lead to apoptosis in the glaucomatous optic neuropathy pathway. To date, none of the research in these areas has led to proven treatments, and the current literature is tellingly silent on the subject. (p. 87)

In fact the "growing list of factors" seems like a major stumbling block in NTG research. A look at the THEME/ PURPOSE topos reveals that the community is much more interested in risk factors than in remedies. Out of the fifteen study-objective statements just five express the authors' interest in treatment; two-thirds of the studies set out to look into some kind of relationship between the known signs or risk factors of the disease or to develop a classification. This ratio shows that the research

has strong theoretical and empirical components but a weak applied component. All popular treatment methods of NTG are aimed at controlling the risk factors. The reports on their effectiveness are mixed and side effects are often significant enough to outweigh their benefits (Orgül, Zawinka, Gugleta, & Flammer, 2005).

In spite of the community's attention to risk factors, the idea receives a remarkably narrow interpretation in the corpus. It is well understood that NTG is a systemic disease, with vascular factors and immunity playing a major role in it, but links between general and ocular health come up exclusively at the stage of the screening of the study participants. The only two types of interventions discussed throughout the corpus are surgery and pharmaceuticals. The context of the research, as it is understood in the corpus, seldom outstrips medical discourse. The papers are based exclusively on ophthalmic literature and the patients' medical histories. Life-style factors, such as nutrition, exercise, education, or natural environment – let alone participants' input – never enter the picture. [84] The disease is seen as a separate matter from the participants' health.

NTG is a challenging subject because the systemic changes that lead to it are complex and may be too weak to be reflected in the patients' medical histories (Orgül, Zawinka, Gugleta, & Flammer, 2005; cf. Gierl, Bull, & Schmidt, 1998, p. 273; Segal, 2007, p. 239). Yet it seems that the slow progress also has to do with the field's received argumentation practices. Positivism, the dominant paradigm of biomedical research and evidence-based medicine, is not up to the challenge, but it is hard to resist. Its important appeal is simplicity and "problem-solving effectiveness" (Foley, 1993, p. 223). It collapses causes with 'natural laws', and sees remedies as the removal of the causes (Connelly & Johnson, 1980; Hjørland, 2005; Woodward, 2000). The researchers just have to maintain observations, make generalizations, and draw links till the 'true' causes present themselves, which will in turn lead to the ultimate good-for-all therapy. This is a caricature of course, but some papers in my corpus bear disturbing resemblance to it.

The remedies are slow in coming, but the paradigm serves up a peculiar compromise: until the mystery is solved, some treatment is better than no treatment. For example, Levene (1980) finds that intensive therapy is not very effective in slowing eyesight deterioration in NPG patients. Nonetheless, he recommends it because it is the only kind of intervention that produces some positive effect, no matter how insignificant (pp. 643-654). The problem with Levene's idea is not in its form or textual context, but in its discursive environment. The domain is caught in a vicious circle of "dead rhetoric" (Kitcher, 1995, pp. 56ff). Restricted to a narrow set of traditional treatment methods and over-dependent on problem-solving, the research seeks to make itself significant with ever finer detail of investigations into existing theory and methods.

Some epistemicists have suggested that underlying these practices is a model of healthcare that has been extrapolated from the branches of medicine that concern themselves with acute problems, such as food poisoning or appendicitis. King (1982) tells us that this model conceives of

[84] This goes not just for the annotated set of clinical studies but for the entire corpus of fifty-five papers including case studies, literature reviews, methodological inquires, as well as clinical, experimental, and laboratory investigations.

heath problems as coherent entities with singular causes, uniform natural histories, signs, and symptoms. The clarity may be illusory, but it is underwritten by a system of effective treatments (pp. 131-183). Antibiotics get administered, infected appendices removed, and the patients get well – at least for now. In urgent cases the physicians do not have the time to contemplate the consequences of treatments.[85] The god term of such medicine is the survival of the patients, and for the purposes of acute healthcare it works well. However, Wulff (1990) finds that this value becomes "clearly unsatisfactory" when it comes to dealing with chronic diseases or with cases which call for complex decisions (p. 83). The growth of medical knowledge, he says, has dramatically increased the number of chronic diseases. In such circumstances the existing god terms call for scrutiny.

The idea of 'disease management' is quite prominent in the NTG papers, yet the community prefers to ignore the fact that NTG refers to the type of health problems that Wulff calls 'modern diseases'. This may be a result of misplaced solidarity. Myers's (1990) analysis of the different argumentative practices in hard and soft disciplines sheds light on the phenomenon. Myers finds that

> The striking feature of scientific disciplines is the ability of their members to agree, much more than, say, literary critics, discourse analysts, or sociologists of science, on just what constitutes knowledge at any point, and what does not, and to build cumulatively on the accepted knowledge. Scientific discourse creates the consensus of scientific community; it turns tensions, challenges, and even bitter controversies into sources of strength and continuity. (p. x)

Indeed, in my corpus I found very few negative references to earlier research. But there is a dark side to this solidarity since it can lead to insulation. Myers shows that, apart from pooling the community's resources for a common cause, solidarity and social cohesion can be used to exclude outsiders and stakeholders from the discourse (cf. Miller, 2005). Like the dialectical disputes of the soft disciplines, biomedical disputes cast the public in the role of audience, rather than participants. My corpus bears lexical evidence of this tendency. The terms that the authors use for the study participants are *patients*, *subjects*, *cohort*, and *controls*, but never *participants*.

What does this stylistic feature have to do with the state of the theory of the field? It actually points to a joint in the armour of positivism, namely its poor fit with decision-making. What the paradigm conceals is that the conceptions of health problems always involve decisions. In dividing health from disease and choosing to focus on some causes while dismissing others, practitioners and researchers "draw the limits of relevance partly on the basis of common sense, partly on practical considerations, and partly on ignorance" (King, 1982, p. 206). In acute healthcare, the urgency of the problems limits the range of decisions. The most urgent causes must be treated first, period. And of course the magnitude of acute diseases dwarfs most side effects from the treatments. With "modern diseases," however, the medics do not have the benefit of obvious reference points:

> [W]e can properly say that relationships are so intertwined that any attempt at precise demarcation is philosophically unsound, arbitrary, and always dependent on a particular

[85] In fact Wulff (1990) finds that urgency presents physicians with an *escape* from life-and-death decisions.

> context; any attempt to give a precise answer is a false simplicity, intrinsically wrong, even though often practically useful. (p. 171)

The authors of the papers from my corpus seldom explain what constitutes the practical utility of their methodological choices. Their decisions are typically represented as facts or stipulations in the methodological narratives. Occasional references are made to the randomization procedures or institutional policies underwriting the decisions, as well as their benefits for the studies or for the discipline in general. Yet the authors seldom explain how their decisions are motivated by the clinical circumstances, and the benefits of the decisions for the patients are notable by their absence in an overwhelming majority of the papers.

Alternative argumentative strategies

Dichotomous thinking is a useful formula for explaining the insular and reductionist reasoning practices not only in epistemic discourse but also in my corpus (Jensen, 1990). The pattern is less obvious in the corpus since the suppressed perspectives and options seldom reach the surface of the publications (Farrington & Loeber, 2000). However, it would be naïve to imagine that other perspectives and options do not exist. One perspective that is routinely suppressed in the corpus is the patients' views and even interests. Many papers mention that the study was conducted in accordance with the Helsinki declaration and that informed consent "was obtained." Yet the information of the participants' feedback is reduced to agreeing or, occasionally, declining to sign the consent form and withdrawing from the study. In view of such a limited range of possible responses from the patients, it is no surprise that clinical studies are classified as a type of experimental research (King, 1982, pp. 295-296).

It is disconcerting that the authors see their task as reporting experiment results, rather than their experiences of treating patients. Yet the situation is not hopeless. Even though the mismatch between the complexity of the disease and the reductionist research methods is never raised in the corpus, the clinicians' argumentation patterns seem to be getting more complex and their epistemic lexicon more elaborate. For example, the idea of functional or clinical significance of results is more frequent in the post-1994 part of my corpus.

Two types of commentary can provide further insight into the status and dynamics of the field's meta-theory: the CONSISTENCY and DISPARITY/SIMILARITY ANALYSIS topoi. The CONSISTENCY topoi (RESULTS CONSISTENCY and METHODOLOGICAL CONSISTENCY) are used to compare the study to earlier research. Statements of this type often seem to serve the purposes of self-promotion (cf. Afros & Schryer, 2009), albeit in an indirect way. They typically assert the authors' compliance with the field's practices or point out their achievements. In more recent publications such tactics often give way to synthesis of primary and secondary evidence in the form of the composite DISPARITY/SIMILARITY ANALYSIS topos. This topos is a hybrid of the CONSISTENCY topoi, but the comparison takes backstage in such statements aimed at bringing diverse results to a common denominator. Here the authors' methods and primary results are given less 'special

treatment', and unqualified assertion gives place to explanation. My data suggests that the salience of the DISPARITY/SIMILARITY ANALYSIS topos is a recent development in the community's epistemic lexicon. In the earlier segment of my corpus it appears just once. Since the 1990s, however, it has been a regular presence in a majority of papers, and one of the 2005 publications used twice.

Certainly, complexity alone does not guarantee meaningful argumentation. To assess the quality of argumentation, epistemicists have to look for signs of socially relevant situated research practices. What matters is the researchers' ability to combine sophisticated epistemic and technical discourse with contextual awareness rather than their proficiency in any one of these research modes (Willard, 1987). An important indicator of such ability in my corpus is the status of contingencies. We know that laboratory research is organized in such a way as to sanitize the findings of all contingencies, which are usually called artefacts (e.g. Ericsson & Simon, 1984; Latour, 1993; Latour & Woolgar, 1986). Clinical research often takes a different approach to artefacts and circumstances. For practitioners, contingencies are as important as generalizations. That is why the results of clinical investigations are not always presented as candidates for communal verification and further generalization. The decisions that clinicians make are often very local in nature, based not only on available knowledge and resources but also on circumstances. Such decisions are as much grounded in theoretical knowledge as in ethical norms. For example, one of the popular treatments for NTG is surgery. It can reduce the damaging effects of intraocular pressure but can also cause serious side effects. Decisions involving surgery need to take into account not only the general knowledge about its techniques and effects but also the disease dynamics and the patients' circumstances. A few papers offer extensive commentary on how the authors negotiated these diverse motivations. Here are some typical remarks from my corpus:

> A long term analysis of the incidence of progression for patients in our clinic has shown that 16–25% will not have documented progression over 5 or more years of follow up... Clearly, surgery would not have been justified in this subset. Many of the patients with NTG are elderly and would be at risk of developing lens opacities. These opacities would enhance the visual field defects and mask any progression from their glaucoma…, as well as reducing central acuity. Glaucoma surgery would not be helpful in this group. Many patients have slowly progressing disease, and surgery may not be needed for this group. Surgery remains a good therapeutic option for the patient with disease progression at a rate likely to cause significant functional loss of vision in their lifetime. For patients similar to the cohort presented here, a trabeculectomy with adjunctive 5-FU might be expected to achieve and maintain a suitable target IOP in the majority of cases. (G35)

This passage proposes recommendations supported with secondary evidence *and* analysis of effects. The recommendations cover two scenarios, of which only one applies to the category of patients who participated in the study. The authors make a point of not only explaining the specificity of their circumstances and the reasons for their decisions but also of suggesting how other types of circumstances would invite different treatment options and decisions. The verb tenses in this passage

reveal an important characteristic of decisions in clinical research. On the one hand, decisions convey recommendations for the future: surgery *would not be helpful* for elderly patients with *slowly progressing disease*. On the other hand, the clinicians also make numerous decisions in the course of the study. Thus the phrase *would not have been justified* from the second sentence is an assessment of a past decision that the authors made in the course of the study. Here is a similar statement from another paper:

> In the present study, patients with fixation threatening disease were not randomised as it was considered unethical to withhold treatment from them. (G16)

Such statements reveal one of the most significant distinctions of clinical studies from experiments. Unlike laboratory investigators, clinical researchers cannot insulate their studies from contingencies. Nor can they restrict their work to observations. They need to know about the interactions of the general patterns with individual and local conditions, and they need to adapt the domain's reified knowledge to the contingencies of their practice.

Overall, there are fewer expressions of concern for the patients' wellbeing in my corpus than I had hoped to find. Yet it is encouraging to find that they are more frequent in the post-1994 segment. I think that their very presence in the discourse matters since it creates precedents and challenges the community to develop new linguistic and rhetorical forms to accommodate the increasingly inclusive argumentation.

The failure to accommodate the patients' perspectives may have multiple negative consequences for biomedical research that are not unlike the consequences of epistemic purism that I discussed in the third chapter. We often witness backlash against the insulation of biomedicine from its social and natural environments and against the model of healthcare based on abstract science:

> [M]any react against modern biomedicine: that its procedures and strategies (though contributing to a dramatic increase in average life-expectancy which is in itself a debatable claim) demand a high price for its apparent success… (Jensen, 1990, p. 181)

Jensen reminds us that, like any science, biomedicine produces not only knowledge but also ideology. That is why it cannot afford to gloss over its ethical and methodological foundations. Wulff (1990) proposes a structure for inclusive medical argumentation that resembles decision-making stasis. Apart from scientific problem-solving, he says, medics have to base their decisions on local and universal ethical concerns:

> They must consider the consequences of their actions for the patient…, the general consequences of their actions…, and they must take into consideration the patient's rights and their own duties. (p. 85)

Knowledge and decision-making are complex. They do not 'grow' out of observations all by themselves (King, 1982, Ch. 14); nor do they grow out of experience or theoretical insights alone. Rather, they require a combination of multiple modes of argumentation and consideration of multiple contexts. Above all, they require social responsibility.

These conditions apply not only to clinical research, but also to its assessment and to educational and political interventions into existing practices. That is why in my analysis I have tried

to be responsible in engaging with my own numerous contexts. As an analyst, I have described the superstructure of clinical NTG publications; as a social agent, I have expressed concern about the reductionist argumentation practices that my analysis uncovered; as an educator, I have proposed solutions and alternatives to these tendencies. My study has confirmed Aristotle's insight that knowledge and artistry are impossible without well informed, involved, and cooperative praxis. Importantly, it has also demonstrated that the community of clinical NTG researchers has the epistemic resources to meet the challenge.

Chapter 7: General implications and conclusions

> If you could show the cabbage that I planted with my own hands to your emperor, he definitely wouldn't dare suggest that I replace the peace and happiness of this place with the storms of a never-satisfied greed.
>
> Diocletian

Activity theorists tell us that the outcomes and effects of an activity may diverge from its objectives (Engeström, 1999). This was exactly the case with my project. I designed it to find regular correspondences between linguistic and argumentative organization in biomedical research papers. I was motivated with the hope that my findings could be useful in education, information retrieval, and knowledge management. My study produced the results that I hoped for, albeit in a way that I did not anticipate. I found text and discourse to be more complex and fluid than I had expected, and this required a more intricate inquiry than I originally planned.

The volume of the dissertation has allowed me to indulge in an extensive discussion of the results of my empirical and methodological inquiries. In the second and sixth chapters I spoke about the material cause of my investigation as I discussed the phenomena of epistemic topoi, its functions and linguistic manifestations, as well as the utility of its analysis for the purposes of informatics and knowledge management. I tackled the formal cause in the second, fifth, and sixth chapters where I discussed the research methods, theoretical frameworks and concepts that can be used for analysis of epistemic topoi. The discussion of the efficient cause involved analysis of needed action in the introduction, the second and fourth chapters. Here I spoke about the state of epistemic knowledge, as it pertains to inquiries into argumentative organization, and proposed more inclusive research and argumentation models that can bring epistemic studies up to the challenge. In the fourth and fifth chapters I addressed available theoretical concepts and methods for my own situated study. My analysis of the final cause in the third, fourth, and sixth chapters addressed the benefits and prospects of raising the profile of integrated argumentation among epistemicists and clinical researchers.

Thus my deliberative structure is almost complete. The last item of business remaining for this chapter is the anticipated effects of my inquiry. Specifically, I will explain how my theoretical and methodological findings can contribute to the practical tasks of applied linguistics and information science, as well as to meta-theory across the disciplines.

Technical implications and applications

My analysis corroborates numerous earlier findings of statistical correspondences between the parts of IMRD structure and rhetorical moves, on the one hand, and the linguistic features of these units of

text structure, on the other. The taxonomy of topoi and their linguistic configurations that I arrived at have common features with some topoi and schemata described in earlier publications (Harmsze & Kircz, 1998; Liddy, 1991; Salager-Meyer, 1994; Swales, 2004; Thompson, 1993; Trawiński, 1989). My findings also bear out the idea that argumentative organization is signalled not with isolated linguistic features but with their configurations. Finally, they confirm earlier insights (e.g. Swales, 1990) that the transient lexico-grammatical elements of such configurations are linked to more stable semantic components of the argumentative meanings, which they signal.

The 'added value' of my study is that I managed to draw links between the argumentative and linguistic organization by grounding my taxonomy of epistemic topoi in a systematic description of their linguistic features. Another likely benefit is the description of the method of inductive analysis that allowed me to arrive at these results. In fact this method may turn out to be the only part of my research that can be extrapolated to the analyses of argumentative organization in other genres and domains. While the topical schemata seem to have similar features across research genres (Appendix A), the particular outcomes of any study into these schemata depend not only on the communities' argumentative practices but also on the analysts' methodological decisions. The linguistic configurations of argumentative meanings are easy to observe and describe 'objectively', yet how exactly they are 'broken out' of discourse is a matter of choice. In this study I performed analysis at the level of the clause, as distinct from smaller 'information components' (Liddy, 1991) or larger 'argumentative zones' (Teufel, 1999). However, a detailed description of my framework and methodology in the fifth chapter should make my results comparable and compatible with the results of other similar studies, regardless of differences in the corpora and methodological choices.

The linguistic features of particular topoi may also show significant variation between corpora. For example, in my corpus I did not find a tense shift similar to the one that Myers (1992) and Malcolm (1987) establish in their corpora. These two authors find that the move from the theoretical background to the information on the present study is marked with a grammatical (or 'deictic') shift from the past to present tense, while in my corpus the THEME/ PURPOSE statements have a mixture of present and past tenses. As Kneale (1949) tells us, generalizations can be helpful for formulating future research questions and hypotheses, but they can never be absolutely reliable. Despite such variation, I hope that practitioners may derive helpful insights from the catalogue of the linguistic features, which I found to be correlated with topical organization in my corpus, for their specific IR and KM tasks, such as the development of linguistic ontologies.

The method of analytic induction described in this dissertation combines observation with conceptual and methodological analysis. It allowed me to make conscious decisions in dealing with indeterminate regularities in text and discourse without compromising the generalizability and replicability of my results. Apart from providing practical benefits, such articulation of 'learning' methods can foster greater attention to methodological matters and provide a conceptual apparatus for discussion of the standard analytic procedures in knowledge-intensive domains (Drummond & Japkowicz, 2010).

An important part of my methodology was the technique of visual annotation, which I found

to be indispensable for analysis of complex linguistic phenomena. It holds promise for research into the multidimensional organization of text and discourse since it circumvents the limitations of the traditional tagging methods of corpus annotation by converting the stylistic and textual characteristics of the discourse into visual 'texture' (Shipley, 1993). This technique has the discernment needed for access to the texture of discourse (Halliday & Hasan, 1976) but preserves the data in a format that is amenable to quantitative analysis.

In corpus analysis, visual annotation opens the prospect of capturing non-contiguous units of organization. This possibility is indispensable in dealing with linguistic configurations. Unlike morphemes and words, which can be broken down into strings of contiguous elements, linguistic configurations are similar to idioms in that their elements need not adjoin in the text. In spite of their shiftiness, linguistic configurations can be a profitable medium of analysis for many practical tasks in informatics. Their shallow analysis presents practitioners with an alternative to the current positivist methods. Matching recurrent argumentative meanings to their linguistic configurations can enable the identification of highly specific semantic components of text and discourse without requiring NLP and KM systems to "understand the content of the text at a fairly deep level" (Brandow, Mitze, & Rou, 1995, p. 675). Systems trained to pick out salient linguistic configurations would be more flexible and versatile than systems designed to pick out 'significant' information. Rather than discard part of the content as redundant, such systems would provide access to fine detail of argumentative organization, treating all its parts as potentially relevant for diverse information needs and discourse analysis tasks. At the same time they would permit selection of any highly specific information sought by users, such as study designs, raw data, generalizations, correlations, or artefact management.

Certainly readers would be well-advised to keep in mind the limitations of this study. In particular, the possibility of working with domain experts or with other annotators was beyond my reach. Yet I hope that my analysis of relevant research techniques and theoretical concepts will allow other research projects to pick up where this dissertation leaves off, verifying and expanding the presented results and applying them to practical tasks.

One of the practical tasks in NLP research to which the concept of epistemic topoi and their linguistic configurations can be applied is disambiguation of terms. As I proposed in the fifth chapter, lexical meanings can be identified by reference to their semantic environments. For example, whether the word *positive* communicates approval or is used in a technical sense depends not only on its collocation with other words, such as *trend* or *history*, or on the argumentative zone where it occurs (such as the introduction, discussion, or conclusion), but also on the type of statement that it is used in. Thus, in MOTIVATION statements the term *positive* will in most cases express evaluation, but in COHORT SCREENING statements it will likely mean the mere presence of a certain characteristic.

Another possible application of the concepts of topical organization and linguistic configurations is the addition of a new dimension to the indexing of documents for the purposes of information retrieval, data mining, and knowledge extraction. For example, the advanced search options of a digital library interface could provide users with the option of searching for a term not

just in certain parts of documents (such as anywhere in the text, in the title, or among keywords) but also in specific statement types (such as the HYPOTHESIS, INTERVENTIONS, or STATISTICAL SIGNIFICANCE statements). Similarly, data mining systems could, for example, be trained to extract information only from OBSERVATION DATA statements and to ignore MOTIVATION statements.

Certainly more research would be needed to realize these possibilities, and such research would require more sophisticated theories of text and discourse organization and "model[s] of query-document similarity" (Manning & Schütze, 2000, p. 554). Currently it is the term (typically a word or phrase) that is taken to be the basic unit of meaning in most informatics domains. A conceptual shift from terms to semantic relations as units of meaning could result in more flexible and inclusive approaches (Teubert, 2004), which would account for various forms of meanings in discourse. For example, such approaches would allow the identification of the idea of STUDY DESIGN not only in the form of its metalinguistic tag *study design* (which is exceptionally rare in my corpus) but also in the form of its linguistic manifestations, such as [*the purpose… to classify… patients… to study… parameters… to investigate… variables*] or [*a retrospective review… NPG patients… a single hospital based glaucoma service*] (which have at least one instance in most papers in my corpus). Future participatory and ethnomethodological investigations could verify the appropriateness of the metalinguistic tags matched to the topoi in the present study and thus produce a more accurate vocabulary for the indexing of epistemic topoi in databases and collections of documents. On the other hand, further linguistic and rhetorical analyses would be needed to inquire into the topical organization of research publications in other domains, which would permit generalizations about the particular or special and common or universal topoi across disciplines and genres. Such studies could also produce more accurate and comprehensive generalizations about the linguistic properties of topoi.

Some insights gained from the present study might be useful in educational domains (such as ESP, academic writing, and technical communication) for empirical research into particular textual forms and genres. These studies can be enhanced and facilitated with the presented methods of situated learning, as well as with the proposed classification of epistemic topoi and catalogue of their linguistic features. For example, the genre of the white paper has so far received little attention from educators, despite its prominence in business and technical communication. A combined rhetorical and linguistic analysis of a corpus of white papers could produce an empirically sound description of the genre, including its classification into sub-genres, their rhetorical functions and linguistic attributes. Consultations with domain experts, environmental scans, or literature reviews would allow the analysts to make good decisions regarding the choice and presentation of their findings. Finally, the notion of situated knowledge and learning could help educators to develop engaging and effective learning activities to allow students to apprehend the genre in meaningful ways.

Finally, the presented technique of linguistic analysis of argumentative meanings can be used in empirical policy research. Of course, as I explained in the second and fourth chapters, a mere description of argumentative practices cannot serve as a basis for evaluations, let alone recommendations. That is why political stasis may provide policy researchers with a compact yet

comprehensive model of decision-making argumentation against which to appraise actual argumentative practices. One obvious issue of relevance here, which my analysis of clinical NTG argumentation leaves open, is the exact correspondences between epistemic topoi and stases. Whereas in my study I 'intuited' such correspondences for explanatory purposes, future participatory and ethnomethodological studies could verify and adjust these intuitions and thus reinforce the empirical foundations of argumentation research.

Theoretical implications

Research ethics

Time will show whether or not my technical findings will be taken up or taken on somewhere in the vast field of theoretical and situated information science, language and discourse studies. On a more theoretical plane, my findings have produced some immediate benefits in terms of understanding the organization of argumentation studies and the nature of epistemic research. These findings suggest that epistemicists need to be more persistent in probing received epistemic lexicons and meta-theories.

One notion that is in need of closer scrutiny is research ethics. It is typically analysed in the context of research misconduct: "dual-use, misuse, or abuse of science," to use Lekka-Kowalik's phrasing (2010, p. 41). This approach is based on the view of ethics as epiphenomenal to knowledge (or 'science') and classifies it as a strictly normative or affective matter. In the categories of such epistemic theory, it may seem odd that Aristotle and Spinoza conducted their inquiries into knowledge under the head of ethics. In modern-day epistemics it is typically assumed that researchers can be knowledgeable and moral in spite of their agonistic argumentation practices. Yet, as Wulff (1990) reminds us, the consequences of research are inseparable from its ideology:

> Medical ethicists often discuss respect of individual autonomy *versus* clinical paternalism, and they usually regard this dilemma as a purely ethical one. It is often overlooked that *paternalism is the logical consequence of the biological concept of disease*, and that the rejection of that concept necessitates the participation of the patient in the decision process. (p. 83, emphasis in the original)

The attempts to sever research from ethics are misguided and have implications for research itself, including the shaky empirical foundations of the scholars' engagements with the social world (Fuller & Collier, 2004), as well as a wide-spread mystification about the logistics and motivations of research and learning.

What flies under the radar of epistemicists are the essential links between agency, learning, and knowledge. My analyses of argumentative models and practices in epistemics and clinical research demonstrated that uncritical reductionism imposes serious constraints on researchers in terms of their research options, writing strategies, and collaboration. Moreover, I found that lack of attention to the phenomenal and social environments affect the quality of research outcomes. Pure

observation and pure theory alike fail when it comes to making meaningful decisions. As a result, researchers on both sides of the theory/practice divide find themselves stranded in a sea of speculative or empirical observations that are "remarkable, admirable, difficult, and divine, but useless" (Aristotle, *Nicomachean Ethics*, VI.7.1141b).

Aristotle explains that particular situations calling for an informed decision are the common ground where knowledge meets ethics. Many methodologists agree that situational concerns are the "general element missing" in much of contemporary research (Scriven, 1987, p. 25). It has also been pointed out that by glossing over situational concerns research communities jeopardize their chances of producing meaningful or even coherent research (Hacking, 1981; Putman, 1981). Crawshay-Williams (1957) offers a helpful elaboration of this idea. Like Aristotle, he believes situational awareness to be indispensable for theory. Beyond a small number of self-evident 'factual' ideas, he explains, it makes no sense to judge theoretical statements as true or false in abstraction from their practical outcomes and effects. Thus the essence of any theoretical dispute is not the 'truth' of an idea or 'correctness' of an argument but "the correct method of treating something for a given purpose" (p. 5). There is simply no way to justify a theoretical or methodological statement (such as a classification or description) other than by reference to the situation (p. 140).

Of course the fact that research literature seldom seems meaningless or incoherent to the research communities indicates that it is not aimless. Rather, situational concerns and social aims are 'obliterated' from the literature. The conventions of academic writing permit and even encourage researchers to make appeals to the logos as shorthand for social motivations behind their studies. The logos provides researchers with a system of methodological rules and reified values functioning as criteria of 'good' research. One type of logos that I found across the disciplines is god terms, such as *understanding*, *significance*, or *power*. Another important type of logos is received argumentation practices, such as agonistic argumentation. An essential element of agonistic argumentation is the reduction of research and communication to a single mode of reasoning. The manifestations of such reductionism include 'purely' empiricist, dialectical, or forensic argumentation in the epistemic literature or positivist reasoning in clinical research and information science.

In spite of their apparent differences, these two types of logos are merely facets of the same phenomenon that has deep roots in the cultural traditions underlying contemporary organized research. For example, the values of individual survival and power lurk behind a range of conventional dichotomous divisions, such as the opposition between the self and the other or between health and disease. In turn, the god terms themselves derive their status of unquestionable values from the self-evident clarity of the dichotomies associated with them. For example, Einstein (1982) conceives of theoretical physics as a disinterested quest for coherence. However, his conversation with the Indian philosopher Tagore (1984) reveals a *telos* of intellectual expansion behind this quest, which hinges on binary oppositions: Man vs. the world, and Truth vs. consciousness. With the key terms thus formulated and organized, it is obvious that Man's mission is uninhibited striving after Truth. Einstein insists that this simple semantic construct is a foundational assumption of Western research: "I cannot prove that my conception is right, but that is my religion" (p. 60).

Since the logos is seldom questioned, the relationship of mutual validation between god terms and argumentative practices creates a semantic cocoon insulating scholastic discourse from its social and natural environments. It also works as a mechanism that 'sublimates' this insulation into pursuit of what counts as 'excellence', be it engaging discourse, poignant observations, or statistical significance of results.

I would be much tempted to present my observations in the genre of conspiracy theory had I not observed the damaging effects of uncritical reductionism and agonistic argumentation across the board. These practices have negative consequences for the stakeholders and for the disciplines, as well as for particular publications. Above all, they perpetuate the lack of involvement of organized research with the social world. Of course scholastic conspiracy could be attributed to the illusion that knowledge is finite and thus can somehow run out and leave researchers jobless. For example, Harris (1993) found such apprehensions among linguists. Perhaps these apprehensions explain the belief expressed in some of my theoretical sources that the proliferation of vacuous discourse may benefit epistemics. Such sensibilities are an artefact of dichotomous thinking, which conceives of research as separate from and superior to other human activities. It may also reflect low awareness of the distinction between the short-term and long-term effects of argumentation (cf. Doheny-Farina, 1991).

Perhaps against the background of present-day epistemics, it would be redundant to argue that the idea of finite knowledge is naive. On the other hand, the field is only beginning to understand the damage that hollow discourse can cause not only to the stakeholders but also to the disciplines and communities of practice (e.g. Fahnestock, 2005; Harris, 1993). I hope that my analysis of the dichotomous argumentation models and practices can help to raise awareness of this damage. I also hope that my readers may find useful my analysis of integrated argumentation practices and models. Of special interest is decision-making stasis since it encompasses multiple reasoning modes that communicators, groups, and communities rely on when faced with decision-making tasks. It also accounts for the multiple situational parameters that give rise to argumentation.

Decision-making stasis is broader than the popular models of forensic deliberations. Apart from the traditional forensic issues related to the phenomena or events at hand and the ways of approaching them, it allows the communicators to inquire into the possible responses to the phenomena or events and the implications of these responses. This structure includes between seven and fourteen issues, compared to the three to four issues of forensic stasis. That is why it is hardly realistic to expect short research publications, such as journal papers or conference presentations, to cover the whole range of issues that are relevant to a particular theme. However, the model is a helpful instrument that authors can use as they appraise the state of their disciplinary discourses and make methodological decisions. It can also help disciplinary gatekeepers and patrons to make informed decisions about their 'interventions' into research.

Integrated argumentation is not a theoretical creation. It is an essential factor of learning, decision making, and communication because it allows people to balance multiple motivations, benefit multiple worlds, and account for multiple realities. That is why it has numerous manifestations in research discourse. For example, authors in most disciplines are nowadays

encouraged to include methodological commentary into their research publications. In some disciplines it is also conventional to address the motives behind methodological choices. In particular, biomedical researchers are required to disclose possible conflicts of interests in their journal publications. Some literary critics go even further and explicitly ground their arguments in their cultural and social affiliations. In clinical research publications I also found epistemic topoi that expand the basic positivist model of experimental research. Some of these topoi help authors to take a more inclusive view of the theory of the field; others allow them to account for the specific circumstances of their investigations. Another important resource that researchers have for mastering the element of their disciplinary traditions is epistemic metalanguage. Of course its presence in discourse does not automatically translate into reflective argumentation, but it is indispensable for those authors and communities that wish to take charge of their research and argumentation practices.

There are more reasons than I could cover in this dissertation for researchers to take a serious look at their argumentative practices. I have paid special attention to the futility of agonistic argumentation. The self-defeating argumentation strategies that I found both in epistemic studies and in clinical research are a stark reminder of the simple notion that no researcher is an island. Researchers are not only benefactors but also stakeholders of their professional activities. The price that they pay for insulating their work from human life and activity is frustration of efforts and resources (Gill & Griffin, 2009; Jensen, 1990) and skepticism about the means and ends of organized research (Brown, 2004).

Of course epistemicists should know better than issuing didactic motherhood propositions. Neither the awareness of the limitations of agonistic argumentation nor epistemic prowess alone can move research closer to praxis. Epistemic tribulations are never a purely cognitive matter. My analysis of the social underpinnings of reductionist argumentation models and practices revealed that they are an essential mechanism of researchers' socialization, professional self-identification, and social cohesion, as well as an important organizing principle of research discourse. That is why the methodological norms that require researchers to keep their works and minds free from political, affective, or interdisciplinary contamination are not just a way to circumscribe the scopes of their research projects. They point to the socio-political underpinnings of research organization and to its corporate traits. This means that epistemic innovation will remain wishful thinking unless it addresses the cultural and socio-economical mechanisms that reproduce and perpetuate agonistic argumentation paradigms. That is why I will end my inquiry into integrated knowledge and learning with a brief excursion into their social substratum.

Situated epistemics

What are the chances of finding the counterparts of integrated argumentation in the social medium? It seems that the possibility is not as remote as one might imagine. Flower's (2002) recipe for integrated research policy is "a rhetoric of decision-making," whose role is

> to replace silencing and polarizing discourses (the prestige talk of the academy and

> policy makers, the adversarial talk of advocacy) with a problem-solving discourse in which everyone is a learner and the expertise of ordinary people is central. (p. 250)

King (1983) also calls for more integrated argumentation practices in medicine. In his opinion, medical argumentation has to shift from "reflex medicine" based on bipolar, automatic, problem solving to "reflective medicine" based on "observation and reflection, consideration of alternatives, discrimination, and deliberate choice" (p. 300).

How do we get from the agonistic, "silencing and polarizing discourses" to the discourse of well informed decisions that we all desire? A number of authors have pointed out that "no science or practice can determine its own standards of growth and progress independent of our social world and life world" (Jensen, 1990, p. 181). Star and Griesemer's (1989) analysis of one situated research project shows a practical way of conducting responsible and accountable research. In their study of the founding of Berkeley's Museum of Vertebrate Zoology, they demonstrate how researchers can engage with natural and social environments without relinquishing their professional and economic agendas.

The statement of Star and Griesemer's stance is strikingly different from the mainstream ivory-tower accounts of scholarly research:

> Most scientific work is conducted by extremely diverse groups of actors - researchers from different disciplines, amateurs and professionals, humans and animals, functionaries and visionaries. Simply put, scientific work is heterogeneous. At the same time, science requires cooperation - to create common understandings, to ensure reliability across domains and to gather information which retains its integrity across time, space and local contingencies. (p. 387)

Research activity in general "[encompasses] a range of very different visions stemming from the intersection of participating social worlds" (p. 396), and the "'central tension'… between divergent viewpoints and the need for generalizable findings" is a challenge for situated research projects. The authors find that this tension can be negotiated through egalitarian give-and-take. The mechanism behind such relations is a system of 'boundary objects' that may have different meanings for the parties involved in the enterprise. The boundary objects (such as the 'translations' of the methods of repository collection into the language of amateurs) create possibilities for overcoming conflicts of interests and logistical barriers. The participants agree to respect their socio-economical autonomies in the name of "a mutual *modus operandi*" (p. 388). Notwithstanding the participants' autonomy, the enterprise is not opportunistic but motivated with shared goals that are "lined up in such a way that everybody has satisfying work to perform in each world" (p. 409).

Theory figures prominently in Star and Griesemer's analysis as an essential element of the communication and logistics on situated projects. It is a way of "developing, teaching and enforcing a clear set of methods to 'discipline' the information obtained by… non-scientists" (p. 404). Yet the theory and meta-theory of scientific observation are articulated for the practical tasks of the project rather than through aloof demonstrations. Participation in situated enterprises comes for researchers at the price of relinquishing their prima facie authority:

> Each world is willing – for a price – to grant autonomy to the museum and to conform to [its] information-gathering standards. It is only gradually that a scientist… comes to be an authority. (p. 407)

What is gained is a chance of meaningful research for the whole community. All parties get "to make a substantial contribution" to the common enterprise as well as to their own worlds (p. 407). The respect for other participants' autonomy weans scientific authority from entitlement. Scientists participate in situated projects on a par with their local collaborators, and their long-term reward is the possibility of specialization from which they can "*move into* more theoretical arenas" (p. 407). To make such a move, they have to act as go-betweens, making scientific methods understandable to the amateurs and channelling local knowledge from amateurs back to the academy:

> It would not be enough if all the worlds collected objects which were in some sense challenging old ways of thinking about nature, nor arguing with other parts of science. (p. 409)

As a result of such mediation, the gained insights are not only theoretically sound but also novel, "highly abstract, with a strong empirical base and strikingly strong support from participating worlds" (p. 410).

The movement from the disciplinary margins to the center is not the only kind of development for situated projects. Their participants often advance into new research areas. Like Bazerman and De los Santos (2005), Star and Griesemer suggest that ecological disciplines owe their very existence to situated enterprises (p. 394).

Translation of knowledge and perspectives plays an essential role in situated projects, and Star and Griesemer acknowledge the complexity of this process:

> [Scientific] authority may be either substantive or methodological. Latour and Callon have called this process *interessement*, to indicate the translation of the concerns of the non-scientist into those of the scientist.
>
> Yet, a central feature of this situation is that entrepreneurs from more than one social world are trying to conduct such translations simultaneously. It is not just a case of *interessement* from non-scientist to scientist. Unless they use coercion, each translator must maintain the integrity of the interests of the other audiences in order to retain them as allies. Yet this must be done in such a way as to increase the centrality and importance of that entrepreneur's work. The n-way nature of the *interessement* (or let us say, the challenge intersecting social worlds pose to the coherence of translations) cannot be understood from a single viewpoint. Rather, it requires an ecological analysis… (p. 389)

What the authors here mean by ecology is institutional environment: a kind of coherence which 'chooses' certain participant roles (p. 389). Attention to ecologies shifts the focus of their analysis from contention to collaboration:

> An advantage of the ecological analysis is that it does not presuppose an epistemological primacy for any one viewpoint; the viewpoint of the amateurs is not inherently better or worse than that of the professionals, for instance. (p. 389)

Importantly, ecological analysis recognizes the role of the institution itself as a site that creates the ecology: "It does… entail understanding the processes of management across worlds: crafting, diplomacy, the choice of clientele and personnel" (pp. 389-390). In Star and Griesemer's model, people flow through institutions rather than own them.

A few points of Star and Griesemer's investigation are especially relevant for my work. They make an important distinction between situated and scholarly theoretical frameworks. They also explain the distinct roles and complex dynamics of both types of knowledge. Finally, they propose an attractive model for research institutions. Scientific purity, on their account, amounts to specialization. As members of various discourse communities, scientists win the right to practice science through successful negotiation with other communities over the meaning of boundary objects. This is not to say that there are no ways for 'growing' within well fended research institutions without much contact with the outside world, and the choice in favour of unperturbed existence is well justified in cognitive terms:

> For people, managing multiple memberships can be volatile, elusive, or confusing; navigating in more than one world is a non-trivial mapping exercise. People resolve problems of marginality in a variety of ways: by passing on one side or another, denying one side, oscillating between worlds, or by forming a new social world composed of others like themselves. (p. 412)

We see numerous signs and traces of such struggles between the centripetal and centrifugal forces in the organization of academic disciplines, in their communication forms and practices. But people are more mobile than institutions (p. 412). Their mobility challenges the integrity of institutional ecologies, and Star and Griesemer remark that cooperation is but one method of maintaining this integrity. Yet their analysis demonstrates that cooperation and integration work as actual mechanisms of social construction rather than unattainable ideals or abstract forces that subvert social institutions.

Another important insight from Star and Griesemer's investigation is that accountability is not antithetical to scientific acumen and creativity. The issue of material and intellectual resources that sustain research and education, as well as the issue of research outcomes and effects are unpopular with scholars, who often argue that the outcomes and effects of their activities are hard to assess. For many, this idea leads to the conclusion that the matter is not worth pursuing. As a result, the default measure of academic success is the number of published journal papers. Contrary to these ingrained views, Star and Griesemer show that the success of research does not have to be measured exclusively in the volume of produced literature or the number of students and adherents. It can produce outcomes that are meaningful not only for academic disciplines but also for people on the ground.

Star and Griesemer's argument calls for a non-trivial 'paradigm shift': from the culture of conquest to the culture of symbiosis. It suggests that organized research can engage with society within a framework of collaboration. This proposition is likely to make many researchers uncomfortable because most of us are socialized to segregate research from lives and to value the 'third world' of ideas in and of itself. Moreover, most research communities have learnt to regard

"dual use" projects with well justified suspicion (Lekka-Kowalik, 2010). Above all, research institutions do not typically have infrastructures, mechanisms, and conceptual frameworks for engaging with their environments, and in this way they are no different from other institutions (Bazerman & De los Santos, 2005; Fuller & Collier, 2001; Jensen, 1990; Wulff, 2001). Yet the development of local infrastructures, mechanisms, and frameworks is as worthwhile as the development of theories 'for all reasons'.

Summary

My analysis of argumentative organization in the NTG corpus led to the identification and description of fifty-six epistemic topoi (Appendix F). The topoi were found to be loosely associated with the IMRD structure and signalled with configurations of linguistic features. Configurations work as an epistemic code, defining the functions of statements and relating them to other statements in the texts and discourses. For the classification of the topoi I used rhetorical and linguistic theory and the method of analytic induction. I classified them according to the modes of reasoning they represent and the textual and discursive functions they perform. The descriptions of the topoi were presented along with a catalogue of linguistic features that were found to signal argumentative organization in the corpus.

The internal organization of the articles is not the only type of argumentative patterning that the research into text and discourse semantics needs to take into account. Unfortunately the argumentative organization of the discourse of the domain represented in the corpus was beyond the scope of this study. What I did manage to do is assess the practices of clinical NTG research in terms of situated knowledge and learning. I found that the community conceives of its research as an essentially positivist enterprise and shows little interest in its situational facets.

A secondary objective of my study was a survey of argumentative models and practices in clinical and argumentation studies. I established that the epistemic in these fields are both the conditions and outcomes of their argumentative models and practices. I suggested that dichotomous reasoning practices and over-reliance on reductionist research methods imposes limitations on researchers' possibilities and accomplishments. Apart from identifying the common challenges, I found promising signs of epistemic innovation in both communities. I believe that an account of these alternatives is an important contribution of this work to epistemic and clinical research and practice.

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Appendix A

Elements of argumentative organization across research genres

	Introductions	Methods	Results	Discussions
Liddy's (1991) "discourse-level structure" of empirical abstracts	*Background*: Relation to other research New terms defined Institution Administrators Location of study *Purpose*: Hypothesis: independent variable; dependent variable Research questions Research topic	Subjects: sample selection; control population Number of experiments Time frame Procedures: conditions; materials Data collection Data analysis	Reliability Discussion: unique features; limitations	Significance of results Implications Practical applications Future research needs
Thompson's (1993) rhetorical moves in biochemical research articles			The account of the results Justifications for methodological selections Interpretations of the meaning of experimental results Evaluative comments on the quality of experimental data Statements citing external consistency Statements conceding	

			quantitative discrepancies or admitting difficulty in interpreting results Calls for further research in the results section.	
Salager-Meyer's (1994) rhetorical moves in medical discourse	Motivate the study Justify the reason for the investigation Make claims about statements from other research.	List procedural formulae Describe the process which led to the obtaining of the data	Description of the results Describes the process of manipulating the data obtained during the experimental stage Make limited claims about the statistical tests	Make claims about the research findings Summarize results State conclusions Make suggestions Propose further questions
Harmsze & Kircz's (1998) "modular model" of scientific articles	Situation Central problem	Theoretical methods Experimental method Numerical methods	Raw data Treated results	*Interpretation*: Qualitative interpretation Quantitative interpretation *Outcome*: Findings New problems
Swales's (2004) revised CARS model of research articles	Move 1 *Establishing a territory* Move 2 *Establishing a niche*: Step 1A Indicating a gap or Step 1B Adding to what is known Step 2 Presenting positive justification			

	Move 3 *Presenting the Present Work*: Step 1 Announcing present research descriptively and/or purposively Step 2 Presenting research questions or hypotheses Step 3 Definitional clarifications Step 4 Summarizing methods Step 5 Announcing principal outcomes Step 6 Stating the value of the present research Step 7 Outlining the structure of the paper			

Appendix B

Semantic categories of journal titles in epistemic studies

Scholarly research:

Australasian Journal of Philosophy
Annual Review of Applied Linguistics
Annual Review of Information Science and Technology
Communication Theory
Journal of Information Science
Journal of Philosophical Logic
Journal of Pragmatics
Language Sciences
Philosophical Issues
Rhetoric Review
Social Science Information
Sociological Inquiry
The American Journal of Psychology
The International Journal of Sociology and Social Policy
Theory and Psychology
The Classical Quarterly
The Philosophical Quarterly
The Social Service Review

Interdisciplinary research:

Configurations
Leonardo
Linguistics and Philosophy
Philosophy and Rhetoric
Social Science and Medicine
Synthese

Empirical research:

Argumentation
Argumentation and Advocacy
Cell
Communication Quarterly
Criminal Behaviour and Mental Health
Discourse and Society

Discourse Processes
Discourse Studies
English Studies
Health
Journal of Artificial Intelligence Research
Journal of Business and Technical Communication
Journal of Communication
Journal of Personality Assessment
Journal of Research in Reading
Journal of Risk Research
Journal of Second Language Writing
Journal of Service Research
Language and Communication
Mind
Research on Language and Social Interaction
Science, Technology, and Human Values
Speech Communication
Technical Communication
Technical Communication Quarterly
The Journal of Consumer Research
The Journal of Documentation
The Quarterly Journal of Speech
Written Communication

Applied research:

Applied Linguistics
BMC Bioinformatics
British Journal of Sociology of Education
English for Specific Purposes
Forum Qualitative Sozialforschung / Forum: Qualitative Social Research
Health Informatics Journal
Information Processing and Management
Interacting with Computers
International Journal of Medical Informatics
Journal of Child Neurology
Medical Education
Natural Language Engineering
Philosophy of Science
Qualitative Health Research

Science and Engineering Ethics
Social Science Computer Review
Social Studies of Science
Social Work
TESOL Quarterly
The British Journal for the Philosophy of Science
Theory into Practice

Professional research:

Australian Critical Care
College Composition and Communication
College English
Educational Researcher
IBM Journal of Research and Development
International Journal on Digital Libraries
Journal of English for Academic Purposes
Journal of the Association for Computing Machinery
PLoS Computational Biology
Rhetoric Society Quarterly
The American Journal of Clinical Nutrition
The Canadian Medical Association Journal
The Journal of the American Medical Association

Appendix C

Diachronic analysis of epistemic journal titles (founded between 1950 and 2000)

	Scholarly	Interdisciplinary	Empirical	Applied	Professional
1950	1			1	1
1951		1			
1952					
1953					
1954					1
1955					
1956				1	
1957					
1958					
1959					
1960					
1961	1				
1962				2	
1963					
1964					
1965					
1966	1			1	
1967			1	1	
1968	1	2			
1969					
1970					
1971					
1972	1				1
1973					
1974			1		
1975				2	
1976			1		1
1977	1	1	1		
1978			3		
1979	1				
1980	1			3	
1981	1		1		
1982	1	1	1		
1983					
1984			1		
1985					
1986					
1987			2		
1988			2		1
1989				1	
1990			1		
1991	2			1	
1992			2		
1993		1	1		
1994					
1995				2	
1996			1		
1997			1	2	1
1998			2		
1999			1	1	
2000				1	

Note: The densities of the shading are corresponded with the numbers.

Appendix D

Trawiński's (1989) "content elements" from information science papers

1) Receiver of document
2) Scope of document
3) Idea of solution
4) Presentation of solution in form of an algorithm
5) Mathematical description
6) Theorems
7) Proofs of theorems
8) Illustration of solution
9) Justification of solution
10) Characteristics of solution
11) Idea of testing method
12) Schedule of testing method
13) Model used
14) Justification of testing method
15) Place where testing was carried out
16) Time of testing
17) Evaluation criteria used
18) Characteristics of criteria
19) Justification of criteria
20) Specification of procedures employed in testing
21) Characteristics of procedures
22) Justification of procedure selection
23) Source of procedures
24) Specification of objects used in testing
25) Characteristics of objects
26) Justification of object selection
27) Source of objects e.g., producer or supplier
28) Specification of equipment used
29) Characteristics of equipment
30) Justification of equipment selection
31) Source of equipment e.g., producer or supplier
32) Preliminary activities
33) Side effects
34) Presentation of raw data obtained
35) Data reduction, calculations
36) Presentation of results of calculations
37) Presentation of results in form of tables
38) Presentation of results in form of figures
39) Presentation of results in form of schemes, maps
40) Evaluation of data completeness
41) Evaluation of data precision
42) Analysis of possible errors
43) Statistical analysis of results
44) Description of negative results obtained
45) Explanation of results obtained
46) Generalizations
47) Comparison with results obtained by other authors
48) Possible usage areas in practice
49) Possible usage areas in science
50) Possible ways of improving solution
51) New problems encountered during research
52) Costs of research
53) Financial source

Appendix E

The end-of text outline from Levene (1980): "Low tension glaucoma: a critical review and new material"

I. Sources of information
II. Definitions
    A. Past definitions
    B. Present definitions
    C. Incomplete definitions
    D. Indeterminate cases
III. Terminology
IV. Criteria and characteristics
    A. Visual field
    B. Optic disc
    C. Ocular pressure
    D. Anterior chamber angle
V. Differential diagnosis
    A. Primary open angle glaucoma
    B. Other glaucomas
    C. Myopia
    D. Retinal disease
    E. Optic disc defects
        1. Congenital defects
        2. Ischemic optic neuropathy
        3. Compression of optic nerve
        4. Other
VI. Prevalence and incidence in defined populations
VII. Clinical characteristics
    A. Sources, selection, number of cases, controls
    B. Observation period after diagnosis
    C. Age at diagnosis
    D. Sex
    E. Type of visual field defect glaucoma
    F. Sudden visual loss
    G. Visual acuity
    H. Optic disc
        1. Cupping and pallor
        2. Fluorescein angiography
        3. Splinter hemorrhage

I. Incomplete types
J. Glaucomatous anterior segment disease
    1. Pressure
    2. Shortterm pressure variation
    3. Longterm pressure variation
    4. Facility of outflow by tonography
    5. Water provocative test
    6. Corticosteroid provocative test
    7. Miscellaneous and summary
K. Efficacy of medications for decreasing pressure
L. Refractive error
M. Monocular cases
N. Heredity
O. Course of visual function with and without medical therapy
P. Course of visual function with glaucoma surgery
Q. Summary

VIII. Possible associations
A. Vascular disease
    1. Systemic blood pressure
    2. Reduction of systemic blood pressure by medication
    3. General vascular disease
    4. Carotid artery disease
    5. Ophthalmic artery pressure and perfusion gradient
    6. Retinal vascular occlusion
    7. Sector infarct of the optic disc
    8. Summary
B. Other possible associations
    2. Pigmentary dispersion syndrome and glaucoma
    3. Diabetes
    4. Blood lipids
    5. Blood coagulation
    6. Drug and nutritional factors
    7. Exercise
    8. Miscellaneous

IX. Pathogenesis of visual field loss
A. Choice and identification of variables
B. Independence of variables
C. Evidence for a low resistance
D. Evidence of an abnormal pressure
E. Evidence for vascular changes
F. Interaction at the disc
G. Miscellaneous
H. Summary

X. Summary

Appendix F

Basic epistemic topoi from the NTG corpus

PROBLEM SOLVING: PRIMARY INDUCTION

Study design

Topoi	Content types	Distinctive linguistic features	Examples
COHORT SCREENING	**Knowledge and research**	Past tense or compound modal predicates with perfect infinitive in the main clause Circumscription (e.g. *at least*, *only*, *or better*, ≥) or identity lexis (e.g. *characteristic*, *reliable*, *reproducible*, *typical*), deontic modality (e.g. *had to*, *must*) or designation expressions (e.g. *classify as*, *criteria*, *exclude*, *include*, *judge*), Observation, examination, or clinical practice abstractions	- They all fulfilled the following criteria: peak IOP lower than 26 mmHg as measured in a diurnal curve without medication, the presence of glaucomatous field defects associated with glaucomatous disc changes, and an open chamber angle. (E15) - Eyes were excluded where diagnoses other than glaucoma, which might affect the visual field or visual acuity, had been made. (G33) - The diagnosis of NTG was established by typical optic disc and visual field damage. (G14)
INTERVENTIONS	**Clinical practice** and **knowledge and research**	Mostly past indefinite passive in the main clause Clinical practice (e.g. *apply*, *follow-up*, *operate*, *surgery*, *therapy*, *wash-out*) or examination lexis (e.g. *measure*, *measurements*, *record*)	- Isolated peaks of 26 mmHg were allowed in a diurnal IOP curve without therapy. (E15) - IOP was measured in our hospital for at least 3 days at different times during day and night. (G14) - The patients underwent CDI measurements of ocular perfusion of the right eye by CDI shortly before and 3 to 5 weeks after initiation a local therapy with either latanoprost or bimatoprost. Both eye drops were applied once a day between 6 p.m. and 8 p.m. (G10)

INFORMATION	**Knowledge and research**	Mostly past indefinite in the main clause Summarization lexis (e.g. *all*, *both*, *each*) or small natural numbers, often with the definite article (e.g. *the two*) Analysis (e.g. *calculate*, *classify*, *divide*), examination (e.g. *measure*, *record*), or reasoning lexis with frequent abstractions Participant lexis, *group*, or observation abstractions	- The relationship between the intensity decrease and the intensity variance was examined to determine the difference between the pattern of RNFL loss in the two groups (Fig. 3). (E10) - Of the patients and controls in whom both eyes were considered, we used the mean value of the two eyes. In those in whom only one eye was considered, we used the IOP, PA and POBF values of the single eye. (E3) - For each patient the relative NRR area was calculated. (G36)
DATA HANDLING	**Knowledge and research**	Mostly past indefinite passive in the main clause, often with *by*-agents Objectivity, detachment, separation expressions (e.g. *external*, *separately*, *masked*, *without knowledge*) or specialized lexis (e.g. *bias*, *investigator*, *error*) Analysis (e.g. *calculate*, *classify*, *divide*) or examination lexis (e.g. *enter*, *measure*, *record*) Analysis, observation, examination, or reasoning abstractions	- The visual fields were analyzed by an external observer. (E15) - Each factor was entered in the model separately. (G36) - The measurements of IOP were made by one of two observers masked to the treatment status of the patient (authors AA and MAR). (G16)
INSTRUMENTS	**Knowledge and research**	Mostly past indefinite passive with *with/using*/*on*-instruments in the main clause Analysis (e.g. *calculate*, *classify*, *divide*) or examination lexis (e.g. *enter*, *measure*, *record*) Observation or examination abstractions	- Stereophotographs of the optic discs were taken with the simultaneous stereo fundus camera (Topcon TRC-SS2), using Kodak Ektachrome 100 HC film. (E1) - Blood pressure and heart rate were measured with an automatic device (Dinap Criticare Vital Daten Monitor, Criticare, Tampa, FL, USA). (G34) - Visual field examinations were performed with the 24-2 full-threshold program on the Humphrey field analyzer (HFA; Carl Zeiss Meditec, Inc., Dublin, CA). (G5)

DATA PROCESSING/ ANALYSIS TOOLS	**Knowledge and research**	Mostly past indefinite passive with *in*/*with/using*-instruments in the main clause Analysis lexis (e.g. *assess*, *calculate*, *classify*, *divide*) Observation, analysis, or reasoning abstractions	- All calculations were performed using SAS, version 8.2 (SAS institute Inc, Cary, NC, USA). (G16) - Student's t-test for paired data was used. (G10) - In an a-priori-power-analysis the sample size was calculated. (G10) - Statistical analyses were performed using SAS/STAT software 8.1. (G6)
STIPULATED CONCEPTS/ CLASSIFICATIONS	**Concepts and classifications**	Appearance and indexing (e.g. *indicated*, *index*), designation expressions (e.g. *according to*, *based on*, *consider as/ to be*, *calculate/ define/ record/ take as*, *classify in*), or compound nominal predicates Analysis, clinical practice, examination, reasoning, or observation abstractions	- The intensity decrease was an index for the diffuse retinal damage, whereas the intensity variance indicated an index for estimating the localized retinal damage... (E10) - The median of the IOPs in the 2 years before surgery for each patient was taken as the preoperative baseline. (G35) - POAG was defined to meet the same criteria of NTG except for intraocular pressure greater than 21 mm Hg in an eye without antiglaucoma medication… (G21) - Differences reaching $P < 0.05$ were considered statistically significant. (G5)

Results

Topoi	Content types	Distinctive linguistic features	Examples
INTERVENTION DATA	**Clinical practice**	Past tense in the major clause Clinical practice or examination lexis Numerals or summarization lexis (*all*, *most*) Participant lexis or *group*	- All patients had a general ophthalmological examination. (E15) - Of the remaining 83 patients, 28 had fixation threatening field defects and were started on treatment. (G16) - Twelve patients had less than five visual field examinations after surgery. (G31)
PARTICIPATION DATA	**Instances and precedents** or **knowledge and research**	Mostly past indefinite in the major clause Participant lexis with cardinal numerals or summarization lexis Participation lexis (e.g. *drop out*, *enroll*, *withdraw*) or designation expressions (e.g. *eligible*, *excluded*, *selection*)	- Of these 25 patients, 15 could not be properly documented and therefore were excluded from our study. (E3) - None of the patients was lost to follow up. (G36) - The risk of withdrawal from latanoprost during the 12-month treatment period due to an adverse event was 6.4%. (G6)

OBSERVATION DATA	**Instances and precedents**	Mostly past indefinite in the major clause Numerals Participant lexis, *group**, or observation abstractions	- Asymmetry of mean IOP of at least 0.3 mmHg was observed in 22 of the 26 patients (Table 2). The other 4 patients did not differ in mean IOP. (E1) - No significant side effects were encountered. (G24) - CMF in each group was 15.1 ± 4.9 mm Hg for nondippers, 15.6 ± 5.0 mm Hg for dippers, and 18.3 ± 5.8 mm Hg for overdippers. (G5)
DEMOGRAPHICS	**Instances and precedents**	Past indefinite in the major clause Participant lexis with numerals Demographical lexis (e.g. *age*, *Asians*, *women*)	- Nine of 14 patients (64%) with the maximum IOP ≥ 19 mmHg and 10 of 16 patients (63%) with the maximum lOP < 19 mmHg were women. (E10) - Thirty four patients (63%) were women. (G36)
SUMMATED OBSERVATIONS	**Instances and precedents** or clinical practice	Quantifiers, summarization or circumscription expressions (e.g. *all*, *at least*, *none*) or generalization lexis (e.g. *average*, *maximum*, *mean*, *median*) Clinical practice or observation abstractions	- All patients were known at our glaucoma department having low tension glaucoma for an extended period. (E15) - Visual acuity in all eyes was 20/20 or better. (E10) - None of the eyes in the control group had a C/D ratio ≥0.7 (table 3, fig 3). (G12)
COMPARISON	**Instances and precedents**	Mostly past indefinite in the main clause Comparison expressions: - *difference/ similarity/ asymmetry* (*among/ between*…) - *different from…/ similar to…* - *compared to…/ by comparison…/ than…* - Comparative or superlative degrees Participant lexis or *group*	- Comparison of the three groups using the log rank test showed a statistically significant increase in survival time in both the 5-FU and MMC groups compared with the nil adjunct group. (G35) - Angle a in the NTG group (35.1 (20.0)°) was significantly smaller than that of the POAG group (45.9 (21.9)°) (p = 0.02), while angle b in the NTG group (49.0 (31.9)°) was significantly larger than that of the POAG group (33.1 (23.9)°) (p = 0.01) (Fig 3). (G21)
STATISTICAL SIGNIFICANCE		Mostly past indefinite in the main clause *Difference/ correlation/ significance* in the subject position Emphasis lexis	- There was no significant difference between these figures. (G31) - Neither difference was significant between the two groups (both p>0.05). (G21) - No statistically significant difference was found in the IOP range (table 4). (G16)

FOUND ASSOCIATIONS/ CORRELATIONS	**Relations** or **causality**	Past indefinite in the main clause Syntactic patterning: - Comparative degree/ *increased*/ *decreased*/ *reduction*, etc. + *in*/ *for …eyes*/ *patients*/ *subject** / *group …with…* - Comparative degree/ *increased*/ *decreased*/ *reduction*, etc. + *following*/ *after…* - *the* + comparative degree + *the…* - *patients with… showed…* Association or potency and possibility expressions (e.g. *associated*, *correlated*, *linked*, *more likely*, *predictor*, *risk*) Participant lexis, *group*, observation, reasoning, or analysis abstractions	- In patients with NPG and altitudinal visual field loss the retinal AVP time as measured in the corresponding temporal superior or inferior vessel formation was significantly prolonged. In contrast, NPG patients with symmetric field defects, or healthy subjects, showed no circulatory asymmetry among superior and inferior vessel formations. (G34) - In both cases the difference in IOP between the control and randomised treated group increased with increasing age. There was no significant relation found between CCT and baseline IOP. (G16) - As in previous studies…, we found that the higher the baseline IOP, the greater the IOP reduction, and that a statistically significant IOP reduction is more likely to occur at pre-treatment IOP levels of over 15 mmHg. (G6)
FOUND CAUSES/EFFECTS		Past indefinite in the main clause Causation expressions (e.g. *effect*, *lead to*) or affect verbs (e.g. *improve*, *increase*, *reduce*) Clinical practice or observation abstractions	- In agreement with other authors… we also found that medical treatment and argon laser trabeculoplasty (ATP) only slightly reduced the IOP (13%) in eyes with low tension glaucoma. (E15) - Interestingly, age of patient had a significant effect on response to latanoprost. (G16) - In accordance with previous reports dorzolamide led to an increase of blood flow velocity in systole. (G10)

State of the art

Topoi	Content types	Distinctive linguistic features	Examples
OPEN ISSUES	**Knowledge and research**, **relations**, and **causality**	Present indefinite or perfective in the main clause Cohesive links with titles Causation (*cause, efficacy*) or association lexis (*association, correlation, influence, role*) Diminutive/ negative diction diction (*not, unknown, few*) or indirect questions Examination (*examine*), analysis, reasoning, or research lexis (*address, assume, certain, know, literature, question, publish, report*) with frequent abstractions Observation abstractions	- If IOP is assumed to influence such discs, the question arises of what rise in IOP will cause progression of glaucomatous damage. (E1) - However, the correlation of the AVP to the degree of glaucomatous field damage has not yet been examined. (G34) - The influence on POBF of brimonidine is still unknown. (G24) - However, few reports are available upon the long-term IOP-lowering efficacy of latanoprost in NTG. (G6) - To our knowledge, this is the first report to address the association between nocturnal BP reduction and CMF. (G5)
DISPARITY/ UNCERTAINTY	Various observational and methodological content	Cohesive links with the title Syntactic patterning: - Disjunctive and concessive connectives (*either… or*, *however*) or prepositions (*from… to up to…*) - Parallelism, repetition, and/ or synonymy/ antonymy/ metonymy Incongruity or variation lexis (*varies, ranging, asymmetric*)	- The incidence of this pathology varies considerably in the studies that have been carried out, ranging from 5% of all types of glaucoma for some authors… to up to 15% of cases of POAG for other authors… (E3) - Early glaucomatous visual field defects are often asymmetric showing either superior or inferior nerve fibre bundle defects. (G34) - A more important outcome after filtering surgery is the prevention of further visual field deterioration; however, the detection of "real" progression needs to be differentiated from the inherent "noise" in visual field testing. (G31)

AVAILABLE TREATMENT/ RESEARCH	**Knowledge and research** or **clinical practice**	Present perfect in the main clause or time and aspect adverbials (e.g. *in recent years*, *today's*) Frequent existential *there is/ are* Clinical practice, analysis, examination, reasoning, or research lexis with frequent abstractions Observation abstractions (e.g. *damage*, *dysfunction*, *hypotension*)	- Treatment for NTG has therefore concentrated on lowering IOP. (G31) - In recent years, the understanding of development and progression of glaucomatous optic nerve damage has changed. (G14) - Studies have been conducted to investigate the relationship between nocturnal hypotension and glaucomatous optic neuropathy. (G5)
NEW APPROACHES	**Clinical practice**, **causation**, and **concepts and classifications**	Present perfective or indefinite in the main clause Cohesive links with titles Time and aspect lexis	- A new concept has been proposed by Davanger, who accounted for the prevalence of NTG on the basis of the overlapping distribution of IOP in population and the pressure vulnerability of the optic nerve head… (E10) - Latanoprost is a "new generation" drug that has recently been evaluated as a potential therapy for patients with NTG in short term studies… (G16) - The high spatial resolution and multiplaner imaging capability of CT scan, and the more recent MRI techniques, provide the clinician with non-invasive ways to evaluate the intracranial mass and the relation between the ICA and optic nerve. (G12)
KNOWN CAUSES/EFFECTS	**Causality**	Finite epistemic verbs in past or present tenses; other finite verbs in the present indefinite Potency and possibility expressions, reasoning, or research lexis Causation expressions (e.g. *cause*, *effect*, *lead to*, *pathogenesis*) or affect verbs (e.g. *improve*, *increase*, *reduce*) Clinical practice, observation, reasoning, or research abstractions (including specialized medical terms)	- Glaucoma surgery has been shown to slow the rate of progression of this disease… (G35) - The pathogenesis of this condition is thought to be multifactorial. (G31) - There is accumulating evidence for a multifactorial pathogenesis of glaucomatous optic neuropathy. (G14)

KNOWN ASSOCIATIONS/ CORRELATIONS	**Relations**	Finite epistemic verbs in past or present tenses; other finite verbs in the present indefinite Modal, reasoning, or research lexis Association (e.g. *associated*, *risk factor*, *role*), discovery or presentation expressions (e.g. *find*, *present*, *reveal*, *show*) Juxtaposition signals (e.g., *in contrast*) Comparison expressions Participant lexis, *group*, observation or research abstractions	- The difference in pattern of morphological changes suggested a hypothesis that non pressure-related factor may contribute to optic nerve damage in glaucoma. (E10) - It has also been shown that in NPG both central visual field loss, involving the central 10° field, and more peripheral field loss are related to the level of IOP… (G33) - Recently, emerging evidences have pointed to a role of ischemia in the pathogenesis of glaucoma. (G5)
AVAILABLE CONCEPTS/ CLASSIFICATIONS	**Concepts and classifications**	Finite epistemic verbs in past or present tenses; other finite verbs in the past indefinite Reasoning or research lexis Identity expressions (e.g. *distinct*, *form*) or designation expressions (e.g. *consider as/ to be*, *calculate/ define/ record/ take as*)	- Evidence is accumulating that NTG may be quite distinct from primary open-angle glaucoma (POAG)... (E10) - Some authors have identified two distinct categories within this nosological form: a non-progressive and a progressive form. (E3)
PREVIOUS FINDINGS	Various observational or **clinical practice** information	Past indefinite throughout Bibliographical references Quantifiers; discovery, presentation, evaluative lexis; or affect verbs Clinical practice, reasoning, or research lexis with frequent abstractions Participant lexis, *group*, or observation abstractions	- Of a group of LTG patients only 40% showed progression in this series. In those patients that progressed there was a 60% change of repeated periods of progression. (E15) - In an Italian study… based on a sample of 2216 subjects (>18 years) 22% had sensorineural hearing loss. Most common aetiology was presbyacusis (14.5%) and progressive vascular disorders (3.6%). (G14) - In contrast, brinzolamide did not to alter ocular perfusion… (G10)

Present study

Topoi	Content types	Distinctive linguistic features	Examples
THEME/ PURPOSE	**Knowledge and research**	Cohesive links with titles Autoreferential deixis (esp. *this study*/ *paper* in the first half of the sentence) Frequent purpose or volition expressions (e.g. *aim at*, *purpose*, *want to*) Examination, analysis, or research lexis in the role of the subject or with a compliment Observation, reasoning, or research abstractions	- This study is aimed at assessing the effects of therapy on POBF and functional parameters in patients with NTG. (E3) - In this study, we therefore wanted to investigate a possible coincidence between NTG and progressive sensorineural hearing loss (PSHL) and the association to APSA. (G14)
HYPOTHESIS	**Relations** or **causality**	Cohesive links with titles Metalinguistic tags (*hypothesize*, *hypothesis*), fronted conditionals, or subjunctive Association (e.g. *associated*, *risk factor*, *role*), causation expressions (e.g. *cause*, *effect*, *lead to*, *pathogenesis*) or affect verbs (e.g. *improve*, *increase*, *reduce*) Observation abstractions	- If the pattern of RNFL loss in NTG has relationship with IOP, the mechanisms of optic nerve damage in NTG might be similar to its in POAG. (E10) - If there is a simple correlation among IOP, optic disc size, and visual field loss, then in subjects with optic discs of equal size visual field loss would be expected to be more advanced in the eye with higher IOP. Furthermore, in eyes with similar IOPs the degree of visual field loss would be expected to be proportional to the size of the optic disc. (E1) - The significant evidence of differences in NTG and POAG would imply pathogenic differences of optic nerve damage between NTG and POAG. (G21)
LOCAL FACTORS	**Causality** with **knowledge and research** or **clinical practice**	Past indefinite in the proposition, subjunctive or present indefinite in the modus Causation expressions (e.g. *because*, *factors*, *effect*, *cause*, *mechanism*) Observation or reasoning abstractions	- A significant difference was observed between the two eyes because of the selection criteria. (E1) - Although we have looked for the effect of potential confounding factors, unexpected confounding factors cannot be excluded which might provide an alternative explanation for the data. (G35) - Alternatively, there may have been a difference in compliance between the patients. (G16)

QUALIFICATIONS	**Clinical practice** and **knowledge and research**	Simple past tense and autoreferential deixis Diminutive/ negative diction (*small*, *not*), deontic modality (*must*, *should*), or potency and possibility expressions (*cannot*, *possible*) Clinical practice, analysis, reasoning, or research lexis with frequent abstractions Participant lexis, *group*, or observation abstractions	- Given the retrospective nature of our analysis and the small number of patients investigated, our results must be interpreted with caution. (G36) - It should be noted that the results presented here come from a retrospective analysis of data. (G35) - The influence of the tested compounds on perfusion of the entire eye cannot be answered by the present study. (G10)
RESULTS CONSISTENCY	**Relations** and **knowledge and research**	Mostly present indefinite tense Comparison, congruity, or consistency expressions (e.g. *agree*, *comparable*, *consistent*, *surprising*) Observation abstractions (e.g. *size*, *value*) and participant lexis, research (e.g. *studies*) or reasoning abstractions (e.g. *data*, *finding*, *results*)	- Concerning the postoperative complications, our data are consistent with those of others... (E15) - This is a considerably larger value than has been mentioned in previous reports of disc size in normal and NTG eyes… (E1) - This is not surprising because antiphospholipid antibodies increase with age. (G14)
METHODOLOGICAL CONSISTENCY	**Relations** and **knowledge and research**	Comparison, congruity, or consistency expressions (e.g. *agree*, *comparable*, *consistent*, *surprising*) Research (e.g. *studies*) and analysis abstractions	- Diagnostic criteria for NPG were very similar to that of previous studies… (G33) - Our analysis varies from previous studies in that we looked at IOP updated for each 6 month period postoperatively as a risk factor for visual field progression. (G31) - In the present study, we modified the standard for classification of nondippers, dippers, and overdippers, which was adopted in a previous study… (G5)

RESULTS RELIABILITY	**Causation** or **relation** with **knowledge and research**	Mostly past indefinite in the main clause Concession/disjunction syntax or time and aspect diction (*no longer*, *remained*) with congruity or consistency expressions (*compare*, *confirm*, *similar*) Specialized lexis (e.g. *adjust for… factor/difference/ disparity/ etc.*, *avoid… effects*, *limits of agreement*, *confidence interval*, *evaluate errors/ confounding factors*) Observation and clinical practice, analysis, or reasoning abstractions	- After adjusting for the factor of IOP, the increase of mean POBF associated with both regimens no longer reached statistical significance (p = 0.424 and p = 0.345, respectively). To avoid the possible effects of systemic cardiovascular medication on POBF, data were further analysed after excluding patients with such medications. The results remained similar. (G24) - Fifteen pairs of repeated IOP measurements were compared for the calculation of limits of agreement between the two observers. The mean difference of the measurements was 0.3 mm Hg and the 95% confidence interval was 20.2 mm Hg to 0.7 mm Hg. The limits of agreement were 21.3 mm Hg to 1.7 mm Hg. (G16) - Age, gender, ocular laterality, lens status, and the time of day of IOP measurement were evaluated as potential confounding factors, but were not found to be significantly associated with IOP reduction. (G6)

Conclusions

Topoi	Content types	Distinctive linguistic features	Examples
EXTRAPOLATIONS	**Relations causality**, or **signs and indicators**	Present tenses throughout Reasoning, research lexis or modals in the main clause Association, causation, identity, or appearance/ indexing expressions Observation abstractions	- These findings suggest that there may be two different types of NTG, the affected eyes differing in optic disc size and in other ocular characteristics. (E1) - This may be indicative of an active (IgM) and persistent (IgG) autoimmune process. (G14) - These differences suggest that optic nerve compression by ICA may be one of the possible causes or may be a risk factor for optic nerve damage of NTG in some patients. (G12)

RECOMMENDATIONS	**Clinical practice**	Present indefinite, subjunctive, or present tense modals in the main clause Cohesive links with titles Clinical practice lexis Specialized lexis (*is indicated*, *recommend*) or deontic modality Examination or clinical practice abstractions with observation abstractions	- In patients with progressive LTG the normal IOP is relatively too high and a reduction to lower levels by means of filtering surgery is in our opinion indicated to improve the capillary perfusion pressure, resulting in a better oxygenation of the optic nerve head. (E15) - Circulatory changes should be considered in the treatment regimen when the cascade of events leading to loss of visual function is most amenable to being interrupted. (G34) - Based on our findings all patients with NTG or significant hearing loss and elevated levels of IgG and IgM antibodies against phosphatidylserine should have further ophthalmological or otological work up. (G14)
NEW/ REMAINING ISSUES	**Relations** or **causality** with **knowledge and research**	Present indefinite in the main clause Clinical practice and reasoning lexis (*assume*, *certain*, *know*) Causation (*cause*, *efficacy*), appearance and indexing (e.g. *reflect*), or association lexis (*association*, *correlation*, *influence*, *role*) Diminutive/ negative diction (*not*, *unknown*, *few*), indirect questions, or juxtaposition signals Autoreferential deixis or time and aspect diction (*no longer*, *remained*) Observation or reasoning abstractions	- Although filtration surgery may alter the aqueous humour dynamics of the fellow unoperated eye… and uniocular application of topical β blockers may reduce the IOP of the contralateral eye…, we do not know whether treatment given to one eye may influence the natural course of the disease of the contralateral eye. (G36) - However, the primary cause remains unclear when visual field integrity does not necessarily reflect nerve fibre health… (G34) - Whether an increase in POBF is beneficial to the optic disc remains debatable. (G24)
FUTURE RESEARCH	**Knowledge and research**	Present indefinite in the main clause Examination, reasoning, or research lexis (e.g. *confirm*, *suggestion*) Deontic modality (e.g. *need*, *should*) or time and aspect diction (e.g. *further*, *future*) Observation, clinical practice, reasoning, or research abstractions	- Hence, our suggestion that NTG may be subgrouped should be confirmed by further investigations on a larger number of subjects. (E1) - Apart from the long term complications noted above the effect of the IOP reduction on visual acuity needs to be recorded. (G35) - Whether antihypertensive treatment has beneficial effect on CMF by flattening circadian BP fluctuation or not could be another subject for future research. (G5)

KEY FINDINGS	Various observational and methodological content	*In summary*/ (*in*) *conclusion* or autoreferential deixis in the initial position	- In this study, latanoprost 0.005% administered once daily significantly reduced the IOP in NTG patients, and maintained this IOP reduction for up to 12 months. (G6) - In conclusion, a high percentage of patients with NTG had marked nocturnal BP reduction. (G5)

INTERPERSONAL ARGUMENTATION

Affective appeals

Topoi	Content types	Distinctive linguistic features	Examples
NEGATIVE MOTIVATION	**Clinical practice**	Cohesive links with titles Expressions with negative connotations (e.g. *difficult*, *side effects*), deontic modality, or potency and possibility expressions combined with negative diction (e.g. *may*, *can*) Clinical practice lexis with frequent abstractions Observation abstractions	- However, the disease of the small vessels supplying the optic disc is till now hardly accessible for direct therapy. (E15) - The treatment of progressive NTG represents a therapeutic challenge. (G35) - Potential side effects and high frequency of application (four times daily) has reduced the popularity of pilocarpine especially in the presence of newer generation glaucoma medications. (G16)
POSITIVE MOTIVATION	**Clinical practice** or **knowledge and research**	Cohesive links with titles Emphasis (e.g. *important*, *significance*) or positive evaluative lexis (e.g. *ideal*), or potency and possibility expressions (e.g. *can*, *detectable*, *may*, *potent*) Clinical practice, analysis, reasoning, or research lexis (e.g. *extrapolate*, *study*) Clinical practice, (e.g. *clinical practice*, *therapy*, *treatment*), observation, examination, analysis, reasoning, or research abstractions	- It seems therefore to be important to compare visual field behaviour of the operated eye and the non-operated eye in the same patient. (E15) - These techniques are of fundamental importance in the study of pulse amplitude (PA) and the POBF. (E3) - Therefore, POAG patients with uniocular field loss represent an ideal population in which to investigate factors influencing the onset of field loss over a period of time. (G36) - Our analysis may be more easily extrapolated to clinical practice in that the risk of future visual field progression can be estimated from "current" IOP, taken as the median of readings done in the past 6 months. (G31)

PREVALENCE/ INCIDENCE	**Instances and precedents**	Percentages or fractions Distribution diction (e.g. *incidence*, *population*, *prevalence*, *total*)	- In Japan Shiose found a prevalence of NTG of about 2% of residents aged 40 years or older, accounting for about 57% of all types of glaucoma… (E3) - Normal tension glaucoma (NTG) has a prevalence of 0.6% within white populations and is thought to account for 20–30% of primary open angle glaucoma… (G33) - In the general population, approximately two thirds of individuals exhibit a 5% to 10% physiological nocturnal BP reduction. (G5)

Logical appeals

Topoi	Content types	Distinctive linguistic features	Examples
ASSUMED FACTS	Various observational content	Present indefinite tense Causation expressions (e.g. *cause*, *effect*, *lead to*, *pathogenesis*), affect verbs (e.g. *improve*, *increase*, *reduce*), association (e.g. *associated*, *risk factor*, *role*), discovery or presentation expressions (e.g. *find*, *present*, *reveal*, *show*), appearance or indexing expressions (e.g. *appearance*, *indicator*, *manifestation*, *reflect*, *sign*)	- Complications of filtering surgery in LTG are not different from those reported for filtering surgery in POAG. (E15) - The more severe the defect the earlier visual field loss develops in the "second eye". (G36) - Systemic hypertension and diabetes are major causes of vascular dysfunction… (G12)
RELEVANT DETAILS	Various methodological information	Present indefinite or present tense modals Clinical practice (e.g. *management*, *substances*, *treatment*), examination, analysis (e.g. *correction*, *formula*, *model*, *variability*), or observation abstractions (e.g. *damage*, *dysfunction*, *hypotension*)	- The change in POBF should exceed the variability resulting from measurement and physiological variation to be attributable to drug effects. (G24) - Color Doppler imaging (CDI) measures blood flow velocities. (G10) - As indicated in the formula, IOP and BP parameters affect theoretical MOPP value at each point of measurement. (G5)

ASSUMED CONCEPTS/ CLASSIFICATIONS	**Concepts and classifications**	Present indefinite tense Appearance and indexing (e.g. *indicated*, *index*), identity (e.g. *characteristic*, *characterize*, *form*, *normal*, *subset*, *typical*), designation expressions (e.g. *consider as/ to be*, *define/ take as*, *refer to*), or compound nominal predicates Observation abstractions or participant lexis	- Normal-Tension Glaucoma (NTG) refers to a clinical entity of glaucomatous optic disc change and visual field defect without elevated intraocular pressure (lOP)... (E10) - Normal tension glaucoma (NTG) is a subset of primary open angle glaucoma (POAG), with characteristic glaucomatous cupping and field loss, an open drainage angle, and an intraocular pressure (IOP) consistently within the normal range... (G36) - The remaining individuals are classified as either nondippers or overdippers… (G5)
RESEARCH TYPE	**Knowledge and research**	Present indefinite tense Specialized lexis (e.g. *clinical*, *retrospective*, *review*, *trial*)	- This was a retrospective clinical study. (G21) - The study was designed as an interventional, randomized, prospective, institutional, single-blinded, controlled, clinical trial. (G10)
RESEARCH ETHICS		Past indefinite tense Specialized lexis (e.g. *approve*, *informed consent*, *review board*, *the tenets of the Helsinki declaration*) Research lexis	- In every case, informed consent was obtained as to the type of therapeutic approach adopted. (E3) - Institutional review board approval was obtained, and verbal and written consent was obtained from all subjects. (G24) - The study was approved by the Norwich District ethics committee and all patients underwent informed consent. (G16)
DATA PRESENTATION	**Knowledge and research** and **clinical practice**	Mostly present indefinite tense Discovery or presentation lexis (*give*, *represent*, *present*, *show*) Specialized lexis (e.g. *figure*, *table*), observation or reasoning abstractions	- The morphometric characteristics of the optic discs are summarised in Table 2. (G36) - Figure 2 shows the mean diurnal curves for both randomised groups at baseline and at follow up. (G16) - Thus no P-values will be presented for these observational parameters. (G10)
RELEVANT LITERATURE/ COMPANION PUBLICATIONS	**Knowledge and research**	Bibliographical references with research lexis Copyright information with *obtain from*	- The mode of progression of LTG patients has recently been described... (E15) - The effect of such a lowering in IOP is to be addressed in a companion paper… (G35) - The method has been presented in detail elsewhere… (G34)

MANUFACTURERS	**Clinical practice**	Past indefinite tense Names of materials and manufacturers	- Latanoprost (50 µg/ml) was obtained from Pharmacia Pfizer (Karlsruhe, Germany) as Xalatan®. (G10) - Dorzolamide was obtained in form of Trusopt® from MSD-Chibret, Munich, Germany. (G10)

Commentary

Topoi	Content types	Distinctive linguistic features	Examples
METHOD/ DESIGN JUSTIFICATION	**Knowledge and research**	Evaluative lexis (e.g. *advantage, ideal*), potency and possibility expressions (e.g. *can, detectable, may, potent*), or diction with positive or negative connotations (e.g. *ensure, overrepresent*) Observation, analysis, reasoning, research, examination, or clinical practice abstractions	- This approach was chosen because a direct comparison of glaucomatous visual field defect and corresponding retinal microcirculation is possible. (G34) - Analysis using microdensitometry and scanning laser polarimetry has the advantage of evaluating the severity of NFL defects in three dimensional mode by computer system. (G21) - This was to ensure that the IOP measurements between the two observers were comparable. (G16) - Through this method, which has not been used in previous studies, quantitative information about the NFL defects could be obtained. (G21)