

ABSTRACT

Title of Document: RELEVANCE, RHETORIC, AND ARGUMENTATION:
A CROSS-DISCIPLINARY INQUIRY INTO PATTERNS OF THINKING AND INFORMATION STRUCTURING

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This dissertation research is a multidisciplinary inquiry into topicality, involving an in-depth examination of literatures and empirical data and an inductive development of a faceted typology (containing 227 fine-grained topical relevance relationships and 33 types of presentation relationship). This inquiry investigates a large variety of topical connections beyond *topic matching*, renders a closer look into the structure of a topic, achieves an enriched understanding of topicality and relevance, and induces a cohesive topic-oriented information architecture that is meaningful across topics and domains. The findings from the analysis contribute to the foundation work of information organization, intellectual access / information retrieval, and knowledge discovery.

Using *qualitative content analysis*, the inquiry focuses on meaning and deep structure:

- Phase 1: develop a unified theory-grounded typology of topical relevance relationships through close reading of literature and synthesis of thinking from communication, rhetoric, cognitive psychology, education, information science, argumentation, logic, law, medicine, and art history;
- Phase 2: in-depth qualitative analysis of empirical relevance datasets in oral history, clinical question answering, and art image tagging, to examine manifestations of the theory-grounded typology in various contexts and to further refine the typology; the three relevance datasets were used for analysis to achieve variation in form, domain, and context.

The typology of topical relevance relationships is structured with three major facets:

- **Functional role** of a piece of information plays in the overall structure of a topic or an argument;
- **Mode of reasoning**: How information contributes to the user's reasoning about a topic;
- **Semantic relationship**: How information connects to a topic semantically.

This inquiry demonstrated that topical relevance with its close linkage to thinking and reasoning is central to many disciplines. The multidisciplinary approach allows synthesis and examination from new angles, leading to an integrated scheme of relevance relationships or a system of thinking that informs each individual discipline. The scheme resulting from the synthesis can be used to improve text and image understanding, knowledge organization and retrieval, reasoning, argumentation, and thinking in general, by people and machines.

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PATTERNS OF THINKING AND INFORMATION STRUCTURING

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Dedication

To my parents.

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Part 1

Introduction, Literature Review, and Methodology

Chapter 1. Introduction and Purpose of the Research

Chapter 2. Conceptual Framework and Literature Review

Chapter 3. Methodology

Chapter 1. Introduction and Purpose of the Research

The thesis aims to advance thinking on the conceptual nature of topical relevance and, through a multidisciplinary inquiry, to discover a broad range of *topical relevance relationships* beyond topic matching. It will explore the complexity of topical relevance relationships and reveal an enriched concept of topicality. A clearer understanding of topical relevance provides the basis for adapting retrieval and organization of information to the user's task and situation and presenting the user with a multi-faceted view of the topic.

The notion of relevance lies at the heart of intellectual access and in turn topical relevance lies at the heart of relevance. Topical relevance can be broadly defined as the *relatedness* between topics, see detailed discussion in Chapter 2. Although topical relevance is widely recognized as the most important factor in selecting information, our understanding of the notion remains vague, limited, oversimplified, and unexplicated (Bean & Green, 2001; Cooper, 1971; R. Green, 1995; R. Green & Bean, 1995; Huang & Soergel, 2004, 2006; Huang & White, 2005; Rees & Saracevic, 1966; Saracevic, 1975, 1996; P. Wilson, 1973, 1978).

Detecting topical relevance is more complicated than simply matching contents or words between a query and a document; instead, it is a process that heavily involves inference and reasoning (Bean & Green, 2001; Cooper, 1971; R. Green, 1995; Huang & Soergel, 2006; D. Wilson & Sperber, 2002; P. Wilson, 1973). Within this perspective, exploring topical relevance relationships must go beyond the domain of information science into the much broader context of communication and general methods of thinking. In this study, the conceptual analysis of topical relevance

relationships is informed by theories and methodologies from a variety of disciplines: Communication, Rhetoric, Argumentation theory, Reasoning & logic, Information science, Education, Cognitive psychology, History, Law & legal reasoning, Medical problem solving, and the Visual perspective. Findings derived from the analysis not only contribute to our understanding of topical relevance in information-seeking (retrieval) context, but more broadly enrich our knowledge of thinking, reasoning, making inferences, drawing conclusions, and building arguments.

1.1 Problem Statement

Topical relevance is consistently found to be the central criterion for user relevance judgments; yet the rising concern with “user relevance” has shifted attention away from topical relevance. To a large extent, the underlying mechanism of topical relevance still remains a black box to us. As pointed out by Schamber and colleagues, “...an enormous body of information science literature is based on work that *uses* relevance, without thoroughly understanding what it *means*...” (Schamber, Eisenberg, & Nilan, 1990). If this is true about relevance, it is even more so about topical relevance. Although topicality is often mentioned in relevance studies, it is only treated as a primitive (undefined, self-explicable) concept and rarely receives more discussion beyond this general terminology level. In fact, definitions of topical relevance are largely circular and paraphrase-like. There exists much confusion and misunderstanding of topical relevance (for detailed discussion see Section 1.3). Its conceptual nature remains unexplicated and we know little about the fundamental issues of topical relevance, just to name a few:

- What is the mechanism for a piece of information to be identified as topically relevant?

- What other factors are responsible for topical relevance beyond content or term matching?
- What are the types of topical relevance relationships besides matching? How are they defined?
- In what ways do various topical relevance relationships relate to the user's task and situation?
- Ultimately, how does a piece of information contribute to and fit into the user's thinking, understanding, and problem-solving process?

This study is intended to gain insight into the fundamentals of topicality and in particular, to develop a better conceptual understanding of topical relevance relationships. Therefore, the central question of this thesis is,

Are there *multiple types of topical relevance relationships* beyond topic matching? If so, what are they? How are they defined in terms of *functional roles* and *evidentiary connections (modes of reasoning)* exhibited by an information object?

It is concerned with how a piece of information contributes to the overall understanding of a topic, a situation, a problem, or an issue of interest and how it contributes to building an argument, answering a question, deriving a generalization, making a decision, or solving a problem. The analysis focuses on two facets that can be used to characterize this contribution: *functional role* and *evidentiary connection (mode of reasoning)*.

- *Functional role*: the role a piece of information plays in the overall structure of a topic or an argument, by taking into account its relations with other parts

of the given information passage or the argument. Adopting the *rhetorical structure theory* (Mann & Thompson, 1988) perspective, “for every part of a coherent text, there is some function for its presence, evident to readers”, e.g., circumstance, solutionhood, elaboration, background, motivation, evidence and justify, relations of cause, interpretation, evaluation.

- *Evidentiary connection (Mode of reasoning)*: logic- and inference-based relationships that link pieces of information and a topic; it can be seen as the inference chain between information and topic. This perspective is concerned with how pieces of information can be identified through an inference chain and how specifically they relate and contribute to a receiver’s reasoning about a topic, e.g., direct evidence, circumstantial evidence.

The thesis builds upon the key contributions of Cooper, Wilson, and Green and Bean and extends them with the focus on an evidential and functional perspective. Cooper (1971) and Wilson (1973) have in-depth discussions of topical relevance as logical and evidential relationships but they do not aim for providing a detailed typology of relevance relationships in their studies. Green and Bean (1995) set out to identify topical relevance relationships beyond exact topic matching. Their study is based on a linguistic analysis of relationships between a subject heading for which a passage was found relevant by indexer and the passage text, resulting in a set of specific paradigmatic and syntagmatic relationships. Their emphasis is on the semantics of relationships. All these studies stay within the domain of information science.

This thesis extends previous work with a multidisciplinary approach to discovering topical relevance relationships and organizing them into a systematic

comprehensive framework. It applies an “information use” perspective to analyzing and explicating topical relevance relationships; specifically, to find out how a piece of information contributes to understanding the overall user topic and what functional role it plays in the user’s reasoning and problem-solving process. As such, relevance relationships are directly linked to the user’s problem-solving process and provide higher-level support for users’ thinking.

The theoretical analysis of topical relevance relationships has important implications for information seeking and retrieval. Topical relevance has been a fundamental issue and of central concern to IR system design and evaluation. Lacking sufficient knowledge on topicality has substantially compromised IR systems’ ability of *precisely* predicting and *efficiently* providing useful information to the user. Theoretical analysis in this study will be done with a view towards improving the design of user- and task-centered information systems.

The remainder of this section discusses how a better understanding of topical relevance relationships relates to the current trends in information search and retrieval and can be used to overcome limitations of current IR systems.

User-centered and task-centered information search

User-centered and task-centered information search is to allow users to stay at the center of their tasks, without being too distracted by interactions with the system or putting extra efforts to accommodate the system’s maneuvers. Present IR systems are limited in this respect: They are designed to provide only directly-matching information on a topic and do not effectively respond to non-matching types of user requests, especially in the case of exploratory search.

For example, if a user is interested in learning the social context before 9/11, such as cultural conflicts, current IR systems do not directly support such a search. Instead of submitting a query of “social context pre-9/11”, the user probably needs to recall a particular event or a particular person that s/he already knows as relevant to start the search. This requirement is likely to stop users who know little about the background beforehand; even for knowledgeable users, it takes extra mental effort to reformulate original requests to “fit” the system.

It has been long neglected that users’ information tasks are very diversified; seeking for a direct-matching answer right on topic accounts for only one type of information need. With information tasks based on other relevance relationships, users must shift attention to reframe questions and constantly orient themselves to one new instance after another, as a result, users can hardly keep their focus and stay at the center of their tasks. When a system limits its implementation of topicality to direct matching, it limits its search capability and in turn limits the type of questions that a user can ask. To make IR systems more responsive to users’ tasks and more adaptive to users’ exploratory searching behavior, it is important to further explore a broader spectrum of topical relevance relationships beyond direct matching.

Towards more refined and precise information retrieval

The significance of relationships has been well recognized to fine-tune information search. In traditional retrieval process, thesauri devices to specify relationships between terms, such as hierarchical structure, pre-/post-combination, role indicators, links/operators, and relators, are used to prevent false drops and to improve precision of the search (Soergel, 1994). Conventional indexing emphasizes concepts/entities rather than relationships that hold between concepts/entities.

Usually, it identifies only what terms are relevant without indicating why and how they become relevant. Green (1997) concludes that conventional indexing is fairly simple in relational structure and not sufficient for describing users' information needs. She proposes to integrate relational structures (semantic frames) into indexing to describe how words relate to potential user needs on the conceptual level (Green, 1989). Nowadays, full-text indexing and matching applied to advanced retrieval models (vector models, probabilistic models, language models ...) make heavy use of co-occurrence among free-text words or between words and documents. Co-occurrence indicates only associations, but the nature and semantic meaning of these word associations are left undistinguished and unspecified in the process of indexing, leaving plenty of room for fine tuning.

In the current context of the information explosion, we must relieve the burden of information overload on users by making information retrieval more precisely targeted to specific user needs. Meaningful relationships and structures, which are so richly embedded in the information space, become the key to fine tune the correspondence between an information object and a user's request. The field calls for research and proposals that allow us to fully harness relational structures as precision devices for enhancing retrieval performance.

Further specification of topical relevance relationships is one area of the research responding to the call. As reported in my earlier studies (Huang and Soergel, 2004, 2006; Huang and White, 2005), there are multiple ways for a piece of information to become topically relevant to a user's topic beyond exact topic matching, such as:

- by showing circumstantial evidence (inferential)
- by supplementing context (physical, social, cultural, etc.)
- by providing comparative cases (similar, analytical, contrasting)

Recognizing various types of topical relevance relationships allows us to further specify the correspondence between an information object and a user's topic: not only detecting the presence of relevance, but also specifying how an information object contributes to the user's understanding of a topic and how it can be fit into the user's problem-solving process. We can present the specific relevance relationship categories to users and structure retrieval results into the line of argument. For example, we put expandable titles indicating "Social context", "Contrasting examples", etc. on the search interface and organize retrieval results into these categories accordingly, so that users can directly and quickly narrow down to the aspect(s) of interest. This saves users much effort for digging through the hodgepodge of one million results, weeding out aspects outside their interest scope, and organizing search results in a way that is readily helpful for drawing conclusions and solving problems.

Positive impact on users' thinking and learning

In turn, by not limiting relevant information to direct-matching information, search systems help to raise users' awareness and attention to other types of relevant information, therefore, users become more capable of establishing a fuller view and a better understanding of the matter at hand (as shown in my interview study reported later). Also, through rich contextual and analogical information, systems cultivate users' thinking, encourage discoveries of relationships, and forge new linkages between discrete information items. Moreover, an important indication of learning is "creation of new knowledge structure" (Allen, 1996). By fully representing various relevant aspects of a topic, a task, and a problem, search systems help to trigger users'

internal (re)organization of knowledge (information) and structure users' thinking process.

Summary

To summarize, compared to the rapid development of information technologies, conceptual knowledge of the fundamentals, topical relevance in particular, appears limited and insufficient. The mismatch between conceptual understanding and applied technology prevents us from taking full advantage of today's computational power to fulfill users' information needs. More effort is urged to advance the thinking on topical relevance and, ultimately, by incorporating a more complete and adequate notion of topicality, to improve IR systems' capability to better support users' learning, reasoning, and problem solving.

1.2 Themes and Questions

Theme 1. Towards a unified and well-grounded typology of topical relevance relationships

Question 1: Are there *multiple types of topical relevance relationships* beyond topic matching? If so, what are they? How are they defined in terms of *functional roles* and *evidentiary connections (modes of reasoning)* exhibited by an information object?

It is the central question of this dissertation. In the analysis and explication of topical relevance relationships, two facets are stressed:

- *Functional role* (Mann & Thompson, 1988) is concerned with what functional role a piece of information plays in the overall structure of a topic or an argument, e.g., pertaining to the main topic, comparison, context, presupposition, evaluation
- *Evidentiary connection (Mode of reasoning)* is based on logic and inference, concerned with how pieces of information can be identified through an inference chain and how specifically they relate and contribute to a receiver's reasoning about a topic, e.g., circumstantial evidence

To empirically verify and complement the findings derived from answering the primary research question, the study continues to research on the following two aspects of the issue.

Theme 2: Manifestation of topical relevance types across disciplines

Question 2: How do various types of topical relevance relationships *manifest* themselves in different disciplines and different contexts? What are the commonalities and differences?

Chapter 2. Conceptual Framework and Literature Review

2.1 Overview: Relevance Research in Information Science

Relevance is *the* fundamental and central concept in information seeking and retrieval (Borlund, 2003; Froehlich, 1994; Mizzaro, 1997; Saracevic, 1975, 1996, 2006; Schamber, Eisenberg, & Nilan, 1990). Relevance relates the user's information need to the information retrieved by the system. On the one hand, the determination of relevance lies at the heart of designing and evaluating retrieval systems; on the other hand, the investigation of relevance motivates a better understanding of users' needs, tasks, and situations. As such, the notion of relevance bonds the *user*, the *information*, and the *system* within an intimate circle.

Given its importance in information science and particularly in retrieval applications, the subject of relevance has received sustained attention from information scientists throughout the decades:

The first formal basis of relevance, as seen by Saracevic (1975), can be traced back to bibliometrics studies dated as early as 1920s (Lotka, 1926; Bradford, 1934, 1953; Zipf, 1949; Urquhart, 1959; Fairthorne, 1969). In Bradford's (1934) classic paper on the law of literature distribution, he first talked about *relevance to the subject concerned*: the nuclear sense of relevance, or topical relevance, was recognized and applied. The influential IR projects in 1950s, ASTIA (Gull, 1956) and the Cranfield experiments (C.W. Cleverdon, 1960; C. W. Cleverdon, Mills, & Keen, 1966; Thorne, 1955), together with other IR pioneers (Fairthorne, 1955, 1956; Mooers, 1950; Taube, 1955), brought forth the issues of operationalizing and

measuring relevance in retrieval. The early IR applications intensified the debate over relevance and cultivated active thinking on the subject.

The early relevance research (1950s-1970s) is marked by its devotion to understanding the nature and conceptual subtleties of relevance, with an emphasis on “topical appropriateness”. The well-known concepts of *logical relevance* (Cooper, 1971), *situational relevance* (P. Wilson, 1973), and *pertinence* (Foskett, 1972; Goffman & Newill, 1966; Kemp, 1974) were proposed during this period of time. The earlier works of relevance not only explored relevance as a logical construct, but also recognized it as a *user construct*, a manifestation that is highly subjective (Rees & Saracevic, 1966). Experimental studies involving human relevance assessors, as most noted and extensive as in Cuadra & Katter (1967a, 1967b) and Rees & Schultz (1967), were carried out to explore a variety of user variables, such as knowledge level, use orientation, frames of reference, cognitive patterns, personalities, and tasks. Other early works of note include M.E. Maron & Kuhns (1960), Weiler (1962), Doyle (1963), Hillman (1964), Cooper (1973), Kochen (1974), M.E. Maron (1977), Swanson (1977), and Wilson (1978), for a comprehensive review of the earlier relevance literature see Saracevic (1975, 1976).

After about a decade of dormancy in relevance research, the discussion was re-opened by a new generation of relevance researchers, embracing *naturalistic inquiry* and bringing the *real user* perspective into the picture. Ever since, the emphasis of relevance research has shifted from *conceptual* to *empirical*, from *rationalistic* to *naturalistic*, and from *topical* to *non-topical* (Froehlich, 1994; Park, 1994). In the 1990s and 2000s, a number of studies identified numerous relevance criteria other than topicality emerging from real-user relevance assessments, such as recency, novelty, verification, quality, physical availability, just to name a few from many

relevance criteria mentioned in the literature (Barry, 1993; Barry, 1994; Barry & Schamber, 1998; Bruce, 1994; Choi & Rasmussen, 2002; Cool, Belkin, & Kantor, 1993; Froehlich, 1994; Harter, 1992; Hersh, 1994; Janes, 1994; Lawley, Soergel, & Huang, 2005; Park, 1992, 1994; Schamber, 1991, 1994; Schamber, Eisenberg, & Nilan, 1990; Sutton, 1994; Wang, 1994; Wang & Soergel, 1998; Wang & White, 1999; Xu & Chen, 2006). These relevance criteria vary from one individual user to another and among different points of time. Fully taking these criteria into consideration, relevance becomes such a dynamic and situational notion that, these authors believe, only the information user herself, in a particular situation at a particular time, can judge the relevance of retrieved information object(s).

2.2 Conceptual Framework of Relevance in Information Science

Relevance is such a highly complex phenomenon that information scientists have not yet reached a consensus on how the concept should be understood theoretically or measured operationally. In the long history of relevance research, a large literature and numerous views and explications have come forth. From a higher-level analysis and synthesis, some major dimensions emerge for conceptualizing the notion of relevance and investigating the issue of relevance assessment. The concept of relevance in information science, or possibly in a more general context, can be defined as follows (refining the relevance definition framework of Saracevic, 1975):

Relevance

is a relationship **R**
between
an information object **I** and
an information need **N** (topic/request as qualified by user,
task/problem, situation variables, and time)
as determined by an agent **A**
based on representations **I'** of I and **N'** of N.

This conceptual framework of relevance consists of five major dimensions:

R *Relationship type*: at heart, relevance is meaningful relationship (correspondence, connection, fit, bearing, etc.) being perceived. For topical relevance, it is generally assumed there is only a single relationship type “topic matching”, with little attention being paid to other possibilities. However, this widely held assumption is not justified; a wide range of relationship types beyond topic matching account for topical relevance, such as hierarchical and syntagmatic relationships (Green & Bean, 1995). To explore the variety of topical relevance relationship types is the focus of this thesis.

The *information object I* and the *information need N* are the two central entities for defining the notion of relevance. Representations (**I'**, **N'**) involve a set of variables that heavily influence relevance assessments, but conceptually they are not inherent components of the relevance definition.

I *Information object*: Types of information objects include text or multimedia documents, images, speech, music, statements or assertions, a database table, or a row in a database table, etc.

Representation I' of I: referring to a surrogate for representing the information object, such as title, abstract, author/artist, keyword/descriptor, extracted passage(s), snap shot, summary, full text (an information object representing itself), review, etc. These surrogates represent the information object at varied levels of detail. In information search and retrieval, the surrogates are often used as the basis for making relevance judgments. The form of the representation has many effects on the resulting relevance judgments, as summarized in detail in Mizzaro (1997).

Further, many attributes are associated with the information object and its representations, just to name a few: credibility/authority, quality, accuracy, orientation/level/difficulty, recency, novelty, source, genre, style ...

N *Information need*: is multi-dimensional, highly complex, and highly dynamic. It usually revolves around a topic or a subject; but sometimes the topic is implied or so general as to be not salient. But in many cases a topic is an incomplete specification of an information need. An information need is further qualified by

- 1) *User variables*: stock of knowledge, search experience, literacy level, cognitive style, affective state ...
- 2) *Task/problem variables*: purpose/intent/goal, structure of task, stage of problem-solving...
- 3) *Situation variables*: situational constraint (e.g., deadline), broader social/cultural/economic context ...
- 4) *Time* as a factor affects all the above variables and results in changes in the information need.

Due to all the dimensions and circumstantial complexities involved in an information need, relevance is recognized as a multi-dimensional and dynamic concept. Entity N is the emphasis of recent relevance studies and has attracted increasing attention for IR system design and evaluation.

Representation N' of N: the information need is an entity mostly resting on the conceptual level. In the process of information search and retrieval, the conceptual information need is expressed in a variety of forms, such as:

- Request: a statement of information request, in written or oral form
- Topic: subject matter of the request
- Search query: expressed in searching language, such as keywords, Boolean search operators, inclusive search indication, etc.
- Question (especially for question-answering systems)
- Description of intended use of the retrieved information (Cuadra & Katter, 1967)
- Work task simulation/description: as described in the recent development of interactive information retrieval evaluation (Borlund, 2003)

A ***Agent: who determines relevance:*** dimension A can be broadly divided into two categories—by human and by system, as elaborated as follows

A1 ***Human-defined relevance:*** relevance is determined by real users, subject experts, search intermediaries, or other types of human assessors.

A1.1 *User-defined relevance*: relevance is determined by real users with a genuine information need in naturalistic situations. This is the essence of the user view, which considers relevance as a dynamic and subjective experience that involves cognitive restructuring (Borlund, 2003). In most cases, topical relevance is the central ingredient in user-defined relevance.

A1.2 *Non-user-defined relevance*: relevance is determined by subject experts, by information specialists, by consensus of a group, or other types of human assessors. Includes *expert- or consensus-defined relevance*. In many and particularly early IR evaluations, expert- or consensus-defined topical relevance is used as the gold standard against which the system is evaluated. Many authors contrasting the *system view* and the *user view* of relevance (see Section 2.4) consider non-user-defined topical relevance as belonging to the system view, see discussion in Section 2.6.

A2 *System-determined relevance* (“algorithmic relevance”): relevance is determined by “internal aspects and manipulations of the system” (Saracevic, 1975). With the system as the agent, the notion of relevance is reduced to algorithmic approximations. Relevance is equated to relevance scores which are derived on the basis of matching representations of an information need and an information object.

System-determined relevance is intimately related to specific approaches and algorithms implemented by the system to derive document-query matching scores; thus it is also labeled as *algorithmic relevance* by Saracevic (1996) in his relevance framework. Dependent on different retrieval models or algorithms used by specific systems, further specifications can be made of algorithmic relevance,

such as Boolean relevance, vector-space relevance, probabilistic relevance, etc. (Borlund, 2003). These different versions of system-determined relevance are essentially “approximations” of relevance in its strong sense (see Section 2.4.1); and approximations, by nature, are *inadequate* substitutions (Doyle, 1963).

Most IR systems to date determine relevance based only on topic matching. However, a system can use many criteria and complex inferences to determine relevance scores. System-determined topic-matching relevance has been heavily criticized for being static and insensitive to the user’s cognitive states and situations.

The conceptual framework of relevance can be summarized in Figure 2-1. Associated entity types and attributes are listed under each major dimension of the relevance framework. The listing is used here for the purpose of illustrating each dimension and delineating the overall structure. It captures the main facets and provides an overview, but the specification is by no means exhaustive. The listing draws on earlier frameworks (Saracevic, 1975; Schamber, 1994; Green & Bean, 1995; Saracevic, 1996; Mizzaro, 1997; Wang & Soergel, 1998; Huang & Soergel, 2004, 2006;) as well as general knowledge in information science.

Figure 2-1 A Conceptual Framework of Relevance in Information Science

| | |
|---|--|
| <ul style="list-style-type: none"> . Information object (I) .. Type ... Document/article/text ... Image ... Speech ... Music .. Representation (I') ... Title ... Author/artist ... Keyword/descriptor ... Abstract/summary ... Extracted passage/snap shot ... Full text/whole piece of work ... Review .. Attribute ... Quality ... Accuracy ... Credibility/authority ... Recency ... Novelty ... Orientation/level/difficulty ... Source ... Style ... Genre . Relationship type (R) .. Matching relationship ... Exact matching ... Boolean matching ... Probabilistic matching .. Hierarchical relationship ... Taxonomy ... Partonomy .. Structural relationship ... Structural component ... Complex structure .. Functional-Evidentiary relationship ... Direct evidence ... Indirect evidence ... Contextual evidence ... Comparative evidence | <ul style="list-style-type: none"> . Information need (N) .. Qualified by user variable ... Stock of knowledge ... Search experience ... Literacy level ... Cognitive style ... Affective state ... Personality .. Qualified by situation variable ... Constraint Deadline Access to resources ... Broader context Social Cultural Economic .. Qualified by task/problem variable ... Purpose/goal/intent ... Task Structure of task Complexity of task ... Problem Stage of problem solving .. Representation (N') ... Topic/subject ... Request ... Question ... Search query ... Work task description/simulation . Agent (A) .. Human ... Real user as relevance judge ... Non-user as relevance judge Subject expert Information specialist Knowledge consensus .. System, as based on ... Boolean model ... Probabilistic model ... Vector model ... Language model |
|---|--|

The conceptual framework of relevance presented here refines the relevance definition framework of Saracevic (1975), shown below:

Relevance is the A of a B existing between a C and a D as determined by an E, where various values are filled in the slots for various definitions. The following are values available for each slot:

| A | B | C | D | E |
|-----------|----------------|----------------------|-------------------------|------------------------|
| Measure | correspondence | document | query | person |
| degree | utility | article | request | judge |
| dimension | connection | textual form | information used | user |
| estimate | satisfaction | reference | point of view | requester |
| appraisal | fit | information provided | information-requirement | information specialist |
| relation | bearing | fact | statement | |
| | matching | | | |

According to Saracevic’s framework, relevance is defined as a *measure* (slot A) of a *correspondence* or *relationship* (slot B). However, this definition confuses relevance with relevance judgment (Green, 1995) and the “measure” aspect is not inherent in defining the concept of relevance. Therefore, in the current framework, relevance is defined as a relationship (R) rather than a measure of a relationship. The current framework further distinguishes elements that are inherent in conceptualizing the notion of relevance from elements that are pertaining to making judgments about relevance: in slot C of Saracevic’s framework, information object (I) is mixed together with the representation of the information object (I’); in slot D, information need (N) is mixed together with the representation of the information need (N’). Further, agent (A) in the current framework broadens the slot E in Saracevic’s framework to include *system* as one type of agents that participate in identifying/detecting relevance.

This remainder of this chapter lays out the big picture in which the present study can be situated. It does not aim at providing a thorough specification and introduction

to the relevance literature, for detailed specifications and analysis see reviews by Saracevic (1975, 2006), Schamber, Eisenberg, & Nilan (1990), Schamber (1994), and Mizzaro (1997). The following discussion focuses on two dimensions:

- System view vs. user view of relevance
- Entity-based approach vs. relationship-based approach for conceptualizing the concept of relevance

Issues and points of confusion and misunderstandings with respect to topical relevance will be emphasized at the end.

2.3 Conceptual Definition of Topical Relevance

The following definitions capture the essence of *topical relevance* in information science:

- Cooper's *Logical relevance* (1971: 24-25): "A stored sentence is logically relevant to (a representation of) an information need if and only if it is a member of some minimal premiss set of stored sentences for some component statement of that need. That is to say, the relevance of a sentence to a need is dependent entirely upon its membership in a minimal stored set from which an answer to the need can be deduced... As an example of this definition, if two of the sentences stored were 'An atom of hydrogen contains just one proton' and 'No atom of any halogen element contains less than six protons' they would each be considered relevant to the need expressed in the question 'Is hydrogen a halogen element?'"

As concluded by Wilson (1973: 459): "The key to Cooper's definition of logical relevance is the idea that a statement is relevant to a question if it

belongs to a set of statements, a non-redundant or ‘minimal’ premiss set of statements, from which an answer to that question follows logically. The definition of logical relevance thus depends on the concept of logical consequence.”

- Wilson’s *Evidential relevance* (1973: 460) complements the concept of logical relevance by introducing *inductive logic* in the conceptualization: “The notion of relevance has, if anything, an already better established footing in inductive logic than in deductive... This is a sort of relevance: evidential relevance, we shall call it. It is a sort of relevance that cannot be completely understood in terms of the notion of logical consequence, but requires the notion of the degree of confirmation, or probability, of conclusions in relation to given premises. The simplest, no doubt inadequate, explanation of evidential relevance is this: an item of information I_j is relevant to a conclusion h in relation to premises e if the degree of confirmation, or probability, of h on evidence e and I_j is greater or less than the degree of confirmation, or probability, on e alone.”
- Soergel (1994: 589-590) describes *Topical relevance* as “a relationship between an entity and a topic, question, function, or task. A document is topically relevant for a question if it can, in principle, shed light on the question. “In principle” means that the document can do so for a person (or system) who knows the language of the document, has the background to understand the document, and is capable of processing the information transmitted by the document in relation to the question. “Shedding light on” means that the document provides information that either directly answers

the question or is part of a premise set from which the question can be answered through a chain of inferences. The degree of relevance of a document depends on a number of factors: the amount of relevant information given: the strength of the relationship between the information given and the question –for example, the length of the inference chain from the information given to the answer; the strength of the contribution to the quality and/or surety of the answer; and perhaps other factors.”

The conceptualization of topical relevance also involves the understanding of “aboutness”. The truth is, “we are all immediately and intuitively able to understand the meaning of aboutness” and yet it is extremely difficult to specify exactly what “aboutness” means (Maron, 1977: 40; for more discussion on aboutness, see Hutchins, 1977; Bruza, Song, & Wong, 1996, 2000; Wong, Song, Bruza, & Cheng, 2001).

The definition of topical relevance can be further specified by the major dimensions in the conceptual framework of relevance developed in Section 2.1:

R In contrast to the general assumption, topical relevance relationship is not limited to a single type of relationship, *direct matching*. A broad spectrum of relationships account for topical relevance; these relationships can be analyzed from different angles, for example,

- Based on linguistic relationship:
 - Hierarchical relationship (taxonomy, partonomy)
 - Structural relationship (structural component, complex structure), etc.
- Based on functional role and evidentiary connection:
 - Direct evidence

- . Indirect evidence
- . Contextual evidence
- . Comparative evidence, etc.

Topical relevance is determined based on topical representations of the information object (I) and the information need (N), I' and N', respectively. In accordance with the complexities of topical relevance relationships, the determination of topical relevance often involves complex reasoning over these representations:

I' Topical representation of an information object typically refers to indexing terms or subject descriptors assigned to the information object. It can also be the title, abstract, extracted passage(s), summary, full text, etc., as long as it indicates the topical content of the information object. Nowadays, topical representation is derived in a more automatic fashion: automatic indexing, latent semantic analysis, probabilistic topic modeling (Griffiths & Steyvers, 2002; Steyvers & Griffiths, 2006), etc. Using terms as dimensions, these methods reduce high-dimensional document contents to low-dimensional term-based representations. The automatic processes mostly reduce the topical content of a document to a subset of terms within the document. How to adequately capture the topic and make the representation more user-oriented (e.g., “request-oriented indexing”, Mooers, 1958; Soergel, 1974) still remains a question to explore.

N' Topical representation of an information need, in its simplest form, refers to user queries. Since an information need is often circumscribed by the user, task/problem, and situation, an adequate topical representation should draw on all these circumstantial aspects rather than solely on the request. To

identify and effectively extract topical components from the user's task, problem, and situation is important.

A Topical relevance can be determined by human assessors and by systems:

A1.1 As determined by individual real users, the individual user's level of knowledge, cognitive state, biases, and preferences come into play, as is often referred to as *pertinence*, or the *subjective sense of topical relevance* (see Section 2.6.2)

A1.2 As determined by non-user human assessors (subject experts, information specialists, etc.). When topical relevance is judged by experts or based on consensus in knowledge, it refers to the *objective sense of topical relevance* (see Section 2.6.2). In IR evaluation, this type of topical relevance is often used as the gold standard.

A2 As determined by information systems, topical relevance is detected based on a variety of retrieval models and methods. To date, most IR systems determine relevance based only on topic matching, which is a very narrow sense of topical relevance. The system-determined topic-matching relevance is limited in fulfilling users' information needs, as pointed out by many authors.

2.4 The "System View" vs. the "User View" of Relevance

The principal divide in the predominant thinking about relevance has been and still is the divide between the system view of relevance and the user-centered view of relevance. These two views diverge from one another based on whether the

information retrieval system or the user is at the focus of attention (Saracevic, 1975; Swanson, 1980; Harter, 1992; Green, 1995).

2.4.1 System View of Relevance

The system view of relevance emerged as the earliest relevance framework in the field, for its pragmatic applications in IR systems since early 1950s. It has been heavily applied in traditional evaluation of IR systems: the majority of IR evaluation projects in the field, from the Cranfield experiments in 1950s/1960s to Text Retrieval Conference (TREC) in 1990s/2000s, are based on this relevance framework (Saracevic, 1996). In the system view of relevance, the focus is on the task of IR systems which is seen very narrowly as retrieving all information objects that match the topic of an information need, or as Green (1995) puts it “document[s] on the same topic as the user need”. To evaluate a system, one needs to establish ground truth, that is, one needs relevance assessments using this narrow sense of relevance. Thus, the system view of relevance commonly refers to matching documents with a static information need topic. Sometimes, the system view is interpreted more narrowly to “system-determined” or algorithmic topic matching relevance.

The system view corresponds to what Green calls the *weak sense* of relevance. In Green’s discussion of relevance (1995), the *strong sense* of relevance is defined as “having significant and demonstrable bearing on the matter at hand; affording evidence tending to prove or disprove the matter at issue or under discussion” (Merriam-Webster’s Collegiate Dictionary, 10th ed., “relevant”). In the context of information seeking and retrieval, the strong notion of relevance corresponds to the property of an information object that sheds light on the user’s problem and is helpful for solving her information need. However, the strong notion of relevance is very hard

to realize in information systems; Swanson even considers it essentially *intractable* (Swanson, 1986: 395). Consequently, weaker notions of relevance are devised and such notions are considerably more open to evaluation (Green, 1995). To reduce the strong notion to weaker notions of relevance, operational assumptions have to be made, among which the most common ones are: it is assumed that topical content of documents can be represented by terms in the text or assigned, similarly, that a user's information need can be reduced to terms in query, and it is further assumed that the identification of relevant information can be achieved by *matching* term representation of a user query with term representations of documents (for a systematic discussion for the operational assumptions see Belkin (1980), Blair & Maron (1985), and Maron (1985)). By making these assumptions, the notion of relevance becomes operationalized but also substantially reduced, leaving plenty of room for attack.

Leaving out its strength in pragmatism for IR applications and evaluation, the system view of relevance has been heavily criticized for not incorporating any cognitive and situational variables pertaining to individual users, not considering any context related to users and uses, and therefore incapable of facilitating the dynamic and interactive process of information seeking as practiced (Schamber, Eisenberg, & Nilan, 1990; Schamber, 1991, 1994; Saracevic, 1996; Barry & Schamber, 1998; Cosijn & Ingwersen, 2000; Borlund, 2003).

2.4.2 User View of Relevance

Whereas the system view of relevance focuses on evaluating the topic matching performance of IR systems, the user view of relevance focuses on understanding how relevance is established by real users. Much of this section applies also to relevance as

judged by any human assessors (e.g., subject experts, search intermediaries, etc.), particularly for assessments that takes into account the user tasks and situations.

Relevance assessment is the primary research instrument for exploring human (user) relevance view. Since the scope of human assessors is broader than real users, the discussion emphasizes the user view but is not limited to it.

Up to date, many empirical studies have identified topicality as the central and most ubiquitous human (user)-defined relevance criterion (Xu & Chen, 2006). On the other hand, it has also long been discovered that topicality, on its own, is not complete as a measure for effectiveness of search (Cooper, 1971). Froehlich (1994) addressed this consensus when synthesizing the literature for the special ASIST issue on relevance: “The nuclear sense of relevance is topicality...Most of the articles in this issue acknowledge that it is a [*sic*] important aspect of relevance, a necessary but not sufficient condition: if the citation is not on the topic, how could it be relevant for that topic?” Topicality not only belongs to the class of human (user)-defined relevance criteria, but also is the most essential and important member in the class. However, in the rise of user-centered relevance studies in the 1990’s, attention has been largely shifted away from topical relevance, to previously neglected additional criteria, such as novelty, recency, and credibility. In spite of the established importance of topicality in user relevance assessments, there is a wide-spread but nevertheless mistaken view of topical relevance as solely system-determined and not part of user-defined relevance.

Many relevance criteria other than topicality have been identified and discussed since the early 1960s. In the 1960s, the most prominent experimental studies involving human relevance assessors were done by Cuadra & Katter (1967a, 1967b)

and Rees & Schultz (1967). In these experiments, many cognitive and situational variables pertaining to users and uses were identified, such as,

- users' knowledge level
- use orientation
- frames of reference
- cognitive patterns
- personalities
- tasks, etc.

These variables are shown to serve as an important mediator of topicality in the process of making relevance judgments and have a marked effect on the results. These experiments consider relevance as a *user construct*, even though in the experiments subject experts were asked to assume the role of actual users.

Cooper (1971, 1973) introduced the concept of *utility*: "...relevance has to do with *aboutness* (or *pertinence* or *topic-relatedness*) and is ultimately defined in terms of logical implication, whereas *utility* is a catch-all concept involving not only topic-relatedness but also *quality*, *novelty*, *importance*, *credibility* and many other things." He further pointed out that "the purpose of retrieval systems is (or at least should be) to retrieve documents that are useful, not merely relevant." Wilson's *situational relevance* (Wilson, 1973) relates relevance to "a particular individual's situation" as seen by that particular individual. As such, relevance becomes a relation that draws on "a particular individual's stock of information" and "questions of concern to him" (for a full discussion see Chapter 4). Kochen (1974) brought forth the notion of *users' preferences* from the utility theory in decision making.

Starting in the mid-1980s, the discussion of user and use orientation was revived by a new thread of relevance research booming in the 1990s, as represented by the work of Schamber (Schamber, Eisenberg, & Nilan, 1990; Schamber, 1991) and Barry (Barry, 1993, 1994; Barry & Schamber, 1998). Observing relevance assessments in

various settings (preferably in a naturalistic setting), these studies aimed at eliciting relevance criteria from *real users* (Schamber, Eisenberg, & Nilan, 1990; Schamber, 1991, 1994; Schamber, 1991; Harter, 1992; Park, 1992, 1994; Cool, Belkin, & Kantor, 1993; Barry, 1993, 1994; Bruce, 1994; Froehlich, 1994; Hersh, 1994; Janes, 1994; Sutton, 1994; Wang, 1994; Wang & Soergel, 1998; Barry & Schamber, 1998; Wang & White, 1999; Choi & Rasmussen, 2002; Lawley, Soergel, & Huang, 2005; Xu & Chen, 2006). Together these studies identified over 80 relevance factors from users, as grouped by Schamber (1994) in Table 1. This table lists relevance criteria, types of information used, and other factors affecting relevance judgments.

Table 1. Eighty Relevance Factors Suggested in the Literature^a

| | | |
|---|---|--|
| JUDGES | Credibility (3) | Effort expended (3) |
| Biases (1) | Difficulty level (1) | Flexibility (dynamic interaction) (4) |
| Cognitive style (1) | Diversity of content (1) | Formatting (scannability) (4) |
| Concept of relevance (1,2) | Importance (3) | Interfacing (help, orientation) (4) |
| Error preference (1) | Informativeness (3) | Links to external sources (4) |
| Expectations regarding distribution (1) | Interesting content (3) | Ordering (subject matter) (4) |
| Formal education (2) | Level of condensation (1,2) | Physical accessibility (4) |
| Intelligence (1) | Logical relevance (3) | Precision of subject output (4) |
| Judging experience (1) | Novelty (3) | Reliability (consistency) (4) |
| Judgment attitude (1) | Pertinence (3) | Response speed (4) |
| Knowledge/experience (1,2) | Publication source (3) | Selectivity (input choices) (4) |
| Professional involvement (2) | Recency (3) | Simplicity (clarity) (4) |
| Research stage (2) | Scientific "hardness" (1,2) | Time spent (3) |
| Use orientation (1,2) | Specificity/amount of information (1,2) | |
| Vigilance level (1) | Style (1,3) | JUDGMENT CONDITIONS |
| | Subject matter (1) | Breadth of document set (1) |
| REQUESTS | Textual attributes (1) | Definition of relevance (1,2) |
| Diversity of content (1) | Usefulness (2,3) | Order of presentation (1) |
| Difficulty level (1) | | Size of document set (1) |
| Functional ambiguity (1) | INFORMATION SYSTEM | Social pressure toward convergence (1) |
| Specificity/amount of information (1,2) | Access (item identification) (4) | Specification of the task (1,2) |
| Subject matter (1) | Access (subject description) (4) | Time for judging (1) |
| Textual attributes (1) | Access (subject summary) (4) | Use of control judgments (1) |
| Weighting of components (3) | Accuracy (data transfer) (4) | |
| | Browsability (4) | CHOICE OF SCALE |
| DOCUMENTS | Comprehensiveness (coverage) (4) | Availability of anchors (1) |
| Aboutness (3) | Convenience of location (3) | Ease of use (1,2) |
| Accuracy (truth) (3) | Convenience of hours (3) | Kind of response required (1,2) |
| Aesthetic value (3) | Cost saving (4) | Number of rating categories (1) |
| Authorship (3) | Currency (updating) (4) | Type of scale (1,2) |
| | Ease of detection of relevance (3) | |

^aBased on (1) CUADRA & KATTER (1967a), (2) REES & SCHULTZ, (3) COOPER (1971; 1973), and (4) TAYLOR. Includes all factors suggested by Cuadra and Katter and selected factors suggested by others.

Thanks to contributions from this body of work, the human notion in relevance and the user perspective in particular are much better understood. Four central conclusions can be drawn about the notion of user-defined relevance (Schamber, et al, 1990; Schamber, 1991, 1994; Saracevic, 1996; Barry & Schamber, 1998; Borlund, 2003):

- User-defined relevance is a *multidimensional* concept: it consists of both topical and many non-topical relevance criteria as mentioned above
- User-defined relevance is a *cognitive* and *subjective* concept: it is closely related to the human assessor's stock of knowledge, cognitive state, cognitive pattern, frames of reference, previous experience on both work task and search task, etc.
- User-defined relevance is a *dynamic* and *time-dependent* concept: information seeking is an elastic and adaptable process (Dervin & Nilan, 1986) and the user may have different relevance preferences at different stages of information-seeking process (Kuhlthau, 1993). As the search proceeds, the user learns more about the matter at hand and her cognitive state is continuously changing (Belkin, 1977, 1978), and consequently the user's information need is constantly evolving (Bates, 1989). Therefore, relevance is perceived and handled dynamically, varying from stage to stage and from time point to time point.
- User-defined relevance is a *contextual* and *situational* concept: it is related to the user's specific work task, the problem, the user situation and the social context from which the user's information need arises (Wilson, 1973;

Ingwersen, 1992; Belkin, 1993; Belkin, Cool, Stein, & Thiel, 1995;
Saracevic, 1997; Wilson, 1999; Beaulieu, 2000; Ingwersen & Javelin, 2005).

Researchers suggest user-centered relevance as a more realistic framework for IR evaluation, as opposed to static topic-matching relevance as seen in the system view. User-centered relevance “expresses the relationships between the user’s perception of usefulness of a retrieved information object, and a specific work task situation” and thus ensures “an evaluation process and procedure that is as close as possible to end-users’ actual information-seeking and retrieval processes” (Borlund, 2000; Borlund, 2003: 923).

Summary

On closing the discussion on who determines relevance, a more comprehensive perspective should be achieved by recognizing the strengths of both the system and the human (user) views. Relevance is such a highly dynamic and complex phenomenon that it is not subject to any single-sided argument. As addressed by Green (1995: 648), “relevance is a theoretical notion, which cannot be accurately and universally judged by any party in the retrieval process, not the user, not the system, not the search intermediary, not the subject matter expert... While the user is normally the best actual judge of relevance, he or she is not always, and perhaps is seldom, a perfect judge of what literature might help resolve the need at hand.” Users bring in distinctive characteristics and essential elements regarding their tasks, problems, and situations. However, users do not usually possess the perfect knowledge of the subject matter at hand and they are often in a state of partial ignorance concerning the problem they are dealing with. Users may not be able to recognize that a document is

actually relevant to their need (Cooper, 1971) and may not even be able to specify the subject content of their needs (Belkin, 1980). This partial knowledge motivates the search but also prevents users from making fully informed judgments and decisions about what information may best help with their problems. In many of these cases, knowledge from subject experts, information specialists, and systems' linking and modeling processes are beneficial to enhance users' judgments and decisions.

2.5 The Entity-based Approach vs. the Relationship-based Approach to Conceptualizing Relevance

Entity and relationship are the two basic components in human's conceptual and representational system. This gives rise to two approaches for conceptualizing and explicating the notion of relevance (building on Saracevic, 1975: 337):

- *The entity-based approach*: The entity-based approach defines relevance by explicating entities between which relevance relationships hold. Different kinds of relevance are therefore defined by different pairs of entities that are involved in the relevance relationships (Mizzaro, 1997); similarly, different levels of relevance can be defined by entities that participate in relevance relationships from different levels (Saracevic, 1996).
- *The relationship-based approach*: at heart, relevance is meaningful relationship being perceived. The relationship-based approach concentrates on explaining the nature of the relationships that hold between entities, rather than on elaborating the entities that enter into relevance (Saracevic, 1975: 337). Focusing on the relational nature of relevance, it allows us to approach the concept on a more fundamental level; however, relatively little research in information science has taken this approach to examining relevance.

Relationships build upon entities; entities are more concrete, tangible, and straight-forward, whereas relationships are abstract, subtler, and more difficult to specify. Most relevance studies in our field take the entity approach for its tangibility and explicitness over the relationship approach.

2.5.1 Entity-based Approach to Conceptualizing Relevance

The entity-based approach defines relevance by enumerating and explicating the entities between which relevance relationships hold, without further specifying the relationships themselves.

In 1973, P. Wilson concluded that “relevance is not a single notion, but many” (Wilson, 1973: 457). This viewpoint is reinforced and further developed by many later researchers and referred to as the multidimensionality of relevance (Schamber 1991, 1994; Saracevic, 1996, 2006; Mizzaro, 1997; Barry & Schamber, 1998; Cosijn & Ingwersen, 2000; Borlund, 2003). In these writings, multidimensionality is taken in an entity-based sense rather than in a relationship sense. It refers to different kinds of relevance as defined by different pairs of entities that enter into a relevance relationship, or refers to different levels of relevance as defined by entities that participate in relevance relationships from different levels. In either case, what is being “multiple” is the entity rather than the relationship, at least from what has been articulated. In the following sections are some illustrations from the literature:

2.5.1.1 Saracevic (1975): Generic Definition of Relevance

Many definitions and terminologies of relevance sprung up during the early relevance research period (1950s-1970s). With few exceptions (Cooper, 1971; P. Wilson, 1973), these definitions are circular and paraphrasing, as reviewed and

criticized by Saracevic (1975, 1976). According to Saracevic, these definitions of relevance fell into a general pattern as below:

Relevance is the A of a B existing between a C and a D as determined by an E, where various values are filled in the slots for various definitions. The following are values available for each slot:

| A | B | C | D | E |
|-----------|----------------|----------------------|-------------------------|------------------------|
| Measure | correspondence | document | query | person |
| degree | utility | article | request | judge |
| dimension | connection | textual form | information used | user |
| estimate | satisfaction | reference | point of view | requester |
| appraisal | fit | information provided | information-requirement | information specialist |
| relation | bearing | fact | statement | |
| | matching | | | |

As shown, these definitions put the emphasis on enumeration of entities involved in relevance, where relationship is mentioned in slot B but not further specified and explicated. Some of the differences within the entities are mainly terminological, not substantive, for instance, “correspondence, connection, fit, bearing” in B, or “measure, estimate, appraisal” in A.

This type of definitions captures the primary experimental aspects of making relevance judgments (measures). It sheds light on the complexities and confusion involved in the process of conceptualizing relevance. To a large extent, it equates relevance with the measure of relevance and particularly with relevance assessment. By doing so, it provides a more tangible focus on the objects, entities, and factors that are concerned to relevance assessments and experiments. However, as definition of relevance, it confuses the conceptual notion of relevance with the performative act of relevance judgment. It was pointed out precisely by Green (1995: 648) that, “relevance is not a measure of a correspondence; it is the correspondence... relevance is not here taken as a measure of something else, but is that which is being measured”.

Adopting the “measure” view point, many researchers are looking into relevance judgments rather than the notion of relevance per se.

2.5.1.2 Mizzaro (1997): *Four-dimensional Relevance Model*

Similarly, Mizzaro (1997) conducted a systematic review of 157 relevance papers and proposed a four-dimensional relevance model to summarize how relevance should be defined and understood. In this model, each kind of relevance can be seen as a point in a four-dimensional space, with the following values on each of the four dimensions (Mizzaro, 1997: 812):

- Dimension 1: *Surrogate* (title, keyword, etc.), *Document*, and *Information*
- Dimension 2: Query, Request, Information need, and Problem
- Dimension 3 (each of the entities involved in dimension 1 or 2 can be decomposed in the following three components): *Topic*, *Task*, and *Context*
- Dimension 4: *Time* (various time instants in the process)

This four-dimensional space is further illustrated by the diagram (Figure 2-2):

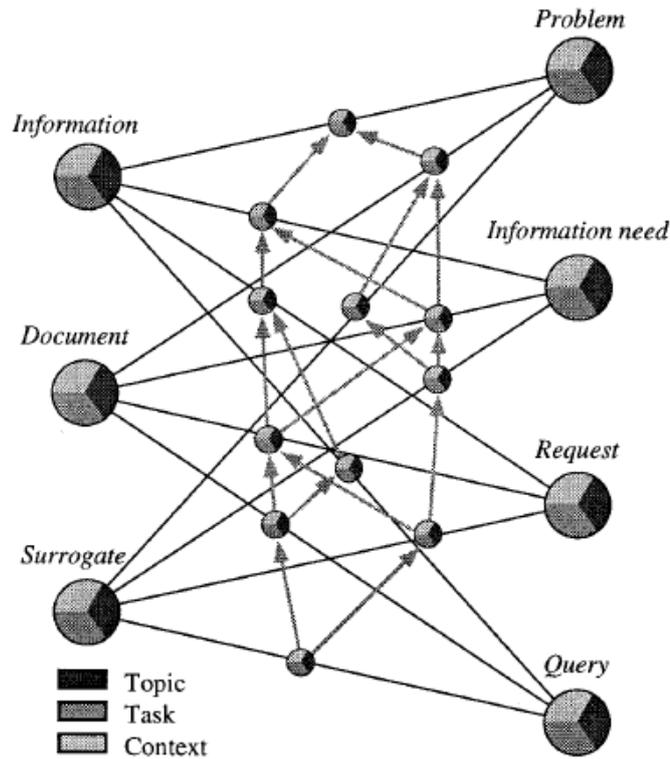


Figure 2-2 Mizzaro's Four-Dimensional Model Of Relevance (From Mizzaro, 1997)

Many similarities can be perceived between the early relevance definition pattern and the four-dimensional relevance model; there is a direct correspondence between slot C and dimension 1 and between slot D and dimension 2. Both of them focus on elaborating the entities that participate in the relevance relationship rather than the relationship itself. The latter adds an explicit dimension of time to emphasize the dynamic nature of relevance and attends to the influence of topic, task, and context more explicitly.

Taken broadly, the dimension 1 and 2 in Mizzaro's model correspond, respectively, to information object I and information need N in the conceptual framework of relevance developed earlier in Section 2.2. Dimensions 1 and 2 each mixes the central entities of conceptualizing relevance (information object and information need, respectively) with their representations (surrogate and query,

respectively). Although the representations influence relevance assessments in practice, conceptually they are not inherent components of relevance definition. Dimension 3 (task, context) and dimension 4 (time), rather than staying on the same entity level as information need and information object, serve as circumstantial variables that give rise to or confine an information need.

2.5.1.3 Saracevic (1996): *A Stratified System of Relevances*

To put an explicit emphasis on levels of relevance, Saracevic (1996) suggested a system of relevances based on his stratified model of IR interaction. Saracevic considers IR interactions between the user and the system take place in a number of connected strata; as a result, relevance manifests itself as relationships and inferences at a number of levels (Saracevic, 1996: 210):

- *System or algorithmic relevance*: relation between the query (terms) and the collection of information objects expressed by the retrieved information object(s);
- *Topical or subject relevance*: relation between the topic expressed in a query and topic covered by the retrieved information object(s);
- *Cognitive relevance or pertinence*: relation between the state of knowledge and cognitive information need of a user, and the retrieved information object(s);
- *Situational relevance or utility*: relation between the situation, task, or problem, and the retrieved information object(s);
- *Motivational or affective relevance*: relation between the intent, goal, and motivation of a user the retrieved information object(s).

Saracevic's stratified system of relevances delineates various "levels" involved in conceptualizing and understanding the complex phenomenon of relevance. In its conceptualization, the focus is shifted from elaborating the entities to elaborating the levels of entities. At the end, various levels of participating entities are named but relationships are left unexplicated.

2.5.2 The Relationship-based Approach of Conceptualizing Relevance

The intractable notion of relevance is like a black box. If identifying various kinds and levels of participants in relevance relationships helps to open the black box, the relationship approach helps to take a direct look into the box. However, compared to voluminous entity-based relevance publications, writings that specifically investigate the relational nature of relevance seem scarce. The rest of this section illustrates this approach with a few examples:

The well-known concepts of *logical relevance* (Cooper, 1971) and *situational (evidential) relevance* (Wilson, 1973) opened the discussion of the relational nature of relevance. They both concentrate on the *nature of relationships* between elements (entities), rather than on *enumeration of elements (entities)* that enter into relevance (Saracevic, 1975: 337). To avoid the trap of circularity in defining relevance, Cooper (1971) proposed a mathematically precise definition of logical relevance, i.e. "topical appropriateness". By Cooper's definition, topical relevance is described from the logical point of view, i.e. how topical relevance can be determined by applying deductive logic. Building on Cooper's definition, Wilson (1973) proposed evidential relevance to complement logical relevance by introducing inductive logic in the process of detecting topical relevance. Both works pointed out that the nature of relevance is much more sophisticated than "matching contents" (not to speak of

“matching words”) between a query and a document; instead, the perception of relevance heavily involves fine-tuned reasoning and inferences.

Green and Bean’s work on topical relevance (Bean & Green, 2001; R. Green, 1995; R. Green & Bean, 1995) also falls into the scope of the relationship-based approach to relevance. An important notion brought up in their study is to challenge the widely held yet not justified assumption of topical relevance in information seeking and retrieval that topical relevance is a matching relationship between user topics and document topics. “Hardly any consideration has been given to see the possibility that other relationship types besides matching may account for topical relevance” (Green, 1995: 646). They conducted an empirical investigation and showed that a much broader range of relationships beyond “direct matching” account for topical relevance, e.g., hierarchical and structural (or syntagmatic) relationships. The present study and my previous work (Huang & Soergel, 2004, 2006; Huang & White, 2005) intend to continue this line of research and to further explicate the rich relationships involved in topical relevance.

Since the relationship-based view of relevance is what this thesis intends to further develop, the previous works within this scope are particularly important and will be discussed in a greater detail in Chapter 6 (Information Science Perspective).

Summary

At heart, relevance is meaningful relationship/correspondence being perceived. In terms of defining and understanding the matter of relevance, the entity approach is peripheral and the relationship approach is direct and central. Naming entities without articulating the nature and type of relationships easily gives rise to circular definitions, which “simply substitute terms that are as undefined as the term which they tried to define.” (Saracevic, 1975: 328) It also leads to making blinded and

oversimplified assumptions about relationships that account for relevance. To summarize, our understanding of the relational nature of relevance is still very limited; more attention is needed to address this central yet neglected area of relevance research.

2.6 Misunderstandings of Topical Relevance

The understanding of topical relevance is limited in two senses:

- Limited to the system view of relevance
- Limited to topic matching, as implemented as content/term matching

Topical relevance is a broader concept than its algorithmic approximations in IR systems; in many cases, it stays at the center of real users' perception of relevance. Being limited to system-determined and topic matching, topical relevance is seen as a static, dry, and straight-forward notion, not varying from user to user, from task to task, or from situation to situation. However, topical relevance in its full sense (not in its approximating forms) is very much cognitively founded, involving all sorts of complexities and dynamics in human thinking and reasoning. It is a mistake to understand topical relevance based on its limited implementations in IR applications and evaluation. In recent relevance studies, its central importance in user relevance judgments is neglected and it is not treated with the attention it deserves.

2.6.1 Misunderstanding 1:

Topical Relevance Seen as Limited to the System View of Relevance

In the literature topical relevance is usually limited to the system view of relevance, such as, “systems view became also known as ‘topical relevance’”(Saracevic, 1996: 207), “topical relevance, also termed system relevance,

is a determination of the intellectual content of a document, usually in terms of some subject classification.” (Froehlich, 1994: 125)

If taken more carefully, “‘topicality’ (a relevance for what concerns the topic component) is conceptually different from ‘system relevance’” (Mizzaro, 1997: 812). In Saracevic’s stratified system of relevances (see Section 2.5.1.3), topical or subject relevance and system or algorithmic relevance are particularly differentiated and placed at two different levels. Borlund (2003) also argued that topical relevance is a subjective type of relevance, or intellectual topicality, and we need to “distinguish the subjective type of topical oriented relevance from algorithmic relevance” (Borlund, 2003: 915).

Topical relevance is a logical and conceptual notion existing on a level that is very much system-independent. A system may fail to detect a certain level of topical relatedness between a user topic and an information object, but the failure of system implementation cannot deny the existence of the topical relatedness. Systems can adopt more advanced approaches and algorithms to improve their rank-list results, but any changes in their rank lists would not affect the existing level of topical relevance. Neither the algorithmic approximations nor the rank-list results should be taken as topical relevance itself. To a large extent, system is “irrelevant” to the conceptual discussion of topical relevance.

Confusing topical relevance with system-determined relevance results in downplaying the importance and contribution of topical relevance. Limitations and critiques of systems are automatically attributed to topical relevance. The insufficiency of system-determined relevance is mistakenly seen as the insufficiency of topical relevance, as shown in the case of Schamber et al. (1990), Barry (1994), Hersh (1994), Sutton (1994), Janes (1994), etc.

2.6.2 Misunderstanding 2:

Topical Relevance Seen as Excluded from User-defined Relevance

In the 1990s, many user-defined relevance factors other than topicality have been identified; however, in many of the user relevance studies, these factors are brought forth in a manner that is in contrast to topicality. It gives the misleading impression that topicality does not belong to the class of “user-defined relevance criteria”, assuming it is solely determined by the retrieval system. As in the extreme case of Harter (1992), “topical relevance became the fall concept against which to develop psychological relevance.” (Saracevic, 1996: 208) Since the last decade, relevance research has been moving into a direction that is increasingly situational and cognitive. Without any justification, it is assumed and decided that topical relevance does not go with this cognitive trend.

On the contrary, topical relevance is very much cognitively founded. In Saracevic’s stratified system of relevances (1996), topical relevance is the first subjective type of relevance. As further articulated by Borlund (2003: 915), “this relevance type is consequently not entirely based on the relationship between a query representation and a retrieved information object. An observer, or an assessor or a user, makes the judgment. It is the kind of subjective relevance assessment we ascribe to individual assessors who participate in common IR experiments like TREC, although their judgments traditionally are intended to be of an objective nature.” Furthermore, as demonstrated by researchers (Maron & Kuhns, 1960; Cooper, 1971; Wilson, 1973), the perception of topical relevance is a highly cognitive process, involving various types of logic and fine-tuned reasoning.

Topical relevance manifests itself both as a consensus notion (the common sense of topical relevance) and as an individualized notion (pertinence). The distinction

between relevance and pertinence is discussed by many early relevance researchers. Foskett (1972) suggested that “relevance means being a part of a paradigm, or public knowledge, or consensus in a field; pertinence means related to the specific pattern of thought in a specific reader’s mind.” Further, Kemp (1974) suggests that “relevance and pertinence are two different qualities, one capable of public objective assessment and the other being capable only of private subjective assessment.” This distinction can be seen as the objective sense of topical relevance and the subjective sense of topical relevance. In either sense, topical relevance is deeply cognitively founded:

- The *Objective sense of topical relevance* refers to relevance as determined by subject experts or by a community of informed assessors in a given field, the judgment involves consensus of knowledge, common beliefs, and authoritative opinions in the field. It is objective in the sense that it does not vary with individual’s perception and knowledge level, not in the sense that it is not cognitively determined. Cooper’s *logical relevance* (1971) refers to the objective sense of topical relevance. According to Cooper, an individual user may not be able to recognize topical relevance in a document at the beginning and s/he may fail to recognize it eventually, but not being perceived by an individual user cannot deny the topical relevance that indeed presents in the document.

The term “topical relevance” often refers to its objective sense. The objective sense of topical relevance is cognitively founded in public knowledge; it is independent of individual perception and therefore relatively stable.

- The *subjective sense of topical relevance* (often called *pertinence*) refers to relevance as determined by individual human assessor (user). It is largely affected by the assessor’s stock of knowledge and frames of reference; it is

more subjective, individualized, and varying from individual to individual (or user to user). Wilson's *situational relevance* (1973) refers to the subjective sense of topical relevance, by considering individual user's preferences and private knowledge (however, the prerequisite of situational relevance, as referred as *evidential relevance*, carries an logical and objective sense, see a full discussion in Chapter 5).

Topicality not only belongs to the class of user-centered relevance criteria, it is the most essential and important criterion defined by the user. Among many factors influencing user's relevance judgments, "one factor that seems ubiquitous is topicality." (Xu & Chen, 2006: 961)

2.6.3 Misunderstanding 3: Oversimplified Conception of Topical Relevance

Despite recognizing the importance of topical relevance, understanding of topical relevance is still limited and oversimplified. As argued by Green (1995), "although topicality is a major factor in the establishment of the correspondence between a text segment and a user need, we have little real understanding of how the topics of text segments relate to the topics of user needs to which they are relevant." In this field, when we speak of topical relevance, we are usually referring to a simple matching between the overall topic of a document and the overall topic of a user need. Without particular warrant, it is generally assumed that topical relevance is merely "on topic", only considering a single relationship—matching, a single type—direct (matching), a single topic level—the overall topic, and a single status—not varying with different user preferences and situations (Huang & Soergel, 2004). Hardly any attention has been paid to possibilities other than direct topic matching.

It has been shown that topical relevance is never as simple, straight-forward as is widely assumed. Evidence from citation analysis, knowledge discovery/synthesis, and recall failure analysis suggests that topical relevance relationships are not limited to topic matching (Green, 1995). There are many levels and types of topical aboutness, as demonstrated by Sutton (1994) when she studied an attorney's relevance judgments: this aboutness can be traced to the relatedness in legal subject matter with the client's problem, or traced to the similarity in context between a legal case and the client's problem, or traced to the similarity of cases of high juristic standing and the client's problem, etc.

The inadequate understanding of topical relevance leads to inadequate treatment of topical relevance in systems, which in turn downplays the potential contribution of topical relevance in fulfilling users' information needs. Traditional retrieval systems implement topical relevance as if it was a single matching type and implemented as content or term matching. More advanced systems based on probabilistic, clustering, language model relax constraints on the degree of matching but look only at this single type of topical relationship (Green, 1995).

Summary

Largely ignored in the recent relevance studies has been topical relevance, which in fact plays a significant role in user's relevance judgments and an understanding of the factors that contribute to topicality. Given the central status of topical relevance in information seeking and IR applications, it is crucial to develop a more solid understanding of topical relevance and in particular, to explore a broader spectrum of topical relevance relationships beyond simple matching. The widely held assumption about topical relevance, i.e., treated as a single relationship, a single level, and a single status, will be further challenged by the analysis in this study.

Chapter 3. Methodology

3.0 Outline of the Research

The research project is comprised of two major components:

Phase 1: Literature-based analysis

To reach a comprehensive understanding of topicality and relevance, an analytical study of relevance literature was conducted in multiple disciplines,

- Communication & rhetoric
- Argumentation, reasoning (inference), and logic
- Information science
- Education & cognitive psychology
- History
- Medical problem solving
- Law and evidence
- Visual perspective and art history

Various types of topical relevance relationships were identified from observations and thinking in different fields. Towards the end of the analysis, a theory-grounded typology containing top-level topical relevance relationships started to emerge.

Phase 2: Manifestation study

Empirical relevance data were analyzed for the theory-grounded topical relevance relationships identified from Phase 1, to see how these relationship types manifest themselves in various contexts and domains.

Three kinds of relevance data were used for the analysis (see detail in Section 3.2.3):

- Topical relevance assessment data from the MALACH project
- Clinical questions and answers
- Art images and subject descriptors describing the images

Through the analysis, additional specific sub-types of topical relevance relationships were identified and organized into the conceptual scheme. A further refined and enriched typology with full-fledged specifications (as adapted to particular data) was developed.

Both Phase 1 and Phase 2 contribute to answering the central question of the study:

What are the multiple types of topical relevance relationships beyond topic matching? How are they defined in terms of functional roles and evidentiary connections (modes of reasoning) exhibited by an information object?

Together Phase 1 and Phase 2 constitute the two steps of developing the major product of this research project, a faceted typology of topical relevance relationships. The initial development is based on literature analysis in Phase 1 and

further specified through empirical data analysis in Phase 2. In addition, the analysis in Phase 2 also covers Research Question 2, manifestation of the typology in various contexts and disciplines.

The process involved close reading of literature (Phase 1), in-depth examination of data (Phase 2), and inductive development of a typology. The focus of the inquiry is not on aspects that can be quantitatively measured or easily manipulated. Meaning and deep structure are being sought after. A relatively small number of cases were closely examined in a non-reductionist manner.

3.1 Literature-Based Analysis

The goal of the literature-based analysis is to construct a unified typology of topical relevance relationships by gleaning knowledge and wisdom from multiple disciplines.

3.1.1 Scope of the Literature to Be Analyzed

To explore the central question, as described in Chapter 1, two facets were stressed in the literature analysis and the conceptual analysis: *Functional role* and *Evidentiary connection (Mode of reasoning)*.

- *Functional role* (Mann & Thompson, 1988) is concerned with what functional role a piece of information plays in the overall structure of a topic or an argument, e.g., pertaining to the main topic, comparison, context, presupposition, evaluation

- *Evidentiary connection (Mode of reasoning)* is based on logic and inference, concerned with how pieces of information can be identified through an inference chain and how specifically they relate and contribute to a receiver's reasoning about a topic, e.g., circumstantial evidence

A good understanding of various types of evidentiary relationships and their roles as reasoning devices draws on knowledge from multiple disciplines. The subject of *Evidence* gains its coherence from *inferential reasoning*; it has been a sustained focus of multi-disciplinary attention and hence been constantly advanced by confluent efforts in, just to name a few, “law of evidence”, “history, social sciences, or economics”, “mathematics or logic”, “witness psychology”, “forensic science (e.g., DNA and footprint analysis)”, “intelligence services”, “evidence-based medicine (EBM)”, and “evidence-based policy making” (William, 2003).

Connecting the concept of topical relevance with the notion of evidence not only brings in perspectives from other disciplines to enrich our thinking on topical relevance, but also takes the discussion into a broader context of human thinking, reasoning, drawing conclusions, building understanding, and building arguments (see Introduction in Chapter 1).

The literature for analysis was identified and perused with a focus on functional roles and evidentiary connections (modes of reasoning) exhibited by information. Areas and topics for the analysis are listed in Table 3-1:

Table 3-1 Areas and Topics for the Literature Analysis

Communication & Rhetoric

- Relevance theory (Sperber & Wilson)
- Rhetoric structure theory (Mann & Thompson)
- Relations and structures in discourse

Argumentation, Reasoning (Inference), & Logic

- Reasoning, inference, and (classical) logic
- Argument and argumentation
- Topical relevance in argumentation (Walton)
- Argumentation theory (Toulmin)
- Propositional logic

Information Science

- Logical relevance (Cooper)
- Situational relevance (Wilson)
- Topical relevance relationships (Green & Bean)
- *Aboutness* in indexing and information retrieval (Hutchin, Maron, etc.)

Education & Cognitive Psychology

- Bloom's taxonomy of educational objectives
- Cognitive mechanisms for knowledge acquisition and restructuring
- Thinking & problem solving:
 - Inductive thinking
 - Deductive thinking
 - Analogical thinking (as based on analogs, models, and examples)
- Cognitive information processing and structural understanding (Gagne, Briggs, Wager, Bruner, Piaget, Ausubel, Schank (Scripts))
- Constructivist learning

Medical Problem Solving

- Medical expertise as efficient knowledge organization
- Illness script (Feltovich & Barrows; Schmidt, et al.)
- Evidence-based medicine (EBM)
- Clinical reasoning and problem solving
- Structured clinical problem representation

Law & Evidence

- Law of evidence and relevance
 - Direct evidence
 - Circumstantial evidence
- Legal reasoning
 - Legal reasoning and argumentation structure
 - Types of reasons and rules
 - Modes of legal reasoning

Visual Perspective & art history

- Topic modeling by image visual content
- Topic modeling by image meaning
 - Levels of meaning
 - Facets of meaning
 - Modeling image topic through textual information
- Topic modeling by image user and use
 - The viewer's perspective to image meaning
 - Types of image-text relationships
 - Functional relationships of images to texts

Analyzing literature from multiple disciplines and “increasing exposure to different theories” function similarly to the process of *triangulation* in qualitative data analysis (Potter, 1996: 153). It helps to strengthen the findings and conclusions of the conceptual analysis.

3.1.2 Literature Analysis Method

This review of literature is a conceptual analysis examining ideas that *inform* thinking and construction of the typology, rather than looking for patterns in empirical data (empirical analyses come in after, see Sections 3.2 and 3.3). To better structure and manage the idea-gleaning process, the analysis borrowed approaches and analytic techniques from qualitative methodology (e.g., grounded theory and open coding).

To keep a focus over the broad range of literature, the analysis concentrated on aspects of theories and discussions that directly contribute to enlighten our thinking on types of topical relevance relationships, rather than summarizing and delineating a full picture of these theories. Aspects and discussions that are not directly related to the evidential and function-based relevance were not covered by the analysis.

More specifically, the conceptual analysis of the literature involved two phases:

1. *Identifying, collecting, and extracting* types of topical relevance relationships, definitions, associated examples, and use contexts from the literature. Although ongoing comparisons took place all along the

reading and coding, this phase focused on the idiosyncratic, or the differences.

2. *Comparing* and *integrating* the relationships identified from different domains into a unified typology of topical relevance relationships. This phase focused on the representative, or the convergences.

3.1.2.1 Identification of Topical Relevance Relationships

The identification process was guided by several desiderata:

- Emphasis on *evidence* (including proof, reasoning) or *functional roles* of information
- The type of (topical) relevance relationship contributes to the receiver's understanding of a topic, a task, or a problem
- The type of (topical) relevance relationship is specified, by providing related definitions, descriptions, examples, or scenarios
- The relevance relationship type is general enough to apply to more than one specific context or subject area
- The treatment of relevance relationship types is systematic and consistent in the particular literature

The topical relevance relationship types and associated descriptions (definitions, examples, and use contexts) were coded with QSR *Nvivo* 2.0, a textual analysis program (see detail at www.qsrinternational.com/). Built upon my previous study

(Huang & Soergel, 2006), the analysis of relevance relationships started with a minimal-structured scheme containing four broad categories:

Functional role

- Evidence relevance
- Context relevance
- Comparison relevance

Evidentiary connection (Mode of reasoning)

- Direct (evidence) relevance
- Indirect (evidence) relevance

Following an approach akin to grounded theory (Glaser & Strauss, 1967), the initial typology (coding scheme) evolved and developed as the analysis proceeded, opening to modifications to existing categories and allowing new categories to emerge and further specifications to develop.

Some examples are provided for illustrating the identification and coding process in the Appendix B.

3.1.2.2 Integration into a Unified Typology

This phase of analysis focused on the convergence among the identified relationships, through comparing and integrating. Different disciplines are likely to discuss (topical) relevance relationships from widely different angles and viewpoints. The relationships identified from the literature might rest on different levels or belong to orthogonal perspectives. Part of the integration was done in the

identification phase, where comparing and merging constantly took place in the coding process. Based on these coding, more formal treatment was applied at this stage to resolve the idiosyncratic differences and inconsistencies:

- All evidentiary connections (modes of reasoning) and functional roles specified in the literature were isolated.
- Different terms for the same or very similar concepts and relations were combined under a single, preferred term (e.g., “Context”, and “Background” are combined under the single term “Context”).
- Scope notes were provided using the original definitions from the articles analyzed.
- Facets among the entries were analyzed and developed.

At the end, the above analysis and organization gave rise to the initial typology of topical relevance relationships. Detailed information associated with the entries was also recorded, including relationship type, definition and scope note, lead-in terms, sources, etc. Methodologically, the resulting typology was used as the coding scheme for subsequent and empirical data analysis in the manifestation study.

3.2 Manifestation Study

This is the empirical component of the research. It adapted the initial typology of topical relevance relationships to empirical data from specific domains and, through analyzing these data, further enumerated and refined the initial typology.

3.2.1 Data: Overview

Three datasets were used for this analysis:

A. Relevance assessment data from the MALACH project:

Query-based relevance assessments made on a large collection of oral history of Holocaust, see detail in Section 3.2.3.1

B. Clinical questions and answers:

A set of 59 real-world clinical questions and associated answers were gathered from two on-line sources (see detail in Section 3.2.3.2):

- Family Practice Inquiries Network (FPIN) at www.fpin.org/
- Parkhurst Exchange at www.parkhurstexchange.com/

C. Art images and subject descriptors (tags) describing the images, see detail in Section 3.2.3.3.

There is a central concern of “topical relevance” engaging the three different types of data. The MALACH relevance assessments were made solely based on the relevance criterion of topicality. As for dataset B, unlike question-answering in more socialized contexts (e.g., Yahoo! Answers) where relevant answers include emotional support and other non-content-based factors (Kim, Oh, & Oh, 2007), clinical question-answering aims at solving specific patient problems. Therefore, the answer is constructed to directly address and resolve problems raised in the clinical question. The prerequisite for an answer to be useful is its content being topically relevant to the question. For dataset C, descriptors were selected and assigned by

indexers to describe the topic/subject of an art image; the relation between a subject descriptor and the art image it is assigned to is essentially a topical relevance relationship.

Each of the three datasets was included into this analysis not only based on the quality but also based on the richness of the relevance data. For this analysis, elaboration of how the relevance is perceived and handled is at least as important as the relevance decision itself. The three relevance datasets provide detailed traces of people's original thinking process in specific situations, either in the form of assessors'/indexers' detailed notes/comments, or in the form of clinicians' elaborative answers that involve rich reasoning and conclusion-drawing. These data allow us to fully understand and explicate topical relevance relationships from the perceiver's point of view.

The data were collected as a *purposeful sample* (Lindlof & Taylor, 2002) rather than a *random sample*, so as to achieve considerable variations within the data. The data collected manifest topical relevance relationships in different forms and in different contexts. In particular, the data vary on several dimensions as follows (Table 3-2):

Table 3-2 Three Sets of Empirical Relevance Data Used in the Analysis

| Dimension | Dataset A | Dataset B | Dataset C |
|--------------------|--|--|---|
| Subject | Oral history | Clinical medicine | Fine arts |
| Setting | Relevance assessment | Question answering | Subject indexing/Tagging |
| Info type | Audio (transcribed) | Text | Image |
| Participant | Graduate students in history or information science | Expert physicians | Art historians or art librarians |
| Sample | 41 detailed relevance assessment notes on 40 topics by 8 assessors | 26 pairs of clinical questions and answers | 11 art images and 768 unique descriptors/tags assigned by 13 indexers |

The variety within data offers a test of the typology’s adequacy and flexibility to express an extensive range of topical relevance relationships in various contexts. It also provides an opportunity to investigate to what extent the same incident of topical relevance relationship is identified similarly in different disciplines.

3.2.2 Method and Procedure of Analysis

The method of *qualitative content analysis*, or *document analysis*, was selected to analyze the relevance data for its emphasis “to capture the meanings, emphasis, and themes of messages and to understand the organization and process of how they are presented” (Insch & Moore, 1997: 33). According to Insch & Moore (1997: 2), qualitative content analysis (document analysis) is “a family of procedures for studying the contents and themes of written and transcribed text... While not unambiguously a quantitative or qualitative method...content analysis possesses

some advantages generally associated with qualitative methods such as richer detail, preservation of greater content information, and the potential for grounded theory development.” Many studies using qualitative content analysis look for “themes” (Trochim, 2005), “patterns” (Thompson, 1996), or largely “rhetorical structure” of texts (Kiser, 1997). In this study, qualitative content analysis was used to identify topical themes in the data and further to specify the topical relationships between the query and the retrieved speech segment, between the clinical question and the answer, and between the art image and the subject descriptor (tag).

Capturing themes, meanings, patterns, and relationships is largely a subjective process; to improve the methodological precision and rigor of this procedure, the analytic techniques of *template analysis* and *editing analysis* (Miller and Crabtree, 1992; Marsh, 2002) were used to guide the content analysis. As described by Miller and Crabtree (1992: 17), *quasi-statistical*, *template*, *editing*, and *immersion/crystallization* are the four major analytic styles in qualitative data analysis and they fall along an *objective-to-subjective* continuum. “*Editing* (more subjective, cut-and-paste-like) and the *template* (less subjective, codebook-based) styles are in the middle of the continuum and are the most commonly used.” (Miller and Crabtree, 1992: 18) In this study, *template analysis* and *editing analysis* were used on two levels of the relational analysis, respectively:

1. *Template analysis* was used for analysis on the higher levels of topical relationships and aimed at identifying broader topical relevance categories in the data. It is a semi-structured coding process that used *templates* and

code books developed prior to data analysis. The template can be thought of as a coding scheme or an analysis guide. The template can be developed based on a variety of preconceptions, such as “theory, research tradition, preexisting knowledge, and/or a summary reading of text” (1992: 19). In this case, the initial typology of topical relationships constructed from the literature analysis was used as such a template to guide the analysis for the broader topical relevance categories. Interaction of the data and the template (scheme) introduced continuous revisions to the template and involved several iterations and more data collection until no new revisions were identified, or reaching the “satiating” point (Lindlof & Taylor, 2002). The template analysis was used to verify and revise the initial typology.

2. *Editing analysis* was used for analysis on the lower levels of topical relationships; it aims at developing specific structures underneath the broader topical relevance categories from the data. Essentially, this procedure mirrors the *open coding* phase in grounded theory (Marsh, 2002; Lindlof & Taylor, 2002), whereby the inquirer approaches the data with minimal preconceptions and proceeds to develop conceptual categories through an inductive process (Strauss & Corbin, 1990). The broad-brush conceptual typology of topic relevance relationships covered mostly the top-level relationships and did not contain full-scale structures and detail. The more specific structures and rich nuances beneath each broad relevance category needed to be *learned* or *inductively developed* from the empirical

data analysis. The editing analysis was used to enrich and refine the initial scheme.

To minimize the risk of overlooking important relationship categories, the data were systematically analyzed with QSR *Nvivo* 2.0 (a software package for qualitative analysis and research, see detail at www.qsrinternational.com/), using “elementary line-by-line analysis” (Strauss, 1987: 82).

3.2.3 Data: Detail

3.2.3.1 MALACH Topical Relevance Assessment Data

Creation of the MALACH Test Collection

The topical relevance assessment data were collected in the context of the development of the MALACH (Multilingual Access to Large Spoken Archives) speech retrieval test collection (available through CLEF 2005 & 2006). MALACH is a five-year research project funded by National Science Foundation. It aimed at improving access to oral history archives through automatic speech recognition (ASR) and subsequent information retrieval assisted by techniques from natural language processing (NLP) (Gustman et al. 2002; MALACH). MALACH worked with the collection of 52,000 Holocaust survivor testimonies assembled by the Shoah Visual Foundation Institute for Visual History & Education at University of Southern California (VHF). 4,000 of these testimonies were carefully indexed: Trained indexers divided each testimony into topical *segments*, wrote a three-sentence segment summary, assigned 3-5 subject descriptors from the VHF Thesaurus and any persons mentioned, and wrote a half-page summary of the testimony as a whole.

We used this collection to develop an oral history speech retrieval test collection, which is used to compare and evaluate the performance of various speech retrieval systems. In 2003, starting from 50 real topics, information requests received by VHF (see an example in Figure 3-2), we configured a test collection of

400 testimonies yielding approximately 20,000 segments such that each topic would have a reasonable number of relevant segments for retrieval experiments. From 2004 to 2006, we added in about 25 topics to the test collection for each year.

| | |
|--------------------|---|
| Title | Death marches |
| Description | Experiences on the death marches conducted by the SS to evacuate the concentration camps as the allied armies approached. |
| Narrative | Of interest are descriptions of the preparation for the marches by the camp administration and by the inmates, conditions during the march, shooting of people who stayed behind, assistance from people living at the route of the march, escape or hiding from the march. |

Figure 3-3 An Example of MALACH Topic

MALACH Relevance Assessment Data

The central part of developing the test collection is to have human relevance assessors make relevance assessments between information items in the test collection and topical information requests, more specifically, to make relevance assessments between interview segments and topics. From 2003 to 2006, in total 12 graduate students in History and Information Studies conducted search-guided relevance assessments for all the topics. Search-guided means that the assessors did not assess every segment for every topic – a task that would be prohibitively expensive – but rather did thorough searches using a retrieval system based on the human indexing and then assessed the relevance of the segments found (Cormack, Palmer, & Clarke, 1998).

Assessors worked with an interface that had a small query pane, a search result list pane, a pane for detailed information on one segment, and a pane for recording relevance assessments (see Figure 3-3). To allow an in-depth analysis of the factors affecting retrieval performance, we defined five types of topical relevance (direct, indirect, context, comparison, and pointer) with a view to the nature of the information requests. For each type of relevance there is a drop-down box to assign a scale value (default 0) and a slider to indicate the approximate percent of a segment that pertains. Relevance was recorded on a five-point scale (0 – 4), which in a pilot the assessors preferred over a three-point scale. Assessors also recorded the fraction of a segment that pertained; the relevance score reflects the relevance of that piece, not matter how small. In addition, assessors recorded a justification by linking a piece of summary text with a type of relevance. Additional information, such as the difficulty of the judgment and source of information used, were also recorded. A total of 240893 records were entered through the interface and stored in the background database by the system.

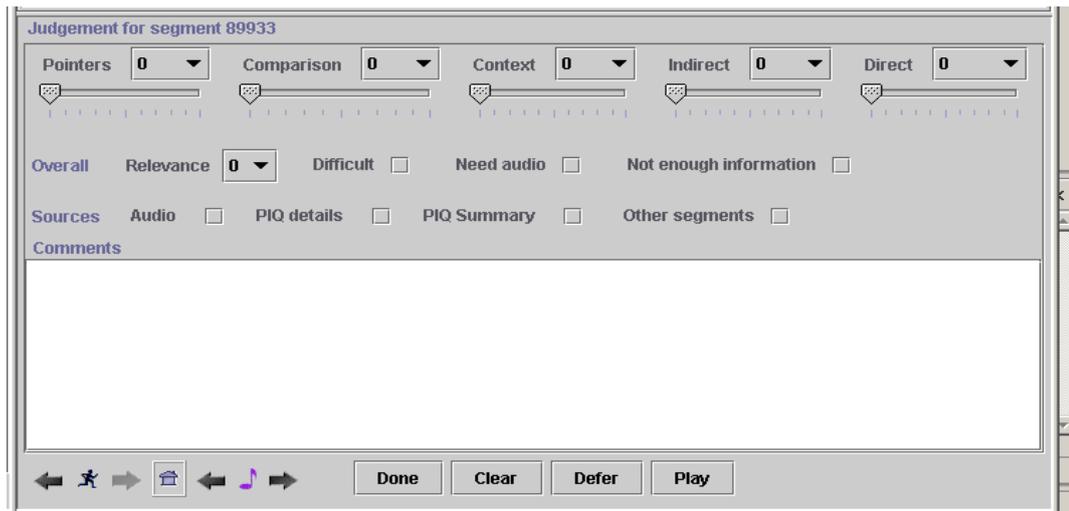


Figure 3-4 MALACH Relevance Assessment Interface

Furthermore, we systematically collected the relevance assessors' thoughts along with the relevance scores that they assigned. For every topic they were working on, the assessors wrote down their understanding of the topic, interpretation of relevance types for the topic, examples they found typical or interesting, together with other thoughts that occurred during the assessment of that topic. Since the notes were taken topic by topic, we call them *Topic Notes*. Appendix C shows a typical example of these Topic Notes. To control the quality of relevance assessment data, for many topics we have more than one assessor to work on. In all we have collected 275 distinct copies of Topic Notes: 54 copies in 2003, 96 copies in 2004, 55 copies in 2005, and 70 copies in 2006.

Previous Work

As a pilot study, Huang & Soergel (2006) analyzed 46 distinct copies of Topic Notes from 9 relevance assessors on 31 topics. Drawing on comments and specific examples in assessor's notes, the paper discusses four types of topical relevance

relationships—direct, indirect, context, and comparison relevance. Based on new insights and a more adequate coding framework derived from the literature-based analysis (see Section 3.1), the coding already done was revisited and revised.

Purposeful Sampling

The whole set of MALACH topical relevance assessment data include both the relevance assessors' notes (275 distinct copies) and the assessment data stored in the system database (total 240893 records). Given the sheer size of the dataset, a purposeful sample was drawn, with the intention of seeking for rich description and illustration of various types of topical relevance relationships. In general, topic notes with more detailed discussion and topic-segment pairs with higher relevance scores (3~4) assigned to them are preferred. In addition, the selection also sought to maximize the variations in relevance assessors and topics, following the principle of *Maximum Variation Sampling* (Lindlof and Taylor, 2002).

3.2.3.2 Clinical Questions and Answers

A set of 59 real-world clinical questions was gathered from the following two on-line sources:

- Family Practice Inquiries Network (FPIN) at <http://www.fpin.org/>
- Parkhurst Exchange at <http://www.parkhurstexchange.com/>

Good and rich topical relevance data are important for the current analysis. These two sites are popular Q & A resources among practicing physicians and they were chosen for the good quality control. Questions submitted to the sites are real-

life clinical questions encountered by practicing physicians. The questions are carefully reviewed, selected, and answered by experts. Good relevance and detailed explanations required by this analysis can be obtained from the answers.

The question collection process was guided by *typical instance sampling* (Lindlof & Taylor, 2002) rather than random sampling, because the goal was not to obtain a fully representative, but rather a typical sample of real-world clinical questions.

According to the literature, approximately 48% of questions asked by physicians are about treatment or therapy (including 5% about pharmacotherapeutics), and 25% about diagnosis. Together, they account for over 70% of physicians' questions (Ebell, 1999; Richardson, Wilson, Nisbikawa, & Hayward, 1995; Smith, 1996).

Guided by the prevalence of types of clinical questions, four types of clinical questions were collected for this study (starting Therapy as the most frequent): Therapy (25), Diagnosis (15), Etiology (12), and Prognosis (7).

26 clinical questions and associated answers collected from the two online QA resources (see Section 3.2.3.2) were analyzed in this study: Therapy (8), Diagnosis (6), Prognosis (6), and Etiology (6).

3.2.3.3 Art Images and Subject Descriptors Describing the Images

The image subject indexing (tagging) data were collected as part of the Computational Linguistics for Metadata Building (CLiMB) project, an active, ongoing research project in the College of Information Studies, at the University of Maryland (<http://www.umiacs.umd.edu/~climb/index.html>); now it has developed

into an IMLS-funded project named T3: *Text, Tags, and Trust*). The CLiMB project developed a Toolkit for image subject indexing. The Toolkit applies computational techniques to extract words and phrases that could enhance subject entries in image catalog records. Achieving this goal required first finding out what terms (words and phrases) are useful for describing image subject and are therefore worth being extracted.

To get a good understanding of this issue, 13 human indexers were recruited to provide subject descriptors (tags) for indexing art images. The data collection took place in the fall semester of 2007. The recruited indexers were art historians or art librarians who were familiar with art image cataloging. Each of them worked on 5-10 images.

The collection of subject descriptors proceeded in three steps:

In the first two steps, indexers were instructed to generate descriptors that would be useful for users (e.g., art historians) to find the image in search, not only for the sake of describing the image itself.

- Phase 1: by viewing the art image alone, the indexer was asked to list all the subject descriptors that come to her mind
- Phase 2: by viewing the art image and reading associated paragraphs of descriptive text about the image, the indexer was again asked to generate (not extract) useful descriptors for subject indexing. Compared to the first step, the generation of subject descriptors now was based on more information about the image. The associated text was used to improve the

indexer's holistic understanding of the image and give the indexer more ideas for indexing the image. But it was not used to directly extract indexing terms from and the descriptor generation was certainly not limited to the provided text

- Phase 3: by viewing the art image and reading associated paragraphs of descriptive text about the image, the indexer was asked to extract the most useful terms directly from the text to describe the subject of the image

The text passage associated with the art image was divided into logical segments which were labeled by the type of information they supplied, using the categories shown in the following list (Passonneau, Yano, Lippincott, & Klavans, 2008):

- Image Content
- Interpretation
- Implementation
- Comparison
- Biographic Information
- Historical Context
- Significance

In addition to providing subject descriptors in each step, indexers were encouraged to supply comments of their thought process and took notes on why

specific terms were selected or not selected for describing the image subject. All the data were collected systematically through an interface dedicated to this task.

Part 2

Literature-Based Analysis of Topical Relevance Relationships Drawing on Multiple Disciplines

Chapter 4. The Perspective of Communication and Rhetoric

Chapter 5. The Perspective of Argumentation, Reasoning (Inference), and Logic

Chapter 6. The Information Science Perspective

Chapter 7. The Perspective of Education and Cognitive Psychology

Chapter 8. The Perspective of Medical Problem Solving

Chapter 9. The Perspective of Law and Evidence

Chapter 10. The Visual Perspective

Chapter 11. A Unified and Theory-Grounded Typology of Topical Relevance

Relationships

Chapter 4. The Perspective of Communication and Rhetoric

The issue of relevance is discussed in different contexts in the variety of communication and rhetoric literatures:

In Sperber & Wilson's (1986b, 1995) *Relevance Theory*, relevance is discussed within the framework of inferential communication. Relevance pertains between evidence (utterances, ostensive stimuli, etc.) and the inferred intention of the communicator, involving tests of interpretive hypotheses (disambiguation, reference resolution, implicature, etc.) In this case, the addressee (audience, listener, or hearer) attending the conversation is the perceiver of relevance.

In Mann & Thompson's (1988, 2006) *Rhetorical Structure Theory* (RST), relevance is discussed in the context of text coherence and organization. Relevance is a functional relation held between text parts that are taken as a whole to convey the writer's intention. In this case, the reader or analyst of the text is the perceiver of relevance.

Both theories emphasize the perceiver drawing conclusions about the intention (or the intended purpose) of a piece of text, speech, or conversation. Apparently, intention is a very important element in this relevance issue, at least from the perspective of communication and rhetoric. To a large extent, searching for relevance in the context of communication means searching for intentions. The perceiver assembles and processes evidence to identify and infer about the communicator's intentions.

Does the element of intention always have a salient presence in the general procedure of information seeking and processing? The answer is No and Yes. It is a

No, because in information search the original purpose and intention is often ignored or diluted. A searcher can use a piece of retrieved information in whatever way that serves her own purpose, regardless of the intention (intended purpose) originally associated with the information. It is a Yes, because relevance is reconstructed and judged according to the new purpose and intention generated by the searcher.

Therefore, information seeking is a process of both deconstruction of the original intention and construction / fulfillment of the new intention. Intention is definitely a critical issue when looking at relevance. Further, the interaction between the old and new intentions (e.g., whether there is a tension, a complementary effect, etc.) is an intriguing topic for future exploration.

4.1 Relevance Theory

Dan Sperber & Deirdre Wilson proposed relevance theory as an inferential account to pragmatics in 1986. Relevance theory is a cognitive psychological theory based on two principles of relevance (Wilson & Sperber, 2002):

- ***Cognitive Principle***: “human cognition is geared towards the maximization of relevance”, or achieving the greatest possible cognitive effect;
- ***Communicative Principle***: “utterances create expectations of optimal relevance,” that is, the ostensive stimuli or utterances chosen by the communicator are worth the hearer’s processing effort and are the most relevant ones among others.

Relevance theory enriches the inferential model of communication and further specifies the non-demonstrative inferential process of communication. It provides a theoretical framework for analyzing non-verbal communication, conversations, and discourses. According to the theory, the hearer starts with the linguistically encoded

utterance meaning and follows the path of least processing effort to work out both the explicated and implicated assumptions embedded in the conversation until she reaches the interpretation that meets her expectation of relevance (Wilson & Sperber, 2002).

4.1.1 Defining Relevance

Sperber & Wilson defined relevance as a function of cognitive effect and processing effort, as excerpted from the 2nd edition of Wilson & Sperber's book, *Relevance: Communication & Cognition* (Sperber & Wilson, 1995: §3.1-2):

“Intuitively, an input (a sight, a sound, an utterance, a memory) is relevant to an individual when it connects with background information he has available to yield conclusions that matter to him: say, by answering a question he had in mind, improving his knowledge on a certain topic, settling a doubt, confirming a suspicion, or correcting a mistaken impression. In relevance-theoretic terms, an input is relevant to an individual when its processing in a context of available assumptions yields a *positive cognitive effect*. A positive cognitive effect is a worthwhile difference to the individual's representation of the world – a true conclusion, for example.

...

What makes an input worth picking out from the mass of competing stimuli is not just the cognitive effects it achieves. In different circumstances, the same stimulus may be more or less salient, the same contextual assumptions more or less accessible, and the same cognitive effects easier or harder to derive. Intuitively, the greater the effort of perception, memory and inference required, the less rewarding the input will be to process, and hence the less deserving of our attention. In relevance-theoretic terms, other things being equal, the greater the *processing effort* required, the less

relevant the input will be. Thus, relevance may be assessed in terms of cognitive effects and processing effort:

- Other things being equal, the greater the positive cognitive effects achieved by processing an input, the greater the relevance of the input to the individual at that time.
- Other things being equal, the greater the processing effort expended, the lower the relevance of the input to the individual at that time.”

Sperber & Wilson’s definition can be easily adapted to the field of information science and shed light on our thinking on relevance. The type of “input” being concerned in the two fields can be slightly different: primitive inputs, such as “a sight, a sound, an utterance, a memory”, are more of interest to communication, whereas more formalized inputs, such as an article, a book, a website, are more often discussed in information science. Nonetheless, the cognitive effect aimed for and the underlying cognitive processes of relevance are largely the same for both fields.

Compared to many relevance definitions in information science, Sperber & Wilson’s definition rests on a more fundamental level of human cognition. It provides a novel angle to understand the concept. Rather than entity- or relationship-centered, their definition is “cognitive effect”-centered by emphasizing the cognitive effect on the perceiver, that is, reaching a conclusion that matters to the perceiver, by answering a question, improving topical knowledge, confirming a hypothesis, correcting a misunderstanding, and so forth. According to this definition, “achieving cognitive effects” is central and inherent for conceptualizing relevance. As such, it provides a theoretical underpinning for relevance research that focuses on characterizing cognitive effects and (functional) contributions of inputs, such as RST (see Section

4.2) and the current inquiry (the functional analysis of topical relevance relationships).

4.1.2 An Inferential Perspective of Relevance

Relevance theory can be seen as a theoretical account of inferential communication and comprehension. It builds upon Grice's inferential model of communication and further develops Grice's perspective on human communication as "a process of inferential intention-attribution". Specifically, communication involves inferential processes of constructing and confirming a hypothesis about the speaker's intention; "understanding is achieved when the communicative intention is fulfilled – that is, when the audience recognizes the informative intention." (Wilson & Sperber, 2002: 255)

The major distinction between the classic code model (linear model) of communication and the inferential model of communication attributes to the fundamental distinction between semantics and pragmatics (Carston, 2004; Carston & Uchida, 1998; Sperber & Wilson, 1986, 1995). The code model describes only the semantics, or encoding/decoding on the linguistic level. However, it is not very often that we can achieve a sufficient interpretation of an utterance solely based on the semantics, or the linguistically encoded information. To disambiguate and to determine the possibilities among multiple interpretations, we need to rely on real-world referents and contextual information. Therefore we need to add an extra pragmatic level of decoding, which is not addressed by the code model. On this pragmatic level, as commonly agreed upon in the field, the mental processes are inferential (Sperber & Wilson, 1986b, 1995). For further discussion on the relation between decoding and inference, see Sperber & Wilson (1986b, 1993, 1995), Wilson (1998), and Carston (1998, 1999, 2004).

Relevance theory explicates the interlock between relevance and inference. Cognitive effects described in Section 4.1.1 are derived from inferential processes (Sperber & Wilson, 1986, 1995). In turn, inferences arise from the natural tendency of seeking and maximizing relevance in the cognitive process. On the one hand, relevance triggers and guides the inferential process; on the other hand, relevance is developed and fulfilled through inferential processes. As such, relevance and inference work hand in hand to allow communication and comprehension to take place.

In terms of the form of reasoning involved in the non-demonstrative inferential process of communication, opinions widely differ in the field. Sperber & Wilson (1986b, 1987, & 1995) used *spontaneous inference* to describe the non-demonstrative inferential process in communication, as opposed to the conscious inference and formal reasoning. Spontaneous inference is “instantaneous, automatic, unconscious” and not strictly logical. On the explication of spontaneous inference, Sperber & Wilson admitted only *forward reasoning* or deductive inference rules, in particular, elimination rules. They argued that *backward reasoning* and introduction rules play no role in spontaneous inferential processes: backward reasoning is used only as “a retrieval strategy rather than a distinct form of reasoning” (Sperber & Wilson, 1990: 181) and introduction rules (and-introduction) are too expensive and inefficient for spontaneous information processing (Sperber & Wilson, 1986, 1987, 1990, 1995). However, Luchjenbroers (1989) pointed out a number of contradictions inherent in Sperber & Wilson’s arguments. Politzer (Politzer, 1990; Politzer & Macchi, 2000) demonstrated that introduction rules and backward inference (deriving a conclusion from an utterance) are also present in spontaneous processing and therefore could not be dispensed. As proposed by another group of researchers (Hobbs, Stickel, Appelt, &

Martin, 1993), abductive reasoning (inference to the best explanation) is beneficial to augment the general process of interpretation as well. The arguments are technical and highly specific to utterance interpretation. It is not the purpose of this inquiry to resolve the controversy in opinions, but it is helpful to broaden the thinking and observe from the literature how various forms of reasoning are linked to relevance.

4.1.3 Context as Premises

Context, one type of topical relevance relationships identified in our early studies (Huang & Soergel, 2004, 2006), is heavily discussed in relevance theory as well. Within the relevance-theoretic framework, no true interpretation and comprehension can ever take place without involving context. The following is a description of context by Wilson & Sperber (1995: 16):

“The set of premises used in interpreting an utterance (apart from the premise that the utterance in question has been produced) constitutes what is generally known as the *context*. A context is a psychological construct, a subset of the hearer’s assumptions about the world.”

Context relates to making assumptions on the part of the speaker and to recovering assumptions on the part of hearer. The speaker and the hearer need to have mutual knowledge and assumptions, or share context, for effective communication. Here is an example of miscommunication due to discrepancy in premises:

(i) *Coffee would keep me awake.*

The speaker of (i) wants to stay awake, and therefore wants to accept his host’s offer of coffee, whereas the host assumes that the speaker does not want to stay awake, and thus interprets (i) as a refusal.

From Wilson & Sperber (1995: 16)

According to Wilson & Sperber (1986b, 1995), “context” encompasses a large variety of information and pre-knowledge, such as:

- “information about the immediate physical environment”
(also identified as a sub-type of Context relevance relationships in Huang & Soergel (2006): “Context/Context by Scope/Context as environmental setting”)
- “information about immediately preceding utterances”
(also identified as a sub-type of Context relevance relationships in Huang & Soergel (2006): “Context/Context by Time Sequence/Context as preceding experience/event”)
- “general cultural assumptions” and “cultural difference”
(also identified as a sub-type of Context relevance relationships in Huang & Soergel (2006): “Context/Context by Scope/Context as social/political/cultural background”)
- “expectations about the future”
- “religious beliefs”
- “scientific hypotheses”
- “anecdotal memories”
- “beliefs about the mental state of the speaker” (non-topical context)

In addition to confirming some earlier findings in Huang & Soergel (2006), the above list further enriches the specification of context as a topical relevance type, in particular, adding four new sub-types: *Expectation*, *Hypothesis*, *Memory*, and *Assumption*. Consolidation of these tentative categories is discussed in Chapter 11.

There is a distinction between premises made about the utterance and premises made about the speaker. Sperber and Wilson did not specify this distinction in their account. Taking this distinction into the information-seeking scenario, a similar distinction presents: premises made within a topic (argument) presented in a piece of

information and premises made about the source of the information. The former can be seen as *topical premise* since it is topically relevant. The latter involves assumptions that are made outside the topic (argument) but related to the credibility / quality of the particular piece of information. This type of assumptions is also relevant but not in a topical sense, so we can call it *non-topical premise*. The following is an example to illustrate the distinction:

Tom said he had returned the money to Jenny.

- Premise about the utterance (topical): Jenny has lent some money to Tom.
Premise about the speaker (non-topical): Tom often tells lies.

In the above example, the non-topical assumption actually affects our judgment on the trustworthiness of the utterance. This is exactly why credibility is considered an important non-topical relevance criterion for evaluating information. If the retrieved information is published in a top-ranked journal and written by a well-known expert in the field, we are likely to have more trust in its findings and to regard it more relevant given all else equal. This pre-knowledge/assumption about the information source is relevant in the sense that it affects our interpretation and evaluation, but not in a topical sense. Therefore, only the topical premise, or the topical context, falls into the scope of the current analysis. The last bullet of the list, “beliefs about the mental state of the speaker”, is non-topical. Only the topical assumption is of interest to this inquiry and will be included as a specific type of topical context.

4.2 Rhetorical Structure Theory (RST)

By essence, *Rhetorical Structure Theory* (RST) deals with analyzing the coherence of a text. Intended for guiding computational text generation (Natural

Language Generation), RST was developed in the 1980s by William Mann, Christian Matthiessen and Sandra Thompson (Taboada & Mann, 2006). In the original account by Mann & Thompson (1988), the theory was defined as follows:

“RST is a descriptive theory of a major aspect of the organization of natural text. It is a linguistically useful method for describing natural texts, characterizing their structure primarily in terms of relations that hold between parts of the text.”

“RST is one of the most fully articulated theories of rhetorical relations” (Goutsos, 1996). As defined in a systematic yet flexible way, the theory has a wide range of applications in text annotation and discourse analysis.

4.2.1 Relation Propositions based on Functional Role

RST provides a rather comprehensive framework for investigating relational propositions based on *functional role*. This framework is highly relevant and inspiring to this dissertation inquiry. RST explains text coherence through *relations between text parts* and describes the relations *in functional terms*, in which “every part of a text has a role, a function to play, with respect to other parts in the text”. These “functional role”-based relations are also referred to in the literature as *coherence relations*, *discourse relations* or *conjunctive relations*. (Taboada & Mann, 2006)

“Within-text” relationships (e.g., discourse relationships, rhetorical structures, and semantic relationships) can be applied as “within-search-result” relationships. In other words, the set of relationships used to organize inside a text or a discourse can easily be applied to organize search results. A coherent discourse is organized around a topic, different text parts play different roles but work together to improve the reader’s understanding of the topic. In information search, the process is quite similar: we first identify a list of search items that are related to a topic in many different ways, e.g., some of them may contain direct answers to the user’s request, some may

provide circumstantial evidence for the user's argument, and some may supply background information or contrasting cases, accordingly we organize these different pieces of information in such a way that the searcher can easily make sense of. In terms of contributing to the receiver's (a reader, a searcher, etc.) understanding of a topic, the functional roles played by different parts of text and those by different pieces of relevant information are much the same.

According to Mann & Thompson (1988), a relation is defined to hold between two non-overlapping text spans: the nucleus (N) and the satellite (S). A relation definition consists of four fields:

1. Constraints on the Nucleus (N),
2. Constraints on the Satellite (S),
3. Constraints on the combination of Nucleus (N) and Satellite (S),
4. The Effect achieved on text receiver (reader) / or intended by the writer (author, speaker)

In the process of text analysis, the analyst makes plausibility judgments to specify each of the four fields, based on her own perception of the text, the context it was written (e.g. , used as news, speech, advertisement), and the cultural background she shares with the writer and intended readers.

As an example, the following is a definition for the relation *evidence* excerpted from the paper (W. C. Mann & Thompson, 1988):

Evidence

Constraints on N:

Reader (R) might not believe N to a degree satisfactory to Writer (W)

Constraints on S:

R believes S or will find it credible

Constraints on the N + S combination:

R's comprehending S increases R's belief of N

The effect:

R's belief of N is increased

(From Mann & Thompson, 1988)

Here are some sample texts containing the relation of evidence (William C. Mann, 2005; W. C. Mann & Thompson, 1988). In both the examples, satellite (S) is intended to increase the reader's belief in the nucleus (N):

Text 1: The program as published for calendar year 1980 really works. In only a few minutes, I entered all the figures from my 1980 tax return and got a result which agreed with my hand calculations to the penny.

Nucleus (N): The program as published for calendar year 1980 really works.

Satellite (S): In only a few minutes, I entered all the figures from my 1980 tax return and got a result which agreed with my hand calculations to the penny.

Text 2: Tempting as it may be, we shouldn't embrace every popular issue that comes along. When we do so, we use precious, limited resources where other players with superior resources are already doing an adequate job.

Nucleus (N): Tempting as it may be, we shouldn't embrace every popular issue that comes along.

Satellite (S): When we do so, we use precious, limited resources where other players with superior resources are already doing an adequate job.

The “Classical RST” defined in the 1988 paper includes 24 rhetorical relations. The set continues to evolve as it adapts to a broader range of linguistic situations. In later research, relations of *List*, *Means*, *Preparation*, *Unconditional*, *Unless*, and *Restatement* are added to the original classic set and together it yields a total of 31. These rhetorical relationships can be broadly divided into two major categories: *nucleus-satellite* (25) and *multinuclear* (7, which contains several nuclei (N) but no satellite (S)).

Table 4-1 provides a complete list of the 31 identified RST relations (William C. Mann, 2005). The RST relations highlight the contribution of the satellite (S) to the nucleus (N). To make it more intuitive and understandable, these relations are rewritten in an S→N direction as in Table 4-1, for instance, *Evidence* is rewritten as “S <*provides Evidence for*> N”.

Table 4-3 A Complete List of RST Relations (rewritten from Mann, W. C. (2005))

| | |
|--|---|
| <p style="text-align: center;">Satellite-nucleus relations (25)</p> | <p>S <provides Evidence for> N S <does Justify> N S <provides Circumstance of> N S <provides Background of> N S <is Antithesis of> N S <provides Concession for> N S <provides Enablement for> N S <provides Motivation for> N S <provides Preparation for> N S <is Condition of> N S <is prevented by> N (Otherwise) S <provides Interpretation of> N S <provides Evaluation of> N S <is solved by> N (Solutionhood) S <is Means to achieve> N S <is Restatement[†] of> N S <is Summary of> N S <is Elaboration of> N S <is Non-volitional Cause of> N S <is Volitional Cause of> N S <is Non-volitional Result of> N S <is Volitional Result of> N S <is Purpose of> N S <is not condition of> N (Unconditional) S <is exception of validity of> N (Unless)</p> |
| <p style="text-align: center;">Multinuclear relations (7)</p> | <p>N1 <provides Contrast to> N2 Conjunction Disjunction Joint Sequence Multinuclear Restatement[†] List</p> |

[†] Note: Restatement is a relation available in both nucleus-satellite and multinuclear forms.

Detailed RST definitions of the above relations are available at the official website of RST: <http://www.sfu.ca/rst/01intro/definitions.html>

4.2.2 RST Relationships vs. Topical Relevance relationships

RST is about how each text part contributes to establish an *effect*, or a “worthwhile difference” in Wilson & Sperber’s term, on the reader. Here are some sample Effects from the RST relation definitions:

- “Reader’s belief of N is increased” (*Evidence* relation),

- “Reader’s ability to comprehend N increases” (*Background* relation),
- “Reader’s positive regard for N is increased” (*Antithesis* relation), and so on.

“An essential part of a relation definition is the section labeled *Effect*...an RST analysis always constitutes a plausible account of what the writer wanted to achieve with each part of the text.”(W. C. Mann & Thompson, 1988) The RST relation definitions are effect-centered; the nature of a relation directly relies on the particular effect it creates. Effect serves as the basis for appropriate selection among various RST relations.

RST relationships and topical relevance relationships are closely linked with each other in that they both aim for achieving “positive cognitive effects” (Wilson & Sperber, 2002) on the receiver (given she a reader, a searcher, a user, or else). By essence, both RST relationships and topical relevance relationships are effect-centered. The difference between the two is that, the positive cognitive effect is *intended* by the writer in a RST relationship, whereas the effect is *established* or *achieved* on the receiver for a topical relevance relationship.

RST is a relationship typology for differentiating cognitive effects to be achieved, by specifying the functional role and highlighting the contribution of text parts. As such, the RST relation typology can be directly applied to identify and specify topical relevance relationships, as summarized in the section 4.2.4.

4.2.3 Analysis for the Mode of Inference

Many of the RST relations can be specified not only by the functional role, but also by the mode of inference (reasoning). As described in earlier chapters, the functional role and the mode of inference (reasoning) are the two major facets being looked at by this inquiry. Broadly speaking, the mode of inference consists of *forward*

inference (deduction), *backward inference* (abduction), *inference from cases* (induction), and *generic inference* (without specifying the reasoning direction) (Huang & Soergel, 2006). Taking *(Non-)Volitional Cause* as an example, knowing the cause (Satellite), we can make forward reasoning to infer about the consequence/result (Nucleus). Conversely, for *(Non-)Volitional Result*, knowing the consequence/result (Satellite), we can make backward reasoning to infer about the cause (Nucleus). For another example, the relation *Purpose* falls into the category of backward reasoning: from the attention for a desired outcome (Satellite) thinking backward for ways to achieve it (Nucleus). The relationships with a salient aspect of inference (reasoning) are summarized in Table 4-2.

Table 4-4 RST Relations Analyzed by the Mode of Inference

| Mode of Inference | RST relation |
|-----------------------------------|--|
| Forward reasoning (Deduction) | S <is Non-volitional Cause of> N S <is Volitional Cause of> N S <provides Motivation for> N |
| Backward reasoning (Abduction) | S <is Non-volitional Result of> N S <is Volitional Result of> N S <is Purpose of> N S <is prevented by > N (Otherwise) |
| Generic inference | S <provides Evidence for> N S <does Justify > N S <is Antithesis of> N |

4.2.4 Topical Relevance Relationships Identified from RST

The analysis for topical relevance relationships focuses on the 25 Nucleus-Satellite (N-S) structured RST relations. The majority of RST relations (25 out of 31) are N-S structured, in which the nucleus (N) is the central unit and the satellite (S) contributes to the reader's understanding of or belief in the nucleus (N). The N-S structure highlights the contributions or functional roles we want to capture for topical relevance. On the other hand, the Multinuclear-structured relations are not as

important for this analysis. In the Multinuclear-structured relations, no central unit presents and thus only very vague contributions / functions, if any, can be characterized. Therefore, only *Contrast* and *Sequence* are included in the analysis, the other 5 Multinuclear-structured relations (*Conjunction*, *Disjunction*, *Joint*, *Multinuclear Restatement*, *List*) are left out in the table.

Moreover, two relations with an emphasis on rhetorical use, *Antithesis* and *Concession* (see the following box), are not included for the purpose of this analysis.

Antithesis

Constraints on N:

Writer (W) has positive regard for N

Constraints on the N + S combination:

N and S are in contrast; because of the incompatibility that arises from the contrast, one cannot have positive regard for both of those situations; comprehending S and the incompatibility between the situations increases R's positive regard for N

The effect:

R's positive regard for N is increased

Example Text

Hundreds of people lined up to be among the first applying for jobs at the yet-to-open Marriott Hotel is an indication of lack of employment, not laziness.

Nucleus (N): Hundreds of people lined up to be among the first applying for jobs at the yet-to-open Marriott Hotel is an indication of lack of employment,

Satellite (S): not laziness.

(From <http://www.sfu.ca/rst/01intro/definitions.html>)

Concession

Constraints on N:

Writer (W) has positive regard for N

Constraints on S:

W is not claiming that S does not hold

Constraints on the N + S combination:

W acknowledges a potential or apparent incompatibility between N and S; recognizing the compatibility between N and S increases Reader (R)'s positive regard for N

The effect:

R's positive regard for N is increased

Example Text

Tempting as it may be, we shouldn't embrace every popular issue that comes along.

Nucleus (N): we shouldn't embrace every popular issue that comes along.

Satellite (S): Tempting as it may be,

(From <http://www.sfu.ca/rst/01intro/definitions.html>)

Table 4-3 provides a summary of “*functional-role*”-based topical relevance relationships identified from the RST relation framework. The corresponding RST relations and their original definitions are listed on the right.

Table 4-5 Topical Relevance Relationships Identified from RST

| <p>Topical Relationship by Functional Role <i>RST Relation</i> (Mode of Topical Reasoning)</p> | <p>Definition[†] (From http://www.sfu.ca/rst/01intro/definitions.html)</p> |
|--|--|
| <p>Direct</p> | |
| <p>. <i>Restatement*</i></p> | <p><i>N+S</i>: S restates N, where S and N are of comparable bulk; N is more central to W's purposes than S is <i>Effect</i>: R recognizes S as a restatement of N</p> |
| <p>. <i>Elaboration*</i></p> | <p><i>N+S</i>: S presents additional detail about the situation or some element of subject matter which is presented in N or inferentially accessible in N in one or more of the ways listed below. In the list, if N presents the first member of any pair, then S includes the second:</p> <ul style="list-style-type: none"> - set :: member - abstraction :: instance - whole :: part - process :: step - object :: attribute - generalization :: specific <p><i>Effect</i>: R recognizes S as providing additional detail for N. R identifies the element of subject matter for which detail is provided.</p> |
| <p>. . <i>Member <is Elaboration of> Set*</i></p> | |
| <p>. . . <i>Instance <is Elaboration of> Abstraction*</i></p> | |
| <p>. . . <i>Specific <is Elaboration of> Generalization*</i></p> | |
| <p>. . <i>Part <is Elaboration of> Whole*</i></p> | |
| <p>. . . <i>Step <is Elaboration of> Process*</i></p> | |
| <p>. . <i>Attribute <is Elaboration of> Object*</i></p> | |
| <p>. <i>Interpretation*</i></p> | <p><i>N+S</i>: S relates N to a framework of ideas not involved in N itself and not concerned with W's positive regard <i>Effect</i>: R recognizes that S relates N to a framework of ideas not involved in the knowledge presented in N itself</p> |

| <p style="text-align: center;">Topical Relationship by Functional Role <i>RST Relation</i> (Mode of Topical Reasoning)</p> | <p style="text-align: center;">Definition[†] (From http://www.sfu.ca/rst/01intro/definitions.html)</p> |
|---|--|
| <p>Context</p> | |
| <p>. <i>Background</i></p> | <p><i>N</i>: R won't comprehend N sufficiently before reading text of S <i>N+S</i>: S increases the ability of R to comprehend an element in N <i>Effect</i>: R's ability to comprehend N increases</p> |
| <p>. <i>Preparation</i></p> | <p><i>N+S</i>: S precedes N in the text; S tends to make R more ready, interested or oriented for reading N <i>Effect</i>: R is more ready, interested or oriented for reading N</p> |
| <p>. Framework <i>Circumstance</i></p> | <p><i>S</i>: S is not unrealized <i>N+S</i>: S sets a framework in the subject matter within which R is intended to interpret N <i>Effect</i>: R recognizes that S provides the framework for interpreting N</p> |
| <p>. By time sequence <i>Sequence</i></p> | <p><i>N+N</i>: There is a succession relationship between the situations in the nuclei <i>Effect</i>: R recognizes the succession relationships among the nuclei.</p> |
| <p>Comparison</p> | |
| <p>. Analogy</p> | |
| <p>. <i>Contrast</i></p> | <p><i>N+N</i>: No more than two nuclei; the situations in these two nuclei are (a) comprehended as the same in many respects (b) comprehended as differing in a few respects and (c) compared with respect to one or more of these differences <i>Effect</i>: R recognizes the incomparability and the difference(s) yielded by the comparison is being made</p> |
| <p>Causal Relation</p> | |
| <p>. Cause</p> | |

| <p style="text-align: center;">Topical Relationship by Functional Role <i>RST Relation</i> (Mode of Topical Reasoning)</p> | <p style="text-align: center;">Definition[†] (From http://www.sfu.ca/rst/01intro/definitions.html)</p> |
|--|--|
| <p>. . <i>Volitional Cause</i> (Forward reasoning)</p> | <p><i>N</i>: N is a volitional action or else a situation that could have arisen from a volitional action</p> <p><i>N+S</i>: S could have caused the agent of the volitional action in N to perform that action; without the presentation of S, R might not regard the action as motivated or know the particular motivation; N is more central to W's purposes in putting forth the N-S combination than S is.</p> <p><i>Effect</i>: R recognizes S as a cause for the volitional action in N</p> |
| <p>. . <i>Non-volitional Cause</i> (Forward reasoning)</p> | <p><i>N</i>: N is not a volitional action</p> <p><i>N+S</i>: S, by means other than motivating a volitional action, caused N; without the presentation of S, R might not know the particular cause of the situation; a presentation of N is more central than S to W's purposes in putting forth the N-S combination.</p> <p><i>Effect</i>: R recognizes S as a cause of N</p> |
| <p>. Consequence</p> | |
| <p>. . <i>Volitional Result</i> (Backward reasoning)</p> | <p><i>S</i>: S is a volitional action or a situation that could have arisen from a volitional action</p> <p><i>N+S</i>: N could have caused S; presentation of N is more central to W's purposes than is presentation of S;</p> <p><i>Effect</i>: R recognizes that N could be a cause for the action or situation in S</p> |
| <p>. . <i>Non-volitional Result</i> (Backward reasoning)</p> | <p><i>S</i>: S is not a volitional action</p> <p><i>N+S</i>: N caused S; presentation of N is more central to W's purposes in putting forth the N-S combination than is the presentation of S.</p> <p><i>Effect</i>: R recognizes that N could have caused the situation in S</p> |
| <p>. . <i>Otherwise</i> (Backward reasoning)</p> | <p><i>N</i>: N is an unrealized situation</p> <p><i>S</i>: S is an unrealized situation</p> <p><i>N+S</i>: realization of N prevents realization of S</p> <p><i>Effect</i>: R recognizes the dependency relation of prevention between the realization of N and the realization of S</p> |
| <p>Evidence</p> | |

| Topical Relationship by Functional Role <i>RST Relation</i> (Mode of Topical Reasoning) | Definition[†] (From http://www.sfu.ca/rst/01intro/definitions.html) |
|---|---|
| <ul style="list-style-type: none"> . Supportive evidence (Generic inference) | |
| <ul style="list-style-type: none"> . . <i>Evidence</i> | <p><i>N</i>: R might not believe N to a degree satisfactory to W <i>S</i>: R believes S or will find it credible <i>N+S</i>: R's comprehending S increases R's belief of N <i>Effect</i>: R's belief of N is increased</p> |
| <ul style="list-style-type: none"> . . <i>Justify</i> | <p><i>N+S</i>: R's comprehending S increases R's readiness to accept W's right to present N <i>Effect</i>: R's readiness to accept W's right to present N is increased</p> |
| <ul style="list-style-type: none"> . Contradictory evidence | |
| <p>Motivation (Forward reasoning)</p> | <p><i>N</i>: N is an action in which R is the actor (including accepting an offer), unrealized with respect to the context of N <i>N+S</i>: Comprehending S increases R's desire to perform action in N <i>Effect</i>: R's desire to perform action in N is increased</p> |
| <p>Purpose (Backward reasoning)</p> | <p><i>N</i>: N is an activity; <i>S</i>: S is a situation that is unrealized <i>N+S</i>: S is to be realized through the activity in N <i>Effect</i>: R recognizes that the activity in N is initiated in order to realize S</p> |
| <p>Condition</p> | |
| <ul style="list-style-type: none"> . <i>Unconditional</i> | <p><i>S</i>: S conceivably could affect the realization of N <i>N+S</i>: N does not depend on S <i>Effect</i>: R recognizes that N does not depend on S</p> |
| <ul style="list-style-type: none"> . <i>Unless</i> | <p><i>N+S</i>: S affects the realization of N; N is realized provided that S is not realized <i>Effect</i>: R recognizes that N is realized provided that S is not realized</p> |

| <p style="text-align: center;">Topical Relationship by Functional Role <i>RST Relation</i> (Mode of Topical Reasoning)</p> | <p style="text-align: center;">Definition[†] (From http://www.sfu.ca/rst/01intro/definitions.html)</p> |
|--|---|
| <p>• <i>Condition</i></p> | <p><i>S</i>: S presents a hypothetical, future, or otherwise unrealized situation (relative to the situational context of S)</p> <p><i>N+S</i>: Realization of N depends on realization of S</p> <p><i>Effect</i>: R recognizes how the realization of N depends on the realization of S</p> |
| <p>• <i>Enablement</i></p> | <p><i>N</i>: presents an action by R (including accepting an offer), unrealized with respect to the context of N</p> <p><i>N+S</i>: R comprehending S increases R's potential ability to perform the action in N</p> <p><i>Effect</i>: R's potential ability to perform the action in N increases</p> |
| <p><i>Method</i> <i>Means</i></p> | <p><i>N</i>: an activity</p> <p><i>N+S</i>: S presents a method or instrument which tends to make realization of N more likely</p> <p><i>Effect</i>: R recognizes that the method or instrument in S tends to make realization of N more likely</p> |
| <p><i>Solution</i></p> | <p><i>S</i>: S presents a problem</p> <p><i>N+S</i>: N is a solution to the problem presented in S;</p> <p><i>Effect</i>: R recognizes N as a solution to the problem presented in S</p> |
| <p><i>Evaluation</i></p> | <p><i>N+S</i>: S relates N to degree of W's positive regard toward N.</p> <p><i>Effect</i>: R recognizes that S assesses N and recognizes the value it assigns</p> |
| <p><i>Summary</i></p> | <p><i>N</i>: N must be more than one unit</p> <p><i>N+S</i>: S presents a restatement of the content of N, that is shorter in bulk</p> <p><i>Effect</i>: R recognizes S as a shorter restatement of N</p> |

[†] N: Constraints (functions) on Nucleus, S: Constraints (functions) on Satellite, N+S: Constraints (functions) on the combination of N and S, W: Writer, R: Reader.

* These RST relations belong to another facet, *Presentation types*, which is developed later in the study (See discussion in Section 11.2; Table 11-1). They do not become part of the typology of topical relevance relationships.

Chapter 5. The Perspective of Argumentation, Reasoning (Inference), and Logic

To a large extent, arguing is reasoning (Toulmin, 1958, 2001, 2003; Toulmin, Rieke, & Janik, 1979/84; Pinto, 2001; Mende, 2002). The focus of this chapter is on reasoning (inference) used in practical arguments; the role a piece of information plays in the structure of an argument gives an important perspective on topical relevance. The emphasis here is on the reasoning structure of arguments, namely, how to support or justify a claim (conclusion) of interest given a set of premises and evidence. Many other aspects of argumentation, such as pragmatical, dialectical, rhetorical, and ethical factors involved in argumentation, although interesting, are outside the scope of the present inquiry.

The reasoning used in arguments directly enriches the deliberation of *topical reasoning* (reasoning involved in determining topical relatedness). As stated earlier, the mode of reasoning (inference) and the functional role are the two major facets I aim to explore for topical relevance. Detecting and determining topical relatedness between two subjects requires reasoning (inference). Topical reasoning can be explicit in some cases, but in many cases it is so spontaneous, non-demonstrative, implicit, and minimal that people do not even notice. Generally speaking, when topical relevance is not discussed in a direct relation to a particular claim or a specific question, it is more likely to be the spontaneous and implicit kind, or merely “subject-matter overlap” (Walton, 1982). But when it is, and especially when it takes several or more inferential steps to reach the particular claim or to answer the specific question, it requires a certain level of explicit and formal reasoning.

This chapter discusses mainly Walton's and Toulmin's works on argumentation and propositional logic for valid arguments in general. Various types of topical reasoning identified from the literature are examined and summarized at the end of the chapter. Other logics, such as predicate logic, modal logic, deontic logic, epistemic logic, tense logic, etc.¹, are not included in order not to complicate the discussion.

Argumentation is rooted in classical logic, dialectic, and rhetoric (van Eemeren & Grootendorst, 1996). Argumentation "always serves the *rhetorical purpose* of making a particular opinion (more) acceptable to an audience" and "the reasons put forward by an arguer must be chosen in such a way that they maximize this *rhetorical effect*." (van Eemeren & Grootendorst, 1996: 101) Argumentation can be considered as one type of rhetoric, in particular, persuasion rhetoric. Connections can be drawn between the *functional roles* identified from rhetoric (see Chapter 4) and the reasoning structure of arguments.

5.1 Definitions and Background

5.1.1 Reasoning, Inference, Logic, and Argument

"Books on *logic*—both formal and informal logic—typically claim to deal with *thinking* or *reasoning*. Yet even the most cursory examination reveals that they talk mostly about what they call *arguments*." (Pinto, 2001: 32). The concepts of logic, reasoning, inference, and argument are all tied together. Before diving into further discussion, let us look at the definitions of these concepts first.

¹ "Arguments whose validity cannot be established in propositional logic may prove to be valid in other logics. One such logic is *predicate logic*, which deals with the use of 'quantifiers' such as "all" and "some" in arguments. Amongst other logics that have so far been developed are *modal* logics, examining the logical behavior of words like "necessary" and "possible," *deontic* logic, concentrating on logical constants such as "obliged" and "permissible," *epistemic* logic, studying the logical behavior of words like "know" and "believe," and *tense* logic, investigating the logical effect of temporal references... Unlike propositional and predicate logic, these logics are "intensional" logics, since they take into account the effect of nonextensional aspects of meaning." (Johnson, 2002: 11)

Reasoning often refers to the process of drawing a conclusion (syllogistically) (Arnauld & Nicole, 1964). “Reasoning is the making or granting of assumptions called *premises* (starting points) and the process of moving towards *conclusions* (end points) from these assumptions by means of warrants.” (Walton, 1990: 403) Both premises and conclusions are *propositions*. Propositions are assertions and beliefs expressed by declarative sentences (Frege, 1918-23, 1977). The term *inference* is commonly used with the same meaning as *reasoning*. “Inference is a process by which one proposition is arrived at and affirmed on the basis of one or more other propositions accepted as the starting points of the process” (Copi & Cohen, 1990: 5)

“*Logic* becomes the study of the relations that hold between the propositions (designated as premises and conclusion) that make up arguments” (Pinto, 2001: 34). In the sense of logic, an *argument* is simply a set of premises and a conclusion. An argument can be decomposed into two essential parts: one or more *premises* and one and only one *conclusion* (Faris, 1962; Copi & Cohen, 1990; Govier, 1997; Hurley, 2000; Johnson, 2002). As such, arguments become the building blocks for discussions and extrapolations in logic and mathematics.

To sum up, “*reasoning* is identified or equated with *inference* (with basing a *conclusion* on *premises*)” (Pinto, 2001: 32). Furthermore, “corresponding to every possible *inference* is an *argument*, and it is with arguments that *logic* is chiefly concerned.” (Copi & Cohen, 1990) The terms of “reasoning” and “inference” therefore are used interchangeably in this study.

It is important to note that reasoning or inference goes beyond the scope of classical deductive logic. The only premiss-conclusion link that classical logic considers as valid is *entailment* or *deductive* reasoning (Pinto, 2001). “Basic to the classical [logic] conception is the assumption that the suitability of the relationship

between premises and conclusion can be appraised simply by examining the propositional content of the premises and of the conclusion (and, in most versions of the classical conception, examining only the ‘logical form’ of that propositional content). ... This approach to appraising the relationship between premises and conclusion has, on the whole, worked splendidly for appraising mathematical and/or ‘deductive’ inferences. But attempts to construct similar logics for other kinds of inference—*inductive* inference, *conductive* inference (Wellman, 1971), *abduction* or inference to the best explanation, as well as large stretches of what AI calls practical or everyday reasoning—have yet to bear anything near final fruit.” (Pinto, 2001: 38)

In many arguments, the claim can not be sufficiently warranted by the content explicitly stated in premises alone, but also draws on world knowledge outside the explicitly stated premises. Evelyn Barker (1989: 187) has said, when discussing analogical reasoning, “like inductive reasoning generally, an inductive analogy is not based merely on its stated premises but on all our knowledge about the world.” This is not so much in the type of reasoning as in what premises are specific to the argument and are therefore explicitly stated and what premises are assumed to be known as general background.

5.1.2 More on Argument and Argumentation

The conceptualization of argument not only has a central status in logic, but also is important in communication, rhetoric, artificial intelligence, sociology, and other related subjects.

“An argument, in the sense of a *train of reasoning*, is the sequence of interlinked claims and reasons that, between them, establish the content and force of the position for which a particular speaker is arguing.” (Toulmin, Rieke, & Janik, 1984: 14) In this sense, an argument is essentially “a tree of inferences” (Mende, 2002). On the other

hand, the concept of argument has its social and communicative sides. Thus it is also “a social and verbal means of trying to resolve, or at least to contend with, a conflict or difference that has arisen or exists between two or more parties...” (Walton, 1990: 411)

Toulmin in his *Return to Reason* (2001) describes and contrasts two types of arguments, or argument in its two senses:

- *Logical arguments*, or arguments in the logicians’ sense as discussed in the last section, are formally logical, abstract and general, empty, context-free, and platonic pure and timeless, and value-neutral;
- *Practical arguments*, on the other hand, are practical and substantive, local, empirical, situation-dependent, and everyday and ethically loaded.

Argumentation is also considered a special kind of speech act (Van Eemeren & Grootendorst, 1982), implemented with *argumentative* uses of language as opposed to *instrumental* uses of language (e.g., order, command, complain, greet, request).

Argumentation is used to refer to “the whole activity of making claims, challenging them, backing them up by producing reasons, criticizing those reasons, rebutting those criticisms, and so on.” (Toulmin, Rieke, & Janik, 1984)

Argumentation is closely related to but also an area somewhat distinct from formal logic, information logic, classical rhetoric, and formal dialectic (Gilbert, 2007). Argumentation theorists attempt to gain sufficient insight into both the *textual* and *contextual pragmatic* factors that play a part in argumentative discourse (van Eemeren & Grootendorst, 1996: 13)

5.1.3 The Tension between Classical Logic and Argumentation

There has always been a tension between the classical formal logic (analytic syllogisms and first-order predicate calculus) and the pragmatic argumentation. The soul of arguments is reasoning. On the one hand, therefore, the rich legacy of classical logic has deeply and profoundly influenced argumentation studies and used to be *the* validity check of a sound argument. On the other hand, however, “[formal logic] eschews ambiguity, requires univocity, and works abstractly with a logically perfect language.” (Boger, 2005: 43). As the validity criteria for gauging and evaluating practical arguments, “it is not uncommon for the fussiness of a formal proof to defeat its own end by making it extremely laborious to follow, if not actually obscure.” (Hamblin, 1993:249) Informal logicians and argumentation theorists experienced uneasiness and frustrations about the inefficacy of formal logic for addressing matters of everyday life. Classical formal logic is widely considered “too shallow a vessel to contain the richness of intellectual life” (Keith, 2005: 244; Toulmin, 2002). “Each of the principal founders of the modern argumentation movement—Chaim Perelman, Stephen Toulmin, and Charles Hamblin –has repudiated the Cartesian rationalism of traditional logic... Accordingly, logic, or the assessment of arguments, has been broadened well beyond the *impersonal character* and *timelessness* of *deductive necessity* to include matters traditionally excluded, namely, matters of rhetoric, pragmatics, dialogical dynamics, critical thinking, and communication studies.” (Boger, 2005: 40)

5.2 Pluralism Concepts of Topical Relevance in Argumentation

In *Topical Relevance in Argumentation* (Walton, 1982), Walton examined an argument as an “organized two-person disputation” and looked at the issue of relevance (or irrelevance) as a significant source of *fallacies*. “The object is to see if

there is a reasonable way of reevaluating criticisms like ‘That’s beside the point!’ or ‘That’s irrelevant!’” (Walton, 1982)

Broadly speaking, three types of topical relevance give rise to criticisms of irrelevance in disputation games of dialogue:

- Subject-matter overlap
- Propositional relevance
- Question-answer relevance

This is referred to as “pluralism concepts of relevance” by Walton (Walton, 1982: 51). Each type of the topical relevance in arguments is discussed in the following sections.

5.2.1 Subject-Matter Overlap as Topical Relevance

“Clearly one fundamental notion of irrelevance is failure of subject-matter overlap of pairs of propositions” (Walton, 1982: 56). Subject-matter overlap is defined, according to David Lewis, for A to be related to B, A and B must “share some common subject-matter”. Given a chosen set of topics T , each proposition is assigned a non-empty subset of T : the subject-matter of proposition A is a , the union of all the assigned topics from T ; similarly, the subject-matter of proposition B is b . Propositions A and B are topically related if and only if $a \cap b \neq \emptyset$, that is, the subject-matter of A shares at least one topic in common with the subject-matter of B.

5.2.2 Propositional Relevance

There are three specific types of propositional relevance as follows. Each of them can be reduced to the propositional structure of arguments in the disputation.

- ***Premissary relevance***: concerned with identifying redundant and useless premises and invalid premises (the fallacy of *ad misericordiam*) in arguments
- ***Conclusional relevance***: concerned with identifying useless conclusions, or “misrefutation” (the fallacy of *ignoratio elenchi*), “basically a fallacy that consists in proving a conclusion *other than* the one that should be proved” (Walton, 1982: 60). There are multiple conclusions established in the process of disputation: the ultimate conclusion and interim conclusions established along the way “leading towards” the ultimate conclusion. In many cases, it is difficult to judge whether a local conclusion at hand is relevant or useful for the overall purpose. Both premissary and conclusional irrelevance may not be fallacious *per se* but represent bad strategies to win the disputation games of dialogue. However, when applied appropriately, they have “diversionary value” as tactics to confuse and mislead the opponent.
- ***Pertinence***: a proposition is pertinent (*pertinens*) if and only if it either follows from or is inconsistent with any subset of the initial and subsequent propositions. “A statement that is *pertinens* is one either that logically follows from what precedes (*sequens*) or is logically repugnant to what precedes (*repugnans*)” (Green, 1963: 54). “For a proposition to be pertinent, it may have a logical relationship with the initial proposition or subsequent propositions either singly or taken together.” (Walton, 1982: 63)

Note: Pertinence here refers to a logical relationship and must not be confused with “pertinence” as defined in information science (see Section 2.1)

5.2.3 Question-Answer Relevance

“Many might be inclined to rule that any reply other than a *direct* answer to a question is an irrelevant and therefore fallacious move in argument.” (Walton, 1982: 11) Such a ruling, however, “turns out to be highly naïve, given the realities of adversarial debates” (Walton, 1982: 65-66). Indirect answers and interim answers leading towards the direct answer, as well as indications of no commitment to the presupposition of a question (trick question like “Have you stopped beating your spouse?”), should also be allowed in arguments.

Therefore, the central concern to question-answer relevance is: what constitutes an answer to a question and in particular, what constitutes a *direct* answer? This concern in turn depends on the type of question that is asked. “Whether-questions, and in particular yes-no questions, are much more easily manageable in games of dialogue than other questions like who-questions, why-questions, what-questions, and the other varieties.” (Walton, 1982: 66) Direct answers to a yes-no question are clearly *yes* and *no*. A whether-question poses a finite number of alternatives and each alternative is a direct answer to the question. As for question types other than yes-no and whether-questions, it is quite a complicated issue to decide what counts as an answer and a direct answer.

5.2.4 Comparing Types of Topical Relevance in Argumentation

The first type of topical relevance in argumentation, subject-matter overlap, gives the general sense of topical relevance. It is not directly tied to a particular

claim/conclusion or to a specific question, but it provides the basis for further-specified relevance types of propositional relevance and question-answer relevance. Subject-matter overlap always runs in the background even when other relevance types are concerned. In other words, to have propositional relevance or question-answer relevance take place, subject-matter overlap between propositions or between question and answer is necessary and given by default.

Subject-matter overlap corresponds to the general notion of topical relevance in everyday use. Although in Walton's discussion a relatively precise definition (see Section 5.2.1) is provided, logical operations on such a definition are still beyond the grasp. In Walton's relatedness-logic modeling, subject-matter overlap is taken as a local binary decision (i.e., relevant-True vs. not relevant-False) made somewhat arbitrarily. The determination of subject-matter overlap is likely to involve only spontaneous, implicit, and non-demonstrative reasoning.

Topical relevance can go beyond this general notion and becomes more specific when a direct link to a particular claim/conclusion or a particular question is established. This gives rise to propositional relevance and question-answer relevance, respectively. Propositional relevance as well as question-answer relevance (to some degree) can be handled by reducing to the propositional structure for conditionals in the argument and thus modeled more precisely with relatedness logic. More explicit and formal reasoning applies to these more specific relevance types, such as the types of reasoning described by Toulmin and his colleagues (see Section 5.3.4).

It is also important to note that proving the *ultimate* conclusion or offering the *direct* answer are not the only cases being considered relevant. Interim conclusions "leading towards" the ultimate conclusion and indirect answers to a question are also

considered topically relevant. These *indirect* and *interim* cases are more difficult to detect and handle but are nonetheless worth our attention.

Subject-matter overlap can be deemed as *under-specified* propositional relevance and question-answer relevance. It is not explicitly linked to any particular claim or question, but it can be thought of as linked to *several* general claims or questions at the same time. For example, for the user who wants to know about the topic of global warming, the topic is automatically linked to (or decomposed into) several general questions: What is global warming? What causes global warming? What are solutions to global warming? Etc. Information (or propositions) providing answers, both direct and indirect, to these questions have subject-matter overlap with the topic. Similarly, conclusions and opinions concerning the topic can help to confirm or disconfirm the user's existing beliefs about global warming, as well as to generate new beliefs that were not processed by the user before. In this sense, subject-matter overlap as a type of topical relevance does not differ very much from the specific relevance, except that it is more general, is not necessarily tied with an explicit argument or question at hand, and is not committed to yielding any specific conclusion and answer.

5.3 Toulmin's Argumentation Theory

Stephen Toulmin is a British philosopher and is a well recognized scholar in the field of argumentation theory. In *The Uses of Argument* (Toulmin, 1958), he first proposed a model for analyzing the structure of arguments, or *Toulmin's model of argumentation*. This model is considered his most influential work and has wide applications in communication and rhetoric and in computer science. (van Eemeren & Grootendorst, 1996)

Toulmin's views on argumentation focus on the justificatory aspect, or how an argument or claim can be justified and validated. His works focus on *practical*

arguments rather than *theoretical arguments* (e.g., in logic). Moreover, Toulmin noticed the norms of argumentation vary from field (discipline) to field (discipline) and demonstrated this field-dependence in law, in natural science, in medicine, in politics, in arts, in commerce, in the ethical realm, etc. (Toulmin, 1958, 2001, 2003; Toulmin, Rieke, & Janik, 1979/84; van Eemeren & Grootendorst, 1996)

5.3.1 Toulmin's Model of Argumentation

The model was first developed based on legal arguments and intended for use in analyzing courtroom arguments. Later the model turned out to be applicable and useful in many other contexts. The model consists of six inter-connected elements as follows:

- *Claim*: the “destination” of an argument, i.e., the conclusion one wants to arrive at, a discovery one wants to induce, or an assertion one wants to make.
- *Data/Grounds*: premises, facts, or data that are used as the foundation to support the claim of an argument.
- *Warrant*: rules, principles, conventions, or rationales that justify the movement from the data / grounds to the claim (destination). The warrant for arguments varies from field to field: in natural sciences, “laws of nature” function as warrants; in legal arguments, statutes, precedents, and rules are used as warrants; in medical diagnosis, diagnostic descriptions provide warrants (Toulmin, 1958, 2001, 2003; Toulmin, Rieke, & Janik, 1979/84).
- *Backing*: credentials that are provided to back up the warrant. Backing is needed when the warrant itself is not sufficiently convincing; backing enhances the credibility and reliability of the warrant.

- *Rebuttal*: exceptions, reservations, or restrictions which can be legitimately applied to the claim. Rebuttals are often given in this way: the claim is true, *unless* such-and-such (the rebuttal).
- *Qualifier*: indications of the speaker’s degree of confidence, certainty, or force concerning the claim s/he makes. Qualifiers are words or phrases such as “absolutely”, “definitely”, “certainly”, “possible”, “probably”, “as far as the evidence goes”, “presumably”, “necessarily”, and so on.

Figure 5-1 is an illustration of how an argument is analyzed for the six elements.

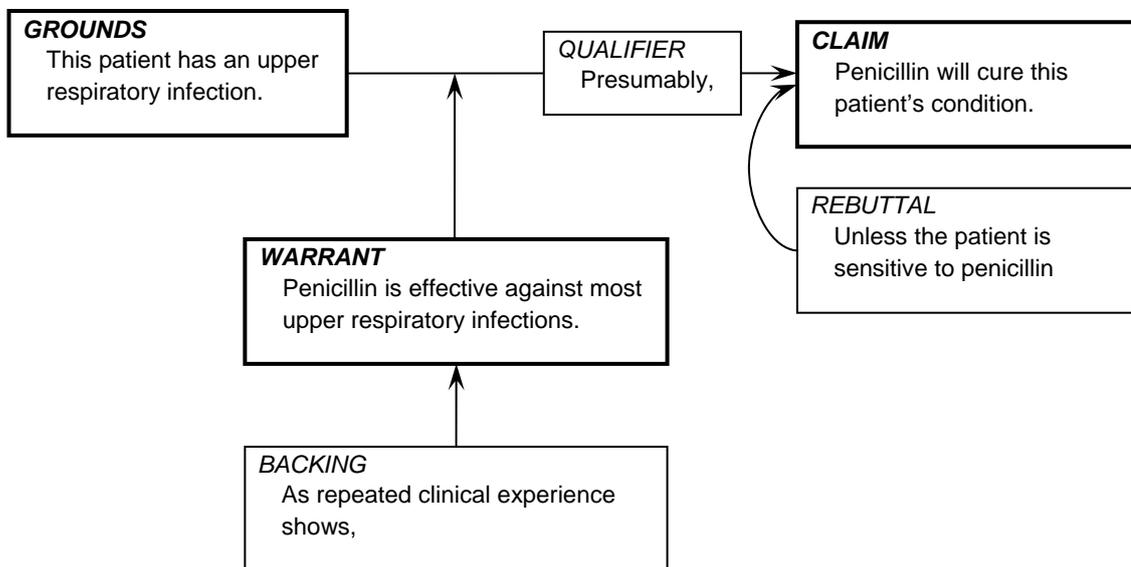


Figure 5-5 An Illustration of Toulmin’s Model of Arguments

(From Toulmin, Rieke, & Janik, 1984: 84)

The first three elements *Claim*, *Grounds (Data)*, and *Warrant* are the central components of practical arguments. They constitute the basic structure of an argument. The other three elements (*Backing*, *Rebuttal*, and *Qualifier*) are peripheral and optional.

5.3.2 What are warrants, exactly?

From reading discussions and examples of Toulmin's argumentation model, it becomes evident that *warrant* is *the* most critical element for the whole model to function at all. One also cannot help wondering what exactly warrants are, because from examples we notice the warrant seems to play a double role: sometimes it performs the role of premises, sometimes it takes the form of rules, and other times it is really a bit of both.

To truly understand this ambiguity issue, we need to take into consideration the historic context in which Toulmin's model was brought forth. There was a tension between classical analytic logic and pragmatic argumentation (see Section 5.1.3). Toulmin's model and his theory was an attempt to resolve the tension and to "drive a wedge between argument and logic" (Keith, 2005: 243). By doing so, "there is a sort of paradox buried at the heart of the Toulmin model, in that he wants to have it both ways: a formalist's sense of the logic of arguments, but a pragmatist's sense of how arguments get used, and of their practical limits; he parses this difference in traditional logical terms, as the difference between formal and substantial concepts of inference. His solution, as we have seen, is to claim that *warrants* are non-formal devices which nonetheless can yield conclusive arguments—*substantial*, yet possessing the attractions of *formal* argument." (Keith, 2005: 247)

The warrant plays a logical role in the argument, but it is more than a formal logic connective. In a sense, it plays double roles, providing not merely formal but also substantial connection between the data (grounds) and the claim. The followings are discussions on warrants by authors in the field may shed more light (or confusion) on the subject:

“the *warrant* is to determine whether the evidence is relevant to the claim and able to generate an inferential leap to it...The warrant is a set of criteria or general principles justifying a person in moving from evidence to claim. The warrant is dynamic and creative: It ‘acts’ rather than is ‘acted upon’, is ‘method’ rather than ‘substance.’” (Brockreide & Ehninger, 1978: 43)

“The warrant, unlike the invariant connective of formal logic, functions as a complex linguistic connective; i.e., it consists of substantive features of both data and claim while providing a lexical and structural link between propositional elements within the arguments.”

(Anderson & Mortensen, 1967)

“When warrants are very strong, they may take the form of rule statements, which look like these:

If A is present, we can be sure that B is also.

When the grounds A are in evidence, we can conclude that B is the case.

...

Grounds: My client was in San Francisco at the time the victim died.

Warrant: A person in San Francisco cannot kill someone in Detroit.

Claim: My client could not be guilty of murdering the victim in Detroit”

(Vancil, 1993: 121~122)

Another example (Rieke & Sillars, 1984: 71):

“Grounds: Socrates is a man.

Warrant: All men are mortal.

Claim: Socrates is mortal.”

(the standard example of *modus ponens*, see Section 5.4.1)

Similarly, a Prolog program (Clocksin & Mellish, 2003) consists of facts (equivalent to the grounds of an argument) and rules we specify how to arrive at conclusion (equivalent to the warrant).

“The warrant expresses the reasoning used to link the data to the claim... Warrants may take the form of rules, principles, or conventions particular to certain fields. Or they may be explicit statements of one of the patterns of reasoning... analogical, inductive, causal, sign, and other types of relationships.”
(Warnick & Inch, 1989: 165)

5.3.3 Relating to Topical Relevance by Functional Role

Essentially, Toulmin’s model lays out the *functional structure* of an argument. It lends itself to analyzing and understanding the issue of topical relevance. The claim / conclusion can be thought of as the center of a user’s request, which is *directly* relevant. The model clearly designates multiple ways in which a piece of information can be topically relevant: it can be the claim itself (*direct relevance*), but it can also be information providing relevant grounds (premises), warrant and its backing, or rebuttal and exceptions. Even the qualifier-type of information indicates the degree of confidence concerning the claim and thus presents some sort of topical relevance. The argumentation structure can provide guidance for information search and retrieval. It helps to recognize and detect various types of relevant information and how each of them functions differently to contribute to the user’s request.

The correspondence between Toulmin’s functional structure of arguments and Mann & Thompson’s Rhetorical Structure Theory (RST) relations is neither exclusive nor one-on-one. Instead, the correspondence is *many-to-many*: each element in Toulmin’s model can take on several functional roles and each functional role can be fitted into the model in different ways. For example, the *claim* can be the “Result” and

the *grounds / data* can be the “Cause”, and vice versa, as illustrated by the following examples:

(1) ***Grounds / Data* = “Cause”, *Claim* = “Result”:**

Grounds / Data: it was snowing heavily last night,
Claim: the traffic this morning is very bad.

(2) ***Grounds / Data* = “Result”, *Claim* = “Cause”:**

Grounds / Data: lots of snow is blocking the traffic this morning,
Claim: it must have been snowing very badly last night

Based on careful examination, there are some vague mapping patterns, rather than *definite* or *unique* correspondence, between Toulmin’s argumentation model and the RST relations. Toulmin’s argumentation theory focuses on the justificatory aspect of arguments, the central element of his model, *warrants*, seem to correspond to “Justify” and also to “Enablement” and “Condition” from RST. *Grounds/data* are linked to “Evidence”, “Motivation”, “Purpose”, “Cause”, “Result”, and “Consequence”. *Backings* correspond to “Elaboration” and “Interpretation” of the *grounds/data*, as well as various types of context, i.e., “Background”, “Preparation”, “Circumstance”, “Sequence”. *Rebuttal* is likely to relate to “Unless” and “Contrast”. The *claim* is a declarative statement and performs as the *nucleus* as opposed to the *satellite* in a given text span. In other words, a *claim* is a declarative nucleus. Some RST relationships do correspond to the types of type of arguments as shown in Table 5-3.

5.3.4 Classification of Arguments (Reasoning)

It is *reasoning* that brings together different elements within an argument. Toulmin, Rieke, & Janik (1979, 1984) proposed a classification of arguments based on the “general types” of acceptable reasoning used in arguments in practical

situations. This classification of arguments (reasoning) directly sheds light on understanding the reasoning component of topical relevance.

In Toulmin's classification, the underlying connections across types of reasoning are not investigated in particular. Therefore, each type of reasoning is discussed and presented in a rather stand-alone fashion, as shown in Table 5-1, left column.

5.3.4.1 Analyzing the Classification for Topical Relevance

As informed by previous findings from Huang & Soergel (2004, 2006), Toulmin's classification is analyzed for topical reasoning. This analysis puts an emphasis on understanding the nature of each type of reasoning and observing the underlying connections across types. The analysis shows that close connections exist between types of reasoning. In fact, rather than standing alone, they really come in pairs: they are either the opposite sides of the same coin, such as *reasoning from analogy* and *from opposite (contrasting)*, or the same reasoning going in opposite directions, such as *reasoning from generalization* and *reasoning from classification (inheritance)*.

The types of reasoning are listed in an order based on their fundamentality in cognition as well as their commonality in use. Being based on the perceived similarity, reasoning from analogy is the most fundamental since identifying similarities in the surrounding environment is the most basic and fundamental cognitive mechanism. It is the basis for recognition, grouping / categorization, and any sort of reasoning to ever take place (Lakoff, 1987). If we observe repeated and consistent similarities among objects and phenomena, we start to form, or better, to *induce* concepts, groups, categories, and ultimately, abstract rules that are constantly in concordance with observations. After getting a hold on these conceptualized and generalized groups, classifications, and rules, we are then able to make deductions.

Moving upon all that, we strive to detect the more elusive and sophisticated relations, such as causation. Just as demonstrated in statistical analysis, detecting homogeneity or heterogeneity between groups / populations (in a sense, determining how similar they are) is basic, identifying correlations is next, and lastly dealing with the “c” word (causal relations) with extreme caution and reservation. This is somewhat contradictory to common sense though. In terms of use, we often think causes take place before effects and naturally assume that it is more common to reason from the cause to the effect (forward reasoning). In the complicated reality, however, we rarely get to pinpoint down the cause first; instead, we are often first cautioned by the effects or consequences and then start to figure out what has gone wrong, for instance, we see symptoms before knowing the disease, or we see signs of economic depression before realizing it has come and worked. Characteristics of the different types of reasoning are further discussed in the following section.

A tentative classification of topical reasoning is developed from the analysis, as also shown in Table 5-1, side by side in comparison with Toulmin’s classification.

Table 5-6 Classification of Arguments vs. Classification of Topical Reasoning

| Classification of Arguments (Toulmin) | Classification of Topical Reasoning (Adapted) |
|--|--|
| Reasoning from analogy | 1. Comparison-based reasoning |
| Reasoning from generalization | 1.1 Reasoning from analogy |
| Reasoning from sign | 1.2 Reasoning from opposites (contrasting) |
| Reasoning from cause | 2. Generalization vs. rule-based reasoning (instance vs. principle) |
| Reasoning from authority [†] | 2.1 Reasoning from generalization / <i>induction</i> |
| Other: | 2.2 Reasoning from classification (principle)/ <i>deduction</i> |
| Arguments from dilemma | 3. Causal-based reasoning |
| Arguments from classification | 3.1 Reasoning from sign (evidence) / <i>abduction</i> |
| Arguments from opposites | 3.2 Reasoning from cause / <i>deduction</i> |
| Arguments from degree [†] | 4. Dilemma-based reasoning |
| | 4.1 Reasoning from constructive dilemma* |
| | 4.2 Reasoning from destructive dilemma* |

[†] Excluded from the analysis for topical reasoning.

* They are not identified directly from Toulmin’s classification, but they can be seen as sub-types of “Arguments from dilemma” and thus relevant to be listed here.

Given that they have little or no relation to topical relevance, two types of arguments (reasoning) listed in Toulmin’s classification are excluded from the analysis, as can be noticed from the table. In particular, *arguments from degree* are rhetorical rather than topical in nature and the reasoning component can be merged into deduction (or rule-based reasoning). As for *reasoning from authority*, what is used to warrant the claim is an external property (knowing the authorities on a particular issue), rather than the topical content of a piece of information.

5.3.4.2 Describing the Types of Topical Reasoning

This section describes in detail the types of topical reasoning identified from Toulmin’s classification.

(1) Comparison-based reasoning

(1.1) Reasoning from analogy

Use the *analogy* to warrant the claim, similar to *resemblance arguments* (Ramage & Bean, 1992), *case-based reasoning* (Schank, 1982) and *analogical reasoning* (Barker, 1989). Comparisons lie at the heart of this type of reasoning. Assume X is true about A. Enough similarities are perceived between case A and case B to support the claim: X is also true about B. In other words, case A and B “share characteristics relevant to the claim being made” and do not show critical “differences that would destroy the analogy” (Toulmin, Rieke, & Janik, 1984: 216). Figure 5-2 illustrates an argument from analogy.

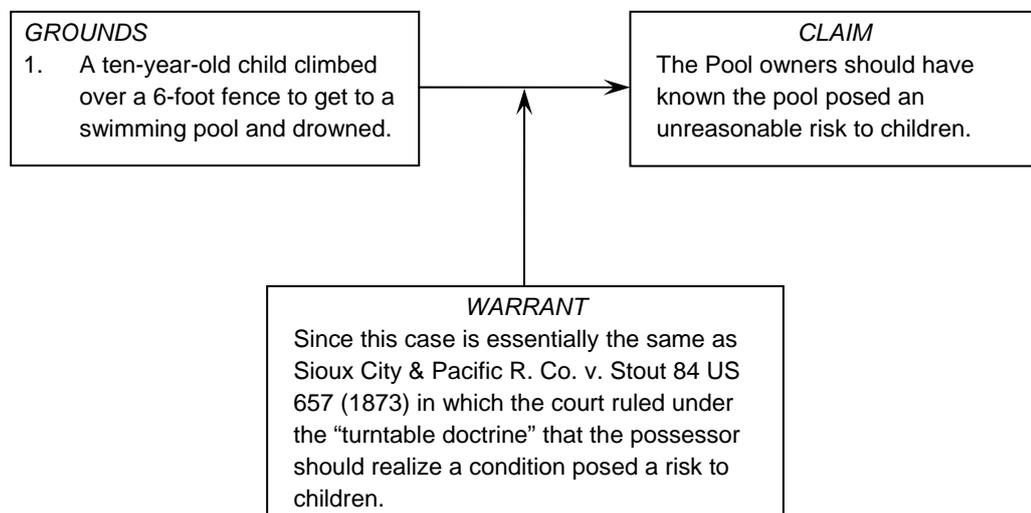


Figure 5-6 Reasoning from Analogy
 (From Toulmin, Rieke, & Janik, 1984: 215)

In the law, making judicial decisions relies heavily on reasoning from analogy. The principle of *stare decisis* guides judges to search for comparable precedents, identify relevant similarities and critical differences between previous cases and the case at hand, and make consistent decisions accordingly. The reasoning and decision-making process is based on the *presence of sufficient similarities* detected between cases as well as the *absence of critical differences* capable of destroying the analogy. However, there do not exist two cases that are perfectly alike, therefore, no analogy is perfect. How similar is similar enough? This question can be addressed only in

relative terms rather than in an absolute sense. According to Toulmin, Rieke, & Janik (1984), the more the relevant “points of comparisons” and the fewer the “relevant points of difference”, the better the analogical claim is supported.

(1.2) Reasoning from opposites (contrasting)

Use the *contrast* to warrant the claim. Toulmin, Rieke, & Janik (1984: 233) described reasoning from opposites as follows:

“Arguments from *opposites*, in which things that are known to be radically different in some given respect are presumed to be equally different in some other respect.”

An example shown in Figure 5-3:

In terms of working style, Ken is self-motivated, well-organized and always plans ahead for projects, whereas Miller is layback and does not start working until the last minute. Therefore, when it comes to spending, their difference is almost expected: Ken keeps a clear budget in mind, spends abstemiously, and saves regularly, but given the same income, Miller, on the other hand, cannot make his ends meet and is trapped in debts.

Figure 5-7 Reasoning from Opposites

Just as reasoning from analogy, comparisons also lie at the heart of this type of reasoning. Reasoning from analogy and reasoning from opposites can be seen as two sides of the same coin. The former emphasizes the *critical similarity* whereas the latter focuses on the *critical difference*. What really lies at the heart of the reasoning is to identify the important dimensions for the claim, to make comparisons, and to draw analogical or opposite conclusions accordingly.

Both reasoning from analogy and reasoning from opposites are discussed under *Comparison Relevance*, a topical relevance relationship type identified from our

earlier empirical studies (Huang & Soergel, 2004, 2006). In these studies, we used examples to illustrate how similar cases and contrasting cases contribute to the subject's overall understanding of a topic.

(2) *Generalization vs. rule-based reasoning*

(2.1) *Reasoning from generalization*

Reasoning from generalization permits the claim: what is true about a sufficient number of the individual cases is true about all (or most) members of the entire group. In terms of reasoning based on perceived similarities and likeness, reasoning from generalization is not very different from analogy, as described by Toulmin, Rieke, & Janik (1984: 221):

“Where people or objects are sufficiently alike, it becomes possible to group them into populations, or ‘kinds,’ and to make general claims about them.

Whereas arguments from analogy typically involve claims based on a close comparison between a few specific instances, arguments from generalization involve examining a sufficiently *large* and *representative* sample of the ‘kind’ in question.”

Arguments from generalization are widely used in simple everyday line of reasoning, as illustrated in Figure 5-4.

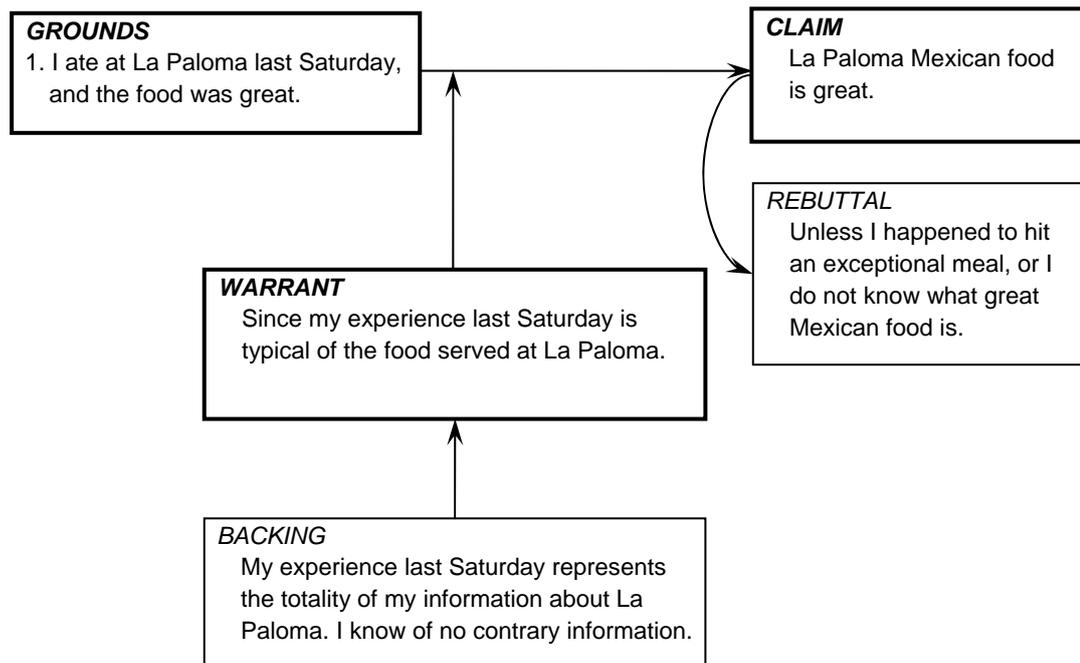


Figure 5-8 Reasoning from Generalization (From Toulmin, Rieke, & Janik, 1984: 220)

Generalizing from individual cases or a sample to the entire population or inducing a general rule for all cases is the process of *induction*. It is identified empirically as a type of topical reasoning, *inference from cases (induction)* from Huang & Soergel (2006). Inductive reasoning is not only ubiquitous in daily use, but also essential to scientific discoveries. With inductive reasoning and thinking, scientists are able to explore the unknown and acquire new patterns and new knowledge.

The selection of “a sufficiently large and representative sample” is critical for making generalized claims. The broader the range of sampling, the larger the chance we encounter *contrary instances*, and therefore the firmer the generalized claim if we do not encounter such contradictory instances. In scientific research, we need to follow rigorous sampling processes to strengthen generalizable conclusions.

(2.2) Reasoning from classification (principle)

Use class inheritance to warrant the claim. Typical properties of a certain category are used as the basis for claims about instances within that category. Reasoning from classification is not discussed in detail by Toulmin et al. We can think of arguments from classification as generalization functioning in the opposite direction. Whereas generalization follows the process of *inductive reasoning*, arguments from classification involves *deductive reasoning*. It is identified as a type of topical reasoning, *forward inference (deduction)*, in our earlier study (Huang & Soergel, 2006).

Both of them are concerned with individual cases (instances, samples) and the overall class (group, category, kind, population, etc.). Generalization is reasoning from instances to the overall population, inferring what is true of the entire population from what is true of the individual cases. Conversely, argument from classification is reasoning from the overall class (population) to individual cases, deriving what is typically true of the individual case from what is typically true of the entire class.

Taking the concept of the “overall class” onto a more abstract and general level, the special yet consistent characteristics and behaviors belonging to a specific class can be regarded as *rules* or *principles*, or the constant truth about the class. In other words, reasoning from classification is *rule-based*. Rieke & Sillars (1984) called it *reasoning from principle*. Figure 5-5 shows two examples given by the authors (Rieke & Sillars, 1984: 71):

| | |
|--------------------|--|
| <i>Example (1)</i> | |
| Grounds: | Socrates is a man. |
| Warrant: | All men are mortal. |
| Claim: | Socrates is mortal. |
| <i>Example (2)</i> | |
| Grounds: | I am a free man. |
| Warrant: | All free men are citizens of Berlin. [Not really a valid warrant] |
| Claim: | Ich bin [ein] Berliner. |

Figure 5-9 Reasoning from Classification (Principle)

(3) Causal-based reasoning

(3.1) Reasoning from sign (evidence)

In Toulmin, Rieke, & Janik’s discussion (1984), “reasoning from sign” is a mixed category. The category bundles simple “sign reading” and “reasoning from evidence” together without much distinction. The term *sign* has a wide range of meanings:

- A sign can be as simple and concrete as “an indication or mark of something”, “a display of message”, or “a signal to draw attention” (from Wikipedia), for example, driving signs, which give instructions *directly* and *explicitly*, involving minimal (if any) inference. The *directness* and *explicitness* render such signified information to fall into the scope of *Direct Relevance* (Huang & Soergel, 2004, 2006).
- Signs can be more complicated and *implicit*, such as, the symptoms of a certain disease as signs of the disease, “economic indicators” for suggesting trends in the present economic development, diplomatic sign reading for understanding another country’s position, and so forth. In such cases, richer reasoning is involved and signs are taken as *evidence* of some underlying cause. Such implicit information falls into the scope of *Indirect Relevance* (Huang & Soergel, 2004, 2006).

The essence of reasoning from sign (evidence) is abduction, or backward inference, which is also identified as topical reasoning in Huang & Soergel (2006). Abduction is “inference to the best explanation” (Hobbs, Stickel, Appelt, & Martin, 1993), in which one chooses the hypothesis that would, if true, best explain the evidence.

Deduction (forward inference) and abduction (backward inference) differ in direction but apply the same rule: p (the antecedent) *entails* q (the consequent), that is, if p is true, q is true.

- in deduction: given p (the antecedent), we derive q (the consequent);
- in abduction: given q (the consequent), we infer p (the antecedent).

As such, abduction is much weaker than deduction in logical sense. In fact, abduction is equivalent to formal fallacy in logic, that is, *affirming the consequent*:

If p , then q .

q .

Therefore, p .

Signs or evidence function in such a way that they are *pointing to a fact* (cause) without *explicitly saying* it. Reasoning from sign (evidence) thus comes with a degree of *implicitness*. In the law, direct witness is often not available and most trials are based on *circumstantial evidence*. One type of circumstantial evidence is the sign used to set up an argument, as illustrated by the following example (Figure 5-6):

The day before the murder, the accused bought herself a one-way air ticket to Mexico; when stopped by the police, she tried to run away; when asked about her whereabouts at the time of the murder, she told a highly detailed story about what she was doing, which there was no way to corroborate. The state then claims that these facts are all signs of guilt, because in the past guilty people have regularly behaved in just this way.

Figure 5-10 Reasoning from Sign (Evidence) (From Toulmin, Rieke, & Janik, 1984: 223)

Similarly, medical diagnosis draws on “signs”, here, signs being symptoms and complaints: just to name a few, low blood count, loss of appetite, dramatic mood swing, high fever, chronic coughing, and other physiological abnormality observed. Physicians use symptoms and complaints as evidence to support or reject the hypotheses of certain diseases causing the symptoms. In diagnosis, physicians are reasoning backward, inferring the underlying cause (disease) from the consequent (symptoms). (In prognosis, they reason forward.)

The strength of abductive reasoning depends on the strength of the association between the evidence and the hypothesis. The central question for this type of reasoning is “how certainly any sign is associated with what it is supposed to signal” (Toulmin, Rieke, & Janik, 1984: 223). For instance, a particular symptom may result from many different diseases. The association between a symptom and a disease is not always inevitable and reliable. All we can say in this case is that a patient has one of these diseases, possibly qualified with probabilities. The strength of abduction of reasoning depends on the number of possible explanations. If any of the possible explanations can be ruled out on other grounds, abduction is strengthened. The more uncertainties and ambiguities are involved, the weaker the reasoning.

(3.2) Reasoning from cause

“Arguments from cause require, first and foremost, a causal generalization asserting that if such-and-such a cause is observed, its effect can be expected to follow.” (Toulmin, Rieke, & Janik, 1984: 226)

Reasoning from the cause to the effect is *deductive*. Ideally, the same cause always entails the same effect, holding all else constant. In the real world, it is difficult to hold all conditions the same to allow the same cause to always induce the same effect across cases. Taking the medical prognosis as an example, the same disease may manifest itself in very different ways on different patients; age, gender, constitution, exposure, risk factors, family medical history, etc. can significantly affect how a disease progresses. For this reason, in scientific research we often use “control group” to isolate the effect of interest from the influence of external conditions.

Deduction (forward inference) is discussed in several places earlier. Simply put, it functions in two ways:

- Inferring from the general rule to individual cases, equivalent to *reasoning from classification (inheritance)*; it differs in direction from induction.
- Inferring from the cause to the effect, equivalent to *reasoning from cause* discussed here; it differs in direction with abduction.

According to Toulmin, Rieke, & Janik (1984), this category should include both forward and backward inference. In other words, either the cause or the effect is observed, the other can be claimed to follow. It is important to note that inference from the effect to the cause is essentially a subset of *reasoning from sign (evidence)*, which is abductive in nature. The effect is just evidence of an underlying cause. For example, symptom X is caused by disease Y, therefore symptom X constitutes evidence (sign) of disease Y. Given the substantial difference in the nature of reasoning between “cause → effect” (deductive) and “effect → cause” (inductive), the two should be differentiated rather than bundled together as if they were homogenous.

(4) Dilemma-based reasoning

The argument from dilemma, according to Toulmin, Rieke, & Janik (1984), refers to arguments with a claim resting upon two and only two possible explanations and the two explanations are equally bad. Here is an example from their discussion (Figure 5-7):

When a Congressman was arrested for soliciting a prostitute in the red-light district of Salt Lake City at 2:00 A.M., many people saw him as being in a dilemma. Either he was guilty as charged and thus should be condemned, or he was talking to the woman innocently, and this—under the circumstances—showed stupidity in a politician running for reelection, so that once again he should be condemned.

Figure 5-11 Dilemma-Based Reasoning (From Toulmin, Rieke, & Janik, 1984: 231)

In logic and mathematics, reasoning from dilemma takes two forms of propositional calculus as follows:

$$(4.1) \text{ Constructive dilemma: } ((p \rightarrow q) \wedge (r \rightarrow s) \wedge (p \vee r)) \vdash (q \vee s)$$

If p then q ; and if r then s ; but either p or r ; therefore either q or s . The above example uses this type of reasoning. If soliciting a prostitute (p), the politician should be condemned for villainy (q); if talking innocently with a woman in the red-light district at 2 AM (r), the politician should be condemned for stupidity (s). Since the Congressman fails to come up with a third explanation for the scene, he can only choose between p and q , therefore, he should be condemned either for villainy (q) or for stupidity (s); from q or s , we can come to the one final conclusion: the Congressman should be condemned.

$$(4.2) \text{ Destructive dilemma: } ((p \rightarrow q) \wedge (r \rightarrow s) \wedge (\neg q \vee \neg s)) \vdash (\neg p \vee \neg r)$$

If p then q ; and if r then s ; but either not q or not s ; therefore either not p or not r ; p and r cannot both be true at the same time.

The constructive and destructive dilemma as defined in propositional logic are value-free, with conclusions of two possible outcomes. If a value component is added, namely, the two outcomes are not desirable, it becomes a dilemma. As seen from the Congressman example, argument from dilemma is value-loaded, that is, we judge both choices of explanations are *bad*, and therefore it differs from dilemma reasoning from the pure logic point of view. The underlying process of reasoning, however, stays the same.

More generally, they are arguments that arrive at the same conclusion starting from different grounds (each ground having its own warrant) or starting from one ground and using two warrants to arrive at the same conclusion. A piece of information is relevant if it sheds light on any of the grounds or warrants involved.

Summary

Toulmin's classification of arguments, on the one hand, confirms the empirical findings from our earlier studies (Huang & Soergel, 2004, 2006); on the other hand, further enrich our understanding of the mode of reasoning (inference) involved in topical relevance.

5.4 Topical Reasoning Identified from Propositional Logic

5.4.1 Propositional Logic

The *constructive* and *deductive dilemma* discussed above fall into the scope of *propositional logic*. "The Internet Encyclopedia of Philosophy"² defines propositional logic as follows:

"Propositional logic, also known as sentential logic and statement logic, is the branch of logic that studies ways of joining and/or modifying entire propositions,

² "The Internet Encyclopedia of Philosophy" is accessible at <http://www.iep.utm.edu/>

statements or sentences to form more complicated propositions, statements or sentences, as well as the logical relationships and properties that are derived from these methods of combining or altering statements.”

(From www.iep.utm.edu/p/prop-log.htm)

Propositional logic or propositional calculus is a *formal* system that is widely used in [logic](#) and [mathematics](#). By following rules of inference and combining atomic (indecomposable) propositions, more complicated propositions or arguments are established. The best-known argument form in propositional logic probably is *modus ponendo ponens*, often abbreviated to *modus ponens*. Modus ponens belongs to Aristotle’s classical set of *analytic syllogisms*, which defines the core of deductive reasoning.

Modus ponens

Propositional calculus: $((p \rightarrow q) \wedge p) \vdash q$

Description: If p then q ;

 p ;

 therefore q .

There are many such basic and derived propositions or arguments in propositional logic. In theory, every one of them informs the identification of topical reasoning to some degree. In fact, more or less, the essence of reasoning expressed in these analytic syllogisms and rules of inference are merged into the types of reasoning as discussed in Section 5.2.3.2, such as, (2.2) reasoning from classification (inheritance) and (3.2) reasoning from cause are largely modus ponens, using deductive reasoning. However, many of these formal arguments are more

cumbersome to follow and not all of them are sufficiently meaningful and practical to be captured as a distinctive type of topical reasoning, such as,

Material implication

Propositional calculus: $(p \rightarrow q) \vdash (\neg p \vee q)$

Description: If p then q is equiv. to not p or q .

5.4.2 The Hypothetical Syllogism as Topical Reasoning

The *Hypothetical syllogism* (or *Transitivity of the Conditional*) is particularly interesting from the viewpoint of topical relevance and worth more of our attention among the others. It is described as bellow,

Propositional calculus: $((p \rightarrow q) \wedge (q \rightarrow r)) \vdash (p \rightarrow r)$

Description: If p then q ; if q then r ; therefore, if p then r .

The transitivity of reasoning expressed in the hypothetical syllogism is important, particularly for identifying relevant information from disjoint literatures and discovering new knowledge. As pointed out by Swanson (1990), as a result from increasing specialization in various disciplines, knowledge fragmentation becomes a serious problem. In his writings, he described cases in which,

1. there does not exist a literature intersection between topic A and topic C (“AC”), but
2. there exist a literature cluster “AB” and a literature cluster “BC”, however,
3. cluster “AB” does not directly interact with cluster “BC”, that is, they do not have common authors, do not cite each other, and do not cite nor being cited by the same literature.

In most of these cases, the conceptual linkage between A and C is lost without being noticed. For instance, there exists a literature cluster “AB” arguing that dietary

fish oil increases red blood cell deformability and reduces blood viscosity; also, there exists a literature cluster “BC” reporting that some patients of Raynaud’s syndrome experience red blood rigidity and high blood viscosity. However, “AB” does not interact with “BC” directly and there exists no direct literature intersection “AC”. Given that, if the user has an information need of discovering what treatments or drugs can relieve Raynaud’s syndrome, cluster “AB” (discussing the effect of dietary fish oil on blood cell deformability and blood viscosity) is topically relevant, although it does not directly address topic C (Raynaud’s syndrome). The chain of topical reasoning is shown in Figure 5-8:

| |
|--|
| A (fish oil) is relevant to B (high blood viscosity); and B (high blood viscosity) is relevant to C (Raynaud’s syndrome); therefore, A (fish oil) is relevant to C (Raynaud’s syndrome). |
|--|

Figure 5-12 An Example of Reasoning from Transitivity

Despite the bibliographic isolation, “AB” and “BC” are conceptually linked; together, they contribute to a valid hypothesis that dietary fish oil may benefit some patients of Raynaud’s syndrome. If the hypothesis is confirmed with empirical evidence, knowledge is advanced through the synthesis of disjoint literatures. (Swanson, 1990; Green, 1995; Green & Bean, 1995)

The topical reasoning shown in Figure 5-8 resembles the hypothetical syllogism with the emphasis on transitivity of reasoning. You may ask how this particular type of reasoning differs from what we call the “chain of reasoning”. In fact, no radical difference except for its emphasis on connecting two *disjoint* ends of the chain. Two disjoint propositions, or two disjoint topics, or two disjoint pieces of information/evidence, can be linked together through a third proposition /topic/ information that relates directly to both the two.

5.5 A Summary Table of Types of Identified Topical Reasoning

Table 5-2 summarizes the types of identified topical reasoning, each with its corresponding argument pattern from the Toulmin's classification. Descriptions are extracted from Toulmin, Rieke, & Janik (1984) for each pattern, as shown in the table. For a complete overview, the additional types of topical reasoning identified from propositional logic are also included in the table, as indicated separately.

Table 5-7 Types of Topical Reasoning Identified from Toulmin’s Classification of Arguments

| <p style="text-align: center;">Mode of Topical Reasoning</p> | <p style="text-align: center;">Description (From Toulmin, Rieke, & Janik, 1984, §22)</p> |
|--|---|
| <p>Comparison-based reasoning</p> <ul style="list-style-type: none"> • Reasoning from analogy (focus on similarity) | <p>In “arguing from analogy,” we assume that there are enough similarities between two things to support the claim that what is true of one is also true of the other... What happened with one dam may reasonably be expected with another one that <i>shares characteristics relevant to the claim being made</i> and does not have <i>differences that would destroy the analogy...</i></p> <p>No two phenomena are exactly alike, so the comparisons involved in all analogies are more-or-less imperfect. The key question is how <i>close</i> the analogy is, and an analogy will be judged as “closer” when the points of comparison between two objects are greater in number, are more directly relevant to the claim being supported, and are countered by fewer relevant points of difference.</p> |
| <ul style="list-style-type: none"> • Reasoning from opposites (focus on difference) | <p>Arguments from <i>opposites</i>, in which things that are known to be radically different in some given respect are presumed to be equally different in some other respect.</p> |

| <p style="text-align: center;">Mode of Topical Reasoning</p> | <p style="text-align: center;">Description (From Toulmin, Rieke, & Janik, 1984, §22)</p> |
|---|--|
| <p>Generalization vs. Rule-based reasoning</p> <ul style="list-style-type: none"> • Reasoning from generalization (induction / backward inference) | <p>Where people or objects are sufficiently alike, it becomes possible to group them into populations, or “kinds,” and to make general claims about them. Whereas arguments from analogy typically involve claims based on a close comparison between a few specific instances, arguments from generalization involve examining a sufficiently large and representative sample of the “kind” in question...</p> <p>So critics of reasoning from generalization will be greatly influenced by the nature of the sample on which it is based, particularly by the relationship between that sample and the larger population about which the subsequent claim is to be made. ...</p> <p>Determining whether a large enough sample is presented is usually a function of the test of whether the addition of more instances requires modification of the claim: <i>are there contrary instances?</i>...</p> <p>Selection of sample groups is done within established guidelines to permit the claim that what is true of the sample is true of the entire population.</p> |
| <ul style="list-style-type: none"> • Reasoning from classification (principle) (deduction / forward inference) | <p>Arguments from <i>classification</i>, in which the typical properties of plants, prize cattle, or whatever are used as the basis for claims about them.</p> <p>Rieke & Sillars (1984) called it reasoning from principle. Here are two examples given by the authors (Rieke & Sillars, 1984: 71):</p> <p>Example (1)</p> <p style="padding-left: 40px;">Grounds: Socrates is a man. Warrant: All men are mortal. Claim: Socrates is mortal.</p> <p>Example (2)</p> <p style="padding-left: 40px;">Grounds: I am a free man. Warrant: All free men are citizens of Berlin. Claim: Ich bin [ein] Berliner.</p> |

| <p style="text-align: center;">Mode of Topical Reasoning</p> | <p style="text-align: center;">Description (From Toulmin, Rieke, & Janik, 1984, §22)</p> |
|---|---|
| <p>Causal-based reasoning</p> <ul style="list-style-type: none"> • Reasoning from sign (evidence) (abduction / backward inference) | <p>In driving, we “reason from sign” repeatedly... Whenever a sign and its referent can reliably be expected to occur together, the fact that the sign is observed can be used to support a claim about the presence of the objector situation the sign refers to.</p> <p>In the law, circumstantial evidence often sets up an argument from sign. Lacking direct proof of the defendant’s guilt, the state may present a series of signs of guilt... Similarly many aspects of medical diagnosis rely on reasoning from sign ...</p> <p>The central question is, simply, just how certainly any sign is associated with what it is supposed to signal.</p> |
| <ul style="list-style-type: none"> • Reasoning from cause (deduction / forward inference) | <p>In certain cases, we can assert the presence of a relationship stronger than that of sign and referent; that is, we may claim that an event or a condition of one kind is the <i>cause</i> of an event or a condition of another kind. These two kinds of event do not just regularly appear together; they are <i>causally connected</i>...</p> <p>Arguments from cause require, first and foremost, a causal generalization asserting that if such-and-such a cause is observed, its effect can be expected to follow.</p> |
| <p>Dilemma-based reasoning</p> <ul style="list-style-type: none"> • Reasoning from constructive dilemma[†] (identified from <i>propositional logic</i>) • Reasoning from destructive dilemma[†] (identified from <i>propositional logic</i>) | <p>Some reasoning is based on the argument from dilemma. Here a claim rests upon the warrant that two and only two choices or explanations are possible, and both are bad.</p> |
| <ul style="list-style-type: none"> • Reasoning from constructive dilemma[†] (identified from <i>propositional logic</i>) | $((p \rightarrow q) \wedge (r \rightarrow s) \wedge (p \vee r)) \vdash (q \vee s)$ <p>If <i>p</i> then <i>q</i>; and if <i>r</i> then <i>s</i>; but either <i>p</i> or <i>r</i>; therefore either <i>q</i> or <i>s</i></p> <p>(Definition from Wikipedia)</p> |

| Mode of Topical Reasoning | Description (From Toulmin, Rieke, & Janik, 1984, §22) |
|--|--|
| <ul style="list-style-type: none"> • Reasoning from destructive dilemma[†] (identified from <i>propositional logic</i>) | $((p \rightarrow q) \wedge (r \rightarrow s) \wedge (\neg q \vee \neg s)) \vdash (\neg p \vee \neg r)$ <p>If p then q; and if r then s; but either not q or not s; therefore either not p or not r (Definition from Wikipedia)</p> |
| <ul style="list-style-type: none"> • Reasoning from transitivity[†] (identified from <i>propositional logic</i>) | $((p \rightarrow q) \wedge (q \rightarrow r)) \vdash (p \rightarrow r)$ <p>if p then q; if q then r; therefore, if p then r (Definition from Wikipedia)</p> |

[†]Not identified directly from Toulmin's classification of arguments; instead, they are identified from propositional logic.

5.6 Analysis of RST Relationships for Modes of Topical Reasoning

In Section 4.2.3, I discussed how the RST rhetorical relations could be specified by three types of inference (reasoning): forward reasoning, backward reasoning, and generic reasoning. The analysis is summarized in Table 4-2.

Based on the in-depth discussion in this chapter, our understanding of topical reasoning is enriched and the typology of topical reasoning is further specified (see Table 5-2). Accordingly, the RST rhetorical relations with a salient aspect of inference (reasoning) are re-analyzed and fitted into the further-developed typology, as show in Table 5-3.

Table 5-8 A Typology of Topical Reasoning (RST relations included)

Mode of Topical Reasoning (Inference)

- **Comparison-based reasoning**
 - • *Reasoning by analogy*
 - • • Reasoning from analogy (Toulmin, Rieke, & Janik, 1984)
 - • • Resemblance arguments (Ramage & Bean, 1992)
 - • • Case-based reasoning (Schank, 1982)
 - • • Analogical reasoning (Barker, 1989)
 - • *Reasoning by contrast*
 - • • Reasoning from opposites (Toulmin, Rieke, & Janik, 1984)
 - • • Contrast (RST)
 - • • Antithesis (RST)
- **Generalization vs. rule-based reasoning**
 - • *Generalization (Induction)*
 - • • Reasoning from generalization (Toulmin, Rieke, & Janik, 1984)
 - • *Rule-based reasoning (Deduction)*
 - • • Reasoning from classification (Toulmin, Rieke, & Janik, 1984)
 - • • Reasoning from principle (Rieke & Sillars, 1984)
- **Causal-based reasoning**
 - • *Forward inference (Deduction)*
 - • • Reasoning from cause (Toulmin, Rieke, & Janik, 1984)
 - • • Volitional cause (RST)
 - • • Non-volitional cause (RST)
 - • • Motivation (RST)
 - • *Backward inference (Abduction)*
 - • • Reasoning from sign (Toulmin, Rieke, & Janik, 1984)
 - • • Volitional result (RST)
 - • • Non-volitional result (RST)
 - • • Purpose (RST)
 - • • Otherwise (RST)
- **Generic inference**
 - • Evidence (RST)
 - • Justify (RST)
- **Dilemma-based reasoning**
 - • Arguments from dilemma (Toulmin, Rieke, & Janik, 1984)
 - • • Constructive dilemma (Propositional logic)
 - • • Destructive dilemma (Propositional logic)
- **Transitivity-based reasoning**
 - • Hypothetical syllogism / Transitivity of the conditional (Propositional logic)

Chapter 6. The Information Science Perspective

Relevance is the most fundamental concept of information science (IS) and information retrieval (IR). In turn, *topical relevance* lies at the heart of relevance. Since the 1940s, there have been numerous papers published on the issue of relevance in this field. Rather than carrying out a comprehensive overview of relevance research in general, this chapter focuses only on the *in-depth* discussion of *topical relevance* in information seeking and retrieval. While there was a booming of relevance research in 1990s that explored the important issue of *non-topical* relevance criteria (e.g., Schamber, Eisenberg, & Nilan, 1990; Schamber, 1994; Barry & Schamber, 1998), as summarized earlier in the chapter of literature review (see Section 2.1, 2.4), these studies do not directly contribute to our understanding of *topical relevance* and thus are not covered in detail here. Exhaustive chronicles of relevance works (topical and non-topical) in the field can be found in Saracevic (1975, 2006) and Mizzaro (1997). Chapter 2 (Literature review) discusses relevance in general and this chapter focuses on topical relevance.

Although topical relevance is widely recognized as the most important factor in selecting information, our understanding of the notion remains vague, oversimplified, and unexplicated. An enormous body of IS literature refers to topical relevance as an atomic, self-evident concept, without a thorough understanding of what it means. Many definitions of topical relevance are circular and paraphrase-like. The common view of topical relevance is limited to a single type of relationship, *topic matching* (Green, 1995) or overlapping (Bruza, Song, & Wong, 2000), resulting in IR systems' failure to detect more complex topical connections that are needed to respond to diversified information needs and user tasks.

The works selected for analysis take two major approaches to explore the conceptual nature of topical relevance: the *logical* approach and the *linguistic* (*semantic*) approach.

- Cooper's *logical relevance* (1971), Wilson's *evidential relevance* as well as *situational relevance* that builds upon it (1973), and the line of *logic-based information retrieval* studies (e.g., Bruza, Song, & Wong, 2000) take the logical approach in defining topical relevance or aboutness. They aim to explore the *logical* nature and logical properties of the notion. The central concern of this approach is how the receiver (e.g., a reader, searcher, and user) constructs meaning and establishes relevance for a topic through inference. Findings from this line of research are mapped to the *reasoning-based* facet (i.e., mode of reasoning) of the topical relevance typology being developed.
- Hutchins (1977) and Green & Bean (1995) take the linguistic (*semantic*) approach in explicating topical relevance or aboutness. They aim to investigate the *relational* nature and semantic *structural* properties of the notion. Instead of directly investigating how the receiver perceives and makes inference from a given piece of information (e.g., a text, discourse), this approach focuses on describing the semantic relationships and structures *internal* to the information. In this sense, research following this approach is more *content-based*. More specifically, the findings give rise to a new facet, *semantic relationships and structures*.

6.1 Cooper's Logical Relevance

6.1.1 Definition of Logical Relevance (Cooper, 1971)

To avoid the trap of circularity in defining relevance, Cooper (1971) proposed a mathematically precise definition of *logical relevance*, i.e. “topical appropriateness”. By Cooper’s definition, topical relevance is described from the logical point of view, i.e. how a retrieval system understands and detects topical relevance by applying deductive logic.

“A stored sentence (either in system memory or the user’s memory) is logically relevant to the user’s information need if and only if:

- (1) It is in a minimal premiss set for some component statement of the tree representing that need; and
- (2) There exist stored premiss sets for all component statements in the tree (except the origin) which are ancestors of this component statement.”

(Cooper, 1971: 24)

The key elements of this definition are *information need*, *logical consequence* (deductive logic), *component statement*, and *minimal premiss set*. As illustrated in Cooper’s article, given that the user wants to know “Is hydrogen a halogen element?”, the user’s information need can be represented by two component statements: “Hydrogen is a halogen element”; and “Hydrogen is not a halogen element”. A minimal premiss set is a minimal set of information (stored sentences) from which a component statement can be derived as a logical consequence. “Minimal” means that no sentence can be removed from the set without destroying the inference. There can be multiple minimal premiss set for the same conclusion. Simply put, if a stored

sentence is a member of a minimal premiss set, it is logically relevant to a given information need.

6.1.2 Influence of Cooper's Definition

As one of the most precise and influential definitions of topical relevance in our field, Cooper's definition of logical relevance greatly improves and inspires our understanding of topical relevance.

- First, Cooper's definition gets to the nuclear sense of the concept: logically deriving conclusion from evidence. It indicates that topical relevance is a more sophisticated concept beyond "meaning matching" (not to speak of "word matching") between a query and a document. Instead, it is a process of "deriving meaning" that heavily involves fine-tuned reasoning.
- Second, this definition advocates that topical relevance is relevance in an absolute sense. Cooper argues in his paper that "it is the philosophy of this definition of relevance, however, that it is simply a fact of life that retrieval system patrons will often be unable to recognize immediately the relevance of a relevant statement, and may perhaps never recognize it. This does not change the fact that it is still relevant in an absolute sense." Logical relevance corresponds to the *objective sense* of topical relevance (see Section 2.6.2 on objective sense vs. subjective sense of topical relevance), which is independent of *individual* users' understanding.
- Third, Cooper further explicates the relationship between topical relevance and utility (the ultimate usefulness of the information to the user). He argues that logical relevance, or topical relevance, "is the most important single factor affecting utility so far as the retrieval system designer is concerned," because "logical relevance is almost the only factor in utility which the designer does

know how to deal with very effectively at present”. Research shows that topical relevance is often the predominant but by no means the only criterion. Moreover, users' decision processes are complex; for example, publication date may become a filter used even before topical relevance is considered. Today we would rather argue that the system designer should use the entire arsenal of tools at her disposal to have the system apply all relevance criteria specified by the user.

6.1.3 Limitations of Cooper's Definition

However, there are also limitations of Cooper's definition.

- First, the definition applies only to the relationship of a static information need to a body of information that can be used as evidence. In many situations the information need changes dynamically as the user learns more about the issue at hand. While the definition applies at any point in the process to the information as it then exists, it does not address the dynamics of the process or the user's role in that process. The user is only implied by query or information need, thus the interactions involving the user's knowledge or other characteristics are not clear.
- Second, the definition is framed for simple questions, in the ideal case for questions that have a yes-or-no answer, and it requires that all the evidence necessary to derive the answer be available. Different pieces of evidence (stored sentences) in a premiss set are only meaningful as a whole as constituting a complete deductive inference chain, not individually; the absence of one piece denies relevance of all the other pieces. Often users' questions are far more complex, and users build up an understanding through a

process in which many pieces of information enter over time, interacting with what the user already knows.

- Although Cooper realized that the user is unlikely to be equally curious about all aspects of an information need, he did not play out how individual pieces of evidence play different roles in the process of deriving conclusions. By Cooper's definition, all the evidence involved is perceived homogenous and contributing equally to the overall topical relevance. The perspective of topical relevance that considers the full range of ways in which a piece of information can serve as a evidence in answering a user's question, in building an argument, remains unexplored. This inquiry focuses on explicating this particular perspective of topical relevance.

6.2 Wilson's Evidential Relevance and Situational Relevance

Based on Cooper's Logical Relevance, Wilson (1973) introduced two important relevance concepts: *Evidential Relevance* and *Situational Relevance*.

6.2.1 Definition of Evidential Relevance (Wilson, 1973)

Evidential relevance complements Cooper's logical relevance by allowing also inductive logic in the process of detecting topical relevance.

Logical relevance asserts that no one element in a set of information elements is relevant if the set cannot logically yield the conclusion. In other words, if a set logically entails a conclusion (and is a minimal premises set), every element in the set is relevant; otherwise, none of them is relevant and thus should be completely ignored by the retrieval system. So there are two conditions for logical relevance:

- (1) Only deductive inference is considered
- (2) A set of information elements must be a complete minimal premiss set for any of the elements to be relevant. (In the narrow context of a logical deduction system deriving an answer to the user's question within the closed world of the sentences it contains this condition makes perfect sense).

As opposed to broadening the strict definition of logical relevance, evidential relevance recognizes relevance (or contribution) in an individual piece of evidence in a premiss set even if the set only "supports" a conclusion but does not necessarily entail it. Wilson's original definition of evidential relevance (Wilson, 1973: 460) is as follow:

"An item of information I_j is relevant to a conclusion h in relation to premiss e if the degree of confirmation, or probability, of h on evidence e

and I_j is greater or less than the degree of confirmation, or probability, on e alone.”

The basic idea is that if by considering a particular piece of information, the confirmation or probability of a conclusion is either increased or decreased, then that particular piece of information is evidentially relevant. It does not necessarily provide a conclusive answer to a user’s question but it does shed light on how to answer the question. As stated by Wilson, evidential relevance (using deductive or inductive logic) is also a logical notion as is Cooper’s logical relevance (using only deductive logic). The two conditions are relaxed:

- (1) Evidential relevance regards inductive evidence, and not just deductive evidence, as valid and valuable in terms of “helping” a user to answer her question even when a conclusive argument is unobtainable.
- (2) Even in the absence of one or more pieces of information the others may still shed light on the question and thus be relevant. (Besides, if the user knows what additional pieces of information are necessary, she may find these missing pieces elsewhere.)

In their very essence, both Cooper’s logical relevance and Wilson’s evidential relevance define topical relevance (or “topical appropriateness”) in terms of reasoning from the evidence to the conclusion, using either deductive or inductive logic.

6.2.2 Definition of Situational Relevance (Wilson, 1973)

Situational relevance is logical relevance or evidential relevance as applied to a particular individual’s knowledge stock and concerns. A piece of information is situationally relevant if it augments the user's knowledge so that it can answer or help

to answer a question of personal concern. Personal concerns can be explained in terms of preferences over a range of alternatives. Here is Wilson's definition of situational relevance (Wilson, 1973: 462):

“Let us use the symbol I^* to stand for a person's whole stock of information (knowledge, belief) at a given time. Then an item from that stock, I_j , is situationally relevant if it, together with other members of the whole stock I^* , is logically or evidentially relevant to some question of concern. It will be logically relevant to a question of concern, in approximately Cooper's sense, if it is a member of a minimal premiss set in I^* from which one of the possible answers to the question logically follows. It will be evidentially relevant to a question of concern if there is some possible answer to the question whose confirmation or credibility is increased or decreased by consideration of I_j , that is, if there is some subset of items I_a not including I_j , such that the credibility of the answer on evidence I_a and I_j , is greater or lesser than the credibility on I_a alone.”

The reasoning logic (deductive or inductive) used in question answering is evidential relevance applied to a personal situation at a given time. Concerns vary with situations and thus “what is situationally relevant today may not be so tomorrow.”

There are two definitions of situational relevance:

- (a) Situational relevance A: If the issues of concern to the user are known, situational relevance as defined so far can be determined independently of the user (in Cooper's “absolute relevance” sense), and it makes sense to consider such a simple definition of situational relevance.

(b) Situational relevance B: Wilson, however, adds a second aspect for a more complex definition: Situational relevance does rely not only on personal concerns at a given time, but also on the user's personal knowledge and personal endorsement. In that sense, a piece of information cannot become situationally relevant if that user does not accept or believe it.

The more complex definition of situational relevance brings in the condition of *individual endorsement* and thus goes beyond the scope of the objective or absolute sense of topical relevance. Instead, it corresponds to what I call the *subjective sense* of relevance. (See Section 2.6.2 objective sense vs. subjective sense of topical relevance)

6.2.3 Direct vs. Indirect Situational Relevance

Furthermore, in his paper Wilson defined *direct situational relevance* and *indirect situational relevance*:

“If an item of information I_j is itself a member of a concern set, we shall say that it is directly relevant situationally; if it is relevant but not a member of a concern set, we shall say that it is indirectly relevant situationally.”

A concern set, or a concern set of statements, is a set of all the possible answers to a question of personal concern. “The same information may be simultaneously an answer to one or more than one question of concern, and indirectly relevant to another question of concern.” The distinction between direct and indirect is more typical and clear when discussed as question-answer relevance instead of subject-matter overlap (Walton, 1982).

Taking away the qualification of “personal situation”, the notions of direct relevance and indirect relevance in this inquiry are essentially the same as Wilson put

above. Direct relevance or direct evidence directly gives an answer to a user's question while indirect relevance or indirect evidence does not directly address the question but provides certain clues to infer something about the answer. Take a user's topic "Food in Auschwitz" as an example, a description of how food was lacking in the camp is direct evidence and a segment describing how people in the camp looked famished, weak, and starving is indirect evidence.

Cooper's logical relevance and Wilson's evidential relevance are both logical by nature. Cooper's logical relevance is based on deductive entailment and Wilson's evidential (situational) relevance adds inductive reasoning in the definition. Both definitions emphasize the element of logic and reasoning in terms of establishing topical relatedness between two entities. They are both logical notions and formally introduce two major modes of reasoning (inferences) in topical relevance relationships: *deductive (backward) reasoning* and *inductive (forward) reasoning*.

6.3 Green & Bean's Classification of Topical Relevance Relationships

Green and Bean (1995, 2001) reported an empirical investigation of what relationship types account for topical relevance. They examined a sample set of potential topical user needs, as backward-generated from the subject headings. 30 subject headings were randomly selected from *A Topical Guide to the Scriptures of the Church of Jesus Christ of Latter-day Saints* (Salt Lake City: Deseret Book, 1977), such as Laziness, Eden, Debt, Comfort, Hypocrisy, Shame, Silence, Widows, and Divorce. By analyzing the relationship between the subject heading and the passages cited by each subject heading, they discovered a large variety of topical relevance relationships in addition to matching relationships. They argued that "there appear to be no constraints on the kinds of relationships that can function as topical relevance relationships." (Green & Bean, 1995: 654)

A total of 33 relationship types were identified and organized into three major categories: *Topic matching relationships*, *hierarchical relationships*, and *structural (syntagmatic) relationships*. According to the analysis, topic matching relationships only accounted for less than one third of the relationship occurrences, hierarchical relationships accounted for fewer than 10%, and structural (syntagmatic) relationships accounted for over a half of the occurrences.

6.3.1 Topic Matching Relationships

Three major subcategories are identified as topic matching relationships:

Reference, definition, and attributes:

- *Reference*: the cited passage mentions or makes reference to the subject heading (user topic). This subcategory corresponds to a *general, undelineated* user request—“I want to know about X” (Green & Bean, 1995: 658). See an example as below.

| | |
|-------------------------|--|
| Subject heading: | Eden |
| Cited passage: | And the LORD God planted a garden eastward in Eden; and there he put the man whom he had formed. (Gen 2.8) |
| Relationship: | Topic matching relationship: (mere) Reference |

(From Green & Bean, 1995: 658)

Reference is very straightforward, by simply mentioning the topic of user’s interest. It is less sophisticated than “subject-matter overlapping” as defined by Walton (1982). This type of topical relevance provides the basis for term matching that is widely implemented in IR systems.

- *Definition*: the cited passage defines the topic of the user need and corresponds to user requests of “What is meant by X?”, or more simply, “What is X?” (Green & Bean, 1995: 658).

| | |
|-------------------------|---|
| Subject heading: | Faith |
| Cited passage: | Now faith is the substance of things hoped for, the evidence of things not seen. (Heb 11.1) |
| Relationship: | Topic matching relationship: Definition |

- *Attributes*: the cited passage expresses either adjectival or adverbial modifications of the user topic. This subcategory corresponds to such user requests as “What are the characteristics of X?” or “What is X like?”

| | |
|-------------------------|--|
| Subject heading: | God, Intelligence of. |
| Cited passage: | (1) O the depth of the riches both of the wisdom and knowledge of God! How unsearchable are his judgments, and his ways past finding out! (Rom 11.33) (2) But the wisdom that is from above is first pure, then peaceable, gentle, and easy to be intreated, full of mercy and good fruits, without partiality, and without hypocrisy. (Jas 3.17) |
| Relationship: | Topic matching relationship: Attribute |

(From Green & Bean, 1995: 658)

6.3.2 Hierarchical Relationships

The identified hierarchical relationships consist of *taxonomy* and *partonomy*.

- *Taxonomy* (x is a kind of y):
- *Class-subclass relationship*: the user topic (as represented by a subject heading) and the topic of the cited passage are related as class and subclass (in either direction).

| | |
|-------------------------|--|
| Subject heading: | Perseverance |
| Cited passage: | Ye are they which have continued with me in my temptations. (Lk 22.28) |
| Relationship: | Hierarchical relationship: Taxonomy: Class-subclass; the cited passage topic of <i>continuance</i> is broader than the user topic of <i>perseverance</i> . |

(From Green & Bean, 1995: 659)

- *Type-token relationship*: the user topic (as represented by a subject heading) and the topic of the cited passage are related as class and class member (in either direction). It occurs more frequently than the class-subclass relationship in the analysis (Green & Bean, 1995). It corresponds to user requests such as “Give me an example of X.”

| | |
|-------------------------|--|
| Subject heading: | Translated Beings |
| Cited passage: | And Enoch walked with God: and he was not; for God took him. (Gen 5.24) |
| Relationship: | Hierarchical relationship: Taxonomy: Type-token; the cited passage topic of <i>Enoch</i> is a member of the user topic of <i>Translated Beings</i> . |

(From Green & Bean, 1995: 659)

In terms of functional role, type-token relationship is to provide *illustrations* through examples.

- *Partonomy* (x is a part of y): the user topic (as represented by a subject heading) and the topic of the cited passage are in part-whole relationship, for example, what sub-activities an activity or process is composed of. It corresponds to the user request of “What does X consist of?” (Green & Bean, 1995: 659)

| | |
|-------------------------|---|
| Subject heading: | Meetings |
| Cited passage: | And when the disciples came together to break bread, Paul preached unto them...; and continued his speech until midnight. (Acts 20.7) |
| Relationship: | Hierarchical relationship: Partonomy; the passage specifies the (sub)activities appropriate to a religious <i>meetings</i> . |

(From Green & Bean, 1995: 659)

The relationship shown in this example is very similar to *elaboration* identified earlier in the RST functional role analysis (see Section 4.2.3)

Classification schemes and thesauri usually cover all hierarchical relationships with broader term (BT) and narrower term (NT) without differentiating between taxonomy and paronymy (Green, 1995). Some schemes consider only taxonomy in their hierarchy.

6.3.3 Structural (Syntagmatic) Relationships

Overall, Green and Bean's analysis was guided by *syntagmatic* and *paradigmatic* relationship inventories. "Paradigmatic relationships are based on patterns built into the language system." (Green, 1995: 366) For example, *orange* "is a kind of" (AKO) *fruit*; the relationship between the meanings of *orange* and *fruit* is paradigmatic: it is built in the language regardless of specific context. Synonymy (x and y have almost the same meaning) and antonymy (x and y have opposite meanings) fall into the scope of paradigmatic relationships. Hierarchical relationships as discussed above, including taxonomy (x is a kind of) and paronymy (x is a part of y), are also paradigmatic. "Syntagmatic relationships, on the contrary, hold between the linguistic elements of a constructed form," for example, "the relationship between the individual words of the phrase 'white shoes' is syntagmatic." (Green, 1995: 366) In other words, syntagmatic relationships present only in specific contexts. In linguistics, syntagmatic relationships are more often used to address phonology (i.e., how sound units are combined to produce a word) and syntactic strata (i.e., how words are combined to produce a sentence in a language). (Green & Bean, 1995)

In the discussion of information organization and topical relevance, we are more concerned about the *concept* and *conceptual relationships* rather than specific words and word combinations. "Conceptual syntagmatic relationships", as named by Green & Bean (1995, 2001), are in nature inter-concept syntagmatic relationships, or

syntagmatic relationships that are held between concepts. In her article of *Syntagmatic relationships in index language*, Green (1995) demonstrated conceptual syntagmatic relationships are important for organizing information yet severely under-treated in indexing.

Green & Bean's analysis of conceptual syntagmatic relationships for topical relevance is schema- and frame-based. Both schemas and frames are conceptual syntagmatic structures that consist of conceptual units (called *components*). "For a topical relevance relationship to be structural or syntagmatic in nature typically means that the topic of the cited passage corresponds to a component within a conceptual syntagmatic structure (or occasionally to the structure at large), while the topic of the user need corresponds to another component within the structure or, again, the structure at large." (Green & Bean, 1995: 660) The following is an example of their analysis.

| | |
|-------------------------|---|
| Subject heading: | Laziness |
| Cited passage: | And they said, Arise, that we may go up against them: for we have seen the land, and, behold, it is very good: and are ye still? Be not <i>slothful</i> to go, and to enter to posses the land. (Judg 18.9) |
| Relationship: | Structural (syntagmatic) relationship: Complex structures: Work = Force·Speed·Time the passage specifies the (sub)activities appropriate to a religious <i>meetings</i> . |

(From Green & Bean, 1995: 661)

The cited passage does not directly address the topic of *laziness*, instead, it mentions *slothfulness*. According to their discussion, laziness and slothfulness are connected within the frame of *work*. Work is defined as the product of three components: force, speed, and time. Laziness is a disinclination to perform work by decreasing force, whereas slothfulness is a disinclination to perform work by decreasing speed.

6.3.4 Integration to the Topical Relevance Typology Being Developed

The paradigmatic and syntagmatic (structural) relationships identified by Green & Bean (1995) focus on *describing* internal semantic structures embedded in a piece of information, rather than *indicating* the specific functional role the information plays in the user's overall understanding of a topic. This study together with Hutchins (1977; discussed shortly) gives rise to a new facet, *semantic relationships and structures*. This facet does not directly relate to the user's reasoning and the use of information. For example, "Structural (syntagmatic) relationship: Work = Force•Speed•Time" as discussed above, lays out the internal structure and mechanism implied by the given information; it does not indicate how specifically the information contributes to the user's understanding of a topic, i.e., supplying context, providing elaboration, showing contrasting cases, etc. Neither does it indicate how the user can put the given information to use in her reasoning or arguments, i.e., performing as premiss, warrant, rebuttal, etc. Therefore, compared to the facets of *function-based* (e.g., RST relations) and *reasoning-based* topical relevance, this facet is more *content-based*.

Being orthogonal, this content-based facet, emphasizing internal semantic relationships and structures, can be used to further specify the other two facets of the emerging typology, i.e., function-based and reasoning-based topical relevance relationships. For example, as shown in figure 6-1, Green & Bean's typology is used to further develop and enrich the category of *direct relevance* relationships (function-based). In fact, not only direct relevance, but also other function-based relevance categories (e.g., context, comparison), as well as the reasoning-based relevance categories (e.g., causal-based), can use the internal semantic facet to work out their further specifications. Some relationships and structures of this internal semantic

facet, such as *temporal relationships* and *hierarchical structures*, are universally applicable and can be fit everywhere in the typology being developed.

- | |
|---|
| <p>Direct relevance</p> <ul style="list-style-type: none"> . Matching (Restatement) . . <u>Reference</u> (Green & Bean) . Elaboration . . Set :: member (Green & Bean: Type :: token) . . . Abstraction :: instance . . . Generalization :: specific . . <u>Class :: subclass</u> (Green & Bean) . . Whole :: part (Green & Bean: Partonomy) . . . Process :: step . . Object :: attribute (Green & Bean: Attributes) . . . <u>Adjectival</u> (Green & Bean) <u>Characteristics</u> (Green & Bean) <u>Magnitude</u> (Green & Bean) <u>Adverbial</u> (Green & Bean) <u>Temporal conditions</u> (Green & Bean) <u>Manner</u> (Green & Bean) . Summary . Interpretation . <u>Definition</u> (Green & Bean) |
|---|

Note: the underlined indicates the relationships identified by Green & Bean (1995)

Figure 6-13 Direct relevance typology enriched by Green & Bean’s (1995) topical relationships

6.4 “Aboutness” in Indexing and Information Retrieval

Direct topical relevance has another name, *aboutness*, in the field of information science and information retrieval. Conventionally, the notion of aboutness has been discussed in a more operational fashion and with a more direct bearing on indexing and retrieval. Both information scientists and system developers recognize the central importance of aboutness. The “inner ability to recognize what a document is *about* is the very heart of the indexing procedure.” (Maron, 1977: 39) Aboutness also lies at the heart of retrieval design (Bruza & Huibers, 1996; Bruza, Song, & Wong, 2000; M. E. Maron, 1985; M. E. Maron & Kuhns, 1960) and retrieval evaluation (Wong, Song, Bruza, & Cheng, 2001).

Yet the field has not reached a consensus on what exactly aboutness means and even less on how it should be operationalized in information retrieval. As pointed out by Maron (1977: 40), “What is especially frustrating is the fact that we are all immediately and intuitively understand the meaning of aboutness just as we immediately and intuitively understand what it means to think or to comprehend. We all are able to think and understand and know what some piece of writing is *about*, yet we can’t say exactly what is going on and, certainly, we cannot prescribe to another how he or she ought to do it.”

6.4.1 About “About”

To gain some insight into the meaning of “about”, let us picture the world’s knowledge as a giant collection of statements formed by connecting entities with relationships (admitting complex multi-way relationships or frames as needed). The entities connected through a relationship will be called the arguments of the relationship.

A topic can then be seen as a set of statements that are “about” the topic. So, what does it mean for a statement to be about a topic? Let us explore this question through the following example.

Topic: *Rembrandt*

All statements in which Rembrandt appears as an argument can be said to be about Rembrandt, such as,

Statement (a): Rembrandt <*wasBornOn*> XXX

Statement (b): Rembrandt <*hasRole*> Painter

Statement (c): XXX <*visited*> (Rembrandt, DateXXX)

Statements (a) and (b) intuitively seem more centrally about Rembrandt than statement (c). The topic specification could express this by giving different weights to different relationship types.

Many attempts have been made to tackle this highly subjective and complex notion and ultimately to reduce it to an operational form for information retrieval. Section 6.4.2 reviews Hutchins's explications of aboutness; Section 6.4.3 reviews the logic-based analysis of the aboutness definitions in retrieval models; Section 6.4.4 briefly reviews Maron's works on aboutness.

6.4.2 Hutchins' Definition In Terms Of the Semantic Network of a Text

Hutchins (1977) related *aboutness* and indexing directly to text comprehension and summarization. He argued that "the ability to say what a text is about must be regarded as one facet of our ability to understand a text; if we do not understand a text we find it difficult to say what it is about." (Hutchins, 1977: Sec. 1) A statement of *aboutness* involves understanding a text and summarizing its semantic content. In turn, to characterize a *topic* draws on analyzing the semantic structure and thematic progression of a sentence, a paragraph, and a text. As Green & Bean's study, Hutchins's research informs the development of the facet of semantic relationships and structures of the relevance typology.

According to Hutchins (1977), a sentence has two basic communicative parts: *theme* and *rheme*:

- The theme: "represents elements that are related in some ways to the preceding text or to features of the environment in which discourse takes place." (Hutchins, 1977: Sec. 3)
- The rheme: "expresses information which is in some sense 'new' to the hearer or reader or which is otherwise unpredictable from what has been said or written already." (Hutchins, 1977: Sec. 3)

The theme is concerned with what the text is “about”, whereas the rheme is concerned with what is “new” in the text. The reader or hearer tends to be more attentive to the information that is new to him / her. Both theme and rheme are important for characterizing what a text is about.

Hutchins, following Van Dijk (1972), further distinguished two levels of structure within the text progression: the *micro-structure* and the *macro-structure*. Macro-structure captures the global semantic and thematic progression, whereas microstructure provides details at a lower level of information granularity. As argued by Hutchins, what a reader remembers of a text is likely to be its macro-structure, i.e., “the sequence of the major episodes in a story”, “the chief participants”, “the general outline of an argument”, and “the main points”, on the other hand, what a reader rarely recalls are the details of micro-structure, i.e., “the particular sequence of events in a given episode or the specific progression of a given stage of the argument.” (Hutchins, 1977: Sec. 6)

Summarization can be seen as “the generalization and reduction of text micro-structure”, by generalizing a major episode and argument stage from single proposition and reducing inessential details (Hutchins, 1977: Sec. 9). Hutchins’ work offers a theoretical basis for a summarization approach to characterize aboutness in retrieval. As opposed to frequency-based and other simple-minded reduction approaches, Hutchins’ proposal emphasizes the need to take into account the semantic structures and linguistic cues of a text in the reduction process.

6.4.3 Logical Analysis of Aboutness Definitions in Prominent Retrieval Models

Aboutness is a fundamental notion underlying much thought in information retrieval (IR), yet IR research lacks a general and formal theory of this fundamental notion. The issue of aboutness has been hidden in discussions of specific retrieval

models and their variations (Bruza, Song, & Wong, 2000). “In the last thirty years of information retrieval research, aboutness has usually only been defined within the framework of a given information retrieval model. In addition, the assumptions regarding the aboutness decision are often not explicitly stated.” (Bruza & Huibers, 1996: 385)

Taking a logic-based approach, IR researchers Van Rijsbergen, Bruza, Huibers, and colleagues started an effort in late 1980s to establish a formal and sound theoretical framework for IR that is independent of specific retrieval models (Nie, 1986; Van Rijsbergen, 1986a, 1989; Lalmas & Van Rijsbergen, 1992; Huibers, 1994; Bruza & Huibers, 1994, 1996; Bruza, Song, & Wong, 2000). This thread of works has contributed to the theoretical treatment of *aboutness* in the context of retrieval.

In particular, Bruza & Huibers (1996) and Bruza, Song, & Wong (2000) examined the operational definitions of aboutness in prominent retrieval models. A primary observation from their examination is the assumption of aboutness as *overlapping*, or *matching* using Green’s term (1995). Most retrieval models intuitively equate aboutness with overlap, that is, two information carriers (e.g., document and query, or query and query) are considered to be about each other when they overlap. This is a commonly occurring intuition. “Almost all information retrieval systems function according to this intuition. For example, the vector space model measures the overlap between a query and a document vector by computing the cosine of the angle between the two vectors.” (Bruza, Song, & Wong, 2000: 1093). In their examination, the implications and consequences of the overlap assumption in retrieval were explored. As the authors suggested, logical prosperities derived from this assumption, such as *left / right monotonicity*, *containment*, *symmetry*, and *simplification*, can negatively impact the retrieval process. (Bruza, Song, & Wong, 2000) Although

intuitive and widely held, the overlapping view of aboutness does not possess a firm footing in theory and careful thinking.

Figure 6-2 shows definitions of aboutness in specific retrieval models, as abstracted from Bruza, Song, & Wong (2000: 1101). These definitions show the way how specific retrieval models compute aboutness and which aboutness postulates they support. There are specific variations for each type of retrieval and each of the following definitions represents an example of the class.

Boolean retrieval aboutness

Let document representation d be a conjunction of terms (atomic propositions) drawn from vocabulary T . Let query q be a Boolean formula whose atomic propositions are drawn from T and combined via the connectives \wedge (conjunction), \vee (disjunction) and \neg (negation). Then,

$$d \models_B q \Leftrightarrow d \vdash q.$$

In other words, d is about q if and only if q can be derived from document representation d .

Unthresholded vector retrieval aboutness

Let d and q be n -dimensional vectors, where n is the cardinality of vocabulary T . Then,

$$d \models_{UV} q \Leftrightarrow \cos(d, q) > 0.$$

Thresholded vector retrieval aboutness

Let d and q be n -dimensional vectors, where n is the cardinality of vocabulary T . Then,

$$d \models_{TV} q \Leftrightarrow \cos(d, q) > \delta \text{ where } \delta > 0.$$

Probabilistic retrieval aboutness

Let d and q be n -dimensional vectors, where n is the cardinality of vocabulary T , and R denote the relevance event. Then,

$$d \models_{PR} q \Leftrightarrow \Pr(R|d, q) > \Pr(\neg R|d, q)$$

In probabilistic retrieval, aboutness between a document representation d and a query q depends on the event “relevance” with respect to a probabilistic decision rule.

Figure 6-14 Operational Definitions of Aboutness in Retrieval Models

From Bruza, Song, & Wong (2000: 1101)

Underlying these definitions is the assumption of overlap aboutness; the definitions simply describe different versions of overlap aboutness. For example, the Boolean retrieval is an “exact-match” model, or called *containment* model by the authors, in which a query q must be derivable from d for d to be relevant to q . The

unthresholded vector retrieval is “a naïve overlap model” where aboutness is observed by a level of overlap larger than zero. The thresholded vector retrieval is a slightly more sophisticated overlap model where the sufficient level of overlap is determined by a specified value. At last, the probabilistic retrieval is a class of overlap models that involve decision rules. (Bruza, Song, & Wong, 2000)

Broadly speaking, the recently emerging works of logic-based information retrieval follows Cooper’s logical approach and tackles the conceptual nature of aboutness from a logic view point (Bruza, Song, & Wong, 2000; Nie, 1986, 1992; Meghini, Sebastiani, Straccia, & Thanos, 1993; Marshall, 1991; Van Rijsbergen, 1986b, 1989; Sembok & Van Rijsbergen, 1990; Chiarmarella & Chevallet, 1992; Hunters, 1995;). These works regard IR as a *reasoning* process of determining aboutness or topical relatedness between two information carriers (e.g., document and query, or document and document) (Bruza, Song, & Wong, 2000). “In a nutshell, the logic-based approaches embody aboutness in the following way: Object O is deemed to be about request q if $\chi(O) \rightarrow q$, whereby the connective \rightarrow signifies implication.” (Bruza & Huibers, 1996: 384) The seemingly only agreement among these authors is that the theoretical framework of aboutness should be logic-based, but what particular type of logic is best for characterizing the notion of aboutness is still in debate. Bruza and colleagues (1996, 2000) proposed a commonsense-logic framework and argued for the nonmonotonic properties of aboutness within the commonsense framework. However, to date, there has not yet reached a consensus on the core set of logical properties of aboutness.

6.4.4 Maron’s Operational Definition of Aboutness

Maron (1977) differentiated three kinds of *about*: *S-about*, *O-about*, and *R-about*.

- *S-about* (subjective about) occurs as a highly personal and subjective “inner experience” of the user; it emphasizes the cognitive process and the cognitive effect from reading a document.
- *O-about* (objective about) concerns about the relationship between search terms and a document; it is “the external correlate of *S-about*.”
- *R-about* (retrieval about) is an operational definition of aboutness for the purpose of retrieval (Maron, 1977: 41). From this point on, Maron further formulated aboutness within a probabilistic framework of user satisfaction (Blair & Maron, 1985; M.E. Maron, 1977; M. E. Maron, 1985; M. E. Maron & Kuhns, 1960).

Maron’s works may contribute to providing an operational definition that is testable in retrieval experiments, but it does not contribute as much to understanding the *logical* and *relational* nature of aboutness, or topical relevance. He is not interested in identifying *types* of topical relevance relationships. Instead, in Maron’s framework, “one’s hands are largely tied when trying to express qualitative properties of aboutness within a probabilistic setting.” (Bruza, Song, & Wong, 2000: 1091)

Chapter 7. The Perspective of Education and Cognitive Psychology

Many studies in Education and Cognitive Psychology are devoted to exploring the cognitive processes of *understanding*. Understanding is the central component of *constructivist learning*, or *meaningful learning* (Anderson & Krathwohl, 2001; Ausubel, Novak, & Hanesian, 1978). Examined closely, *understanding*, also known as *sense making*, is quite a sophisticated process, as distinguished from simple *remembering* or *rote learning*. It requires the learner to identify and attend to the incoming relevant information, to connect the new information with background knowledge structures stored in the learner's mind, to integrate the new information into these stored structures, and finally to make additions or revisions to these structures. By understanding, some aspects of the learner's knowledge representation of the world are updated.

The process of *understanding* and the process of *constructing relevance* are fundamentally inseparable. Recalling Sperber and Wilson's relevance theory (1985, 1995; see Chapter 4), an input (e.g., a sight, an utterance) is defined as relevant when it connects with the background information to arrive at "a worthwhile difference to the individual's representation of the world" (Wilson & Sperber, 2002: 251). At the cognitive level, to detect relevance and to develop understanding are closely related with each other. Furthermore, Hutchins (1977) explicated the notion of *aboutness* (i.e., topical relevance) directly within the framework of text comprehension. As he pointed out, "the ability to say what a text is about must be regarded as one facet of our ability to understand a text; if we do not understand a text we find it difficult to say what it is about." (Hutchins, 1977: Sec. 1)

Therefore, the cognitive mechanisms of constructing relevance largely, if not completely, overlap with the cognitive mechanisms of understanding and learning. This chapter focuses on theories dedicated to cognitive processes and cognitive mechanisms of understanding, learning, and knowledge acquisition.

7.1 Bloom's Taxonomy of Educational Objectives

The well-known *Bloom's taxonomy* was proposed by Benjamin Bloom and collaborators in 1956 (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956) as a comprehensive framework for categorizing educational objectives. It has since been widely used in designing more holistic instruction and testing (i.e., assessments, exams, evaluation) in school. Without exaggeration, the Bloom's taxonomy is literally the teacher's manual for planning curriculums and tests. The original Bloom's taxonomy covers educational objectives in three domains: affective, psychomotor, and cognitive. Here we focus on the cognitive aspect.

In 2001, Anderson and Krathwohl (2001) published a revised version of the Bloom's taxonomy with an emphasis on the cognitive facet. The revised Bloom's taxonomy provides a more detailed description of the major cognitive processes that students actively engage in in constructing meaning and knowledge. Six levels of learning activities or cognitive processes are identified and ordered from low-level to high-level learning as follows (Table 7-1).

**Table 7-9 The Cognitive Process Dimension of the Revised Bloom's Taxonomy
(From Anderson & Krathwohl, 2001: 67)**

| | | |
|----|--------------------|--|
| 1. | Remember: | Retrieve relevant knowledge from long-term memory |
| 2. | Understand: | Construct meaning from instructional messages, including oral, written, and graphic communication |
| 3. | Apply: | Carry out or use a procedure in a given situation |
| 4. | Analyze: | Break material into its constituent parts and determine how the parts relate to one another and to an overall structure or purpose |
| 5. | Evaluate: | Make judgments based on criteria and standards |
| 6. | Create: | Put elements together to form a coherent or functional whole; reorganize elements into a new pattern or structure |

Among the six categories, the category of *understand* directly deals with constructing meaning from incoming relevant information. It refers to the cognitive process of establishing relevance between new information and the learner's existing knowledge structure, fitting the new information to extend (or enrich) the learner's knowledge structure, and correcting (or revising) the original knowledge structure when inconsistencies occur. More specifically, to *understand* involves the following more specific cognitive mechanisms (Table 7-2):

**Table 7-10 The Cognitive Processes of “Understanding”
(From Anderson & Krathwohl, 2001: 67)**

| Cognitive Processes | Alternative Names | Definitions And Examples |
|----------------------------|--|--|
| Interpreting | Clarifying, paraphrasing, representing, translating | Changing from one form of representation (e.g., numerical) to another (e.g., verbal) (e.g., Paraphrase important speeches and documents) |
| Exemplifying | Illustrating, instantiating | Finding a specific example or illustration of a concept or principle (e.g., Give examples of various artistic painting styles) |
| Classifying | Categorizing, subsuming | Determining that something belongs to a category (e.g., concept or principle) (e.g., Classify observed or described cases of mental disorders) |
| Summarizing | Abstracting, generalizing | Abstracting a general theme or major point(s) (e.g., Write a short summary of the events portrayed on a videotape) |
| Inferring | Concluding, extrapolating, interpolating, predicting | Drawing a logical conclusion from presented information (e.g., In learning a foreign language, infer grammatical principles from examples) |
| Comparing | Contrasting, mapping, matching | Detecting correspondences between two ideas, objects, and the like (e.g., Compare historical events to contemporary situations) |
| Explaining | Constructing models | Constructing a cause-and-effect model of a system (e.g., Explain the causes of important 18th-century events in France) |

The cognitive processes involved in understanding (Figure 7-2) are also discussed as “cognitive mechanisms” underlying *knowledge acquisition* and *knowledge restructuring*.

7.2 Cognitive Mechanisms for Knowledge Acquisition and Restructuring

Knowledge acquisition is seen as a cognitive process involving a series of changes to the receiver’s knowledge structures; “some (changes) require the enrichment of existing knowledge structures, and others require the creation of altogether new structures.” (Vosniadou & Brewer, 1987: 62)

The cognitive mechanisms underlying changes or knowledge restructuring are widely discussed in various contexts, e.g., *reading comprehension* (Kavale, 1980), *instructional design* (Wittrock, 1989), and *scientific discoveries* (Darden & Maull,

1977; Gentner, 1980; Langley, 1981). The identified cognitive mechanisms from different studies are summarized and grouped as follows:

Interpretation (Wittrock, 1989): developing clarifications

- *Paraphrases* (Wittrock, 1989): put understanding into own words

Generalization-based mechanisms (Kavale, 1980; Rumelhart & Ortony, 1977):

- *Schema induction* (Rumelhart & Norman, 1981; Rumelhart & Ortony, 1977): discovering the generic features or regularities across similar phenomena
- *Definition* (Kavale, 1980): defining the purpose, function, or use of the named object or phenomenon
- *Summaries* (Wittrock, 1989): abstracting the key points and main ideas

Specialization or Specification (Rumelhart & Ortony, 1977): instantiating the schema with special details and features of a specific case

- *Examples* (Wittrock, 1989): giving examples

Comparison-based mechanisms (Kavale, 1980): comparing

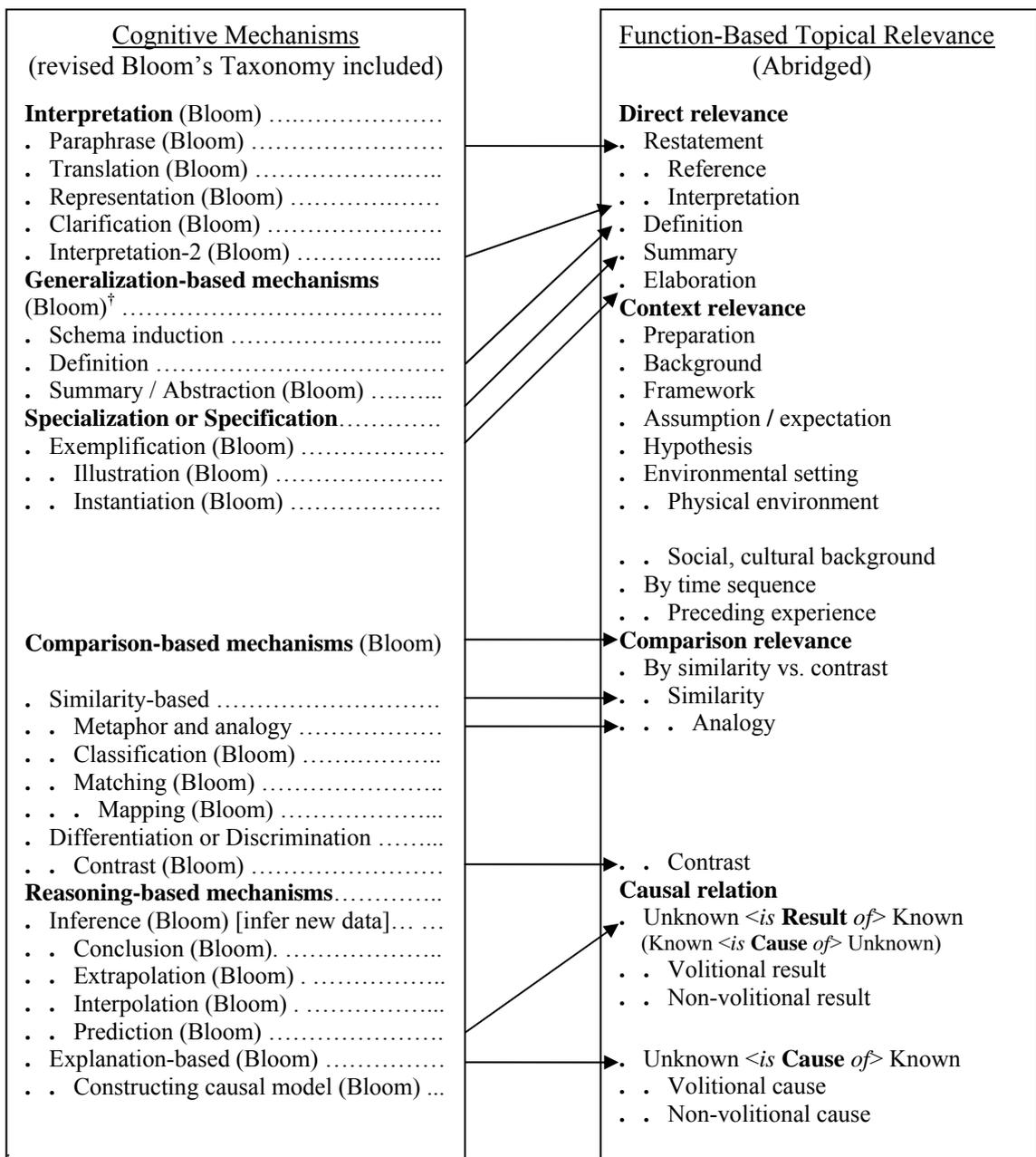
- *Similarity-based mechanisms* (Langley, 1981):
 - *Metaphor and analogy*: using analogies and metaphors from a different domain to construct a new schema of knowledge (Gentner, 1980; Vosniadou & Brewer, 1987; Wittrock, 1989)
 - *Classification*: relating an item to a broader conceptual category (Kavale, 1980; Wittrock, 1989)
- *Differentiation or Discrimination*: recognizing the critical differences between knowledge schemas (Carey, 1985)

Reasoning-based mechanisms

- *Inferences* (Wittrock, 1989): drawing logical conclusions based on premises and evidence

- *Explanation-based mechanisms* (DeJong & Mooney, 1986)

The “knowledge acquisition mechanisms” considerably overlap with the “understanding” process as characterized in the Bloom’s taxonomy. This overlap (as shown in the column of “Cognitive Mechanisms” in figure 7-1) indicates a high-level consensus on the “key elements” that constitute the processes of *understanding* and *constructing relevance*. More interestingly, these cognitive mechanisms can be conveniently mapped to the function-based and the reasoning-based facets of the relevance typology, as discussed in the following section.



[†](Bloom) indicates categories mapped to or added by the revised Bloom's taxonomy

Figure 7-15 Mapping between Cognitive Mechanisms and the Function-Based Topical Relevance

7.3 Mapping between Cognitive Mechanisms and Relevance Typology

7.3.1 Mapping between Cognitive Mechanisms and Function-Based Relevance

Text is constructed by the writer in a way that can be easily comprehended and that can effectively facilitate the reader's understanding and learning about a topic. Therefore, there is a natural correspondence between the functional roles of text pieces and the reader knowledge-acquisition mechanisms. In other words, different parts of the text tend to address different kinds of knowledge-restructuring changes involved in the reader's understanding process. For instance, different parts of a text may provide definition, interpretation, illustration, comparative cases, analogies, summarization, and so on. Figure 7-1 demonstrates the mapping between cognitive mechanisms and the function-based facet of the relevance typology being developed.

7.3.2 Mapping between Cognitive Mechanisms and Reasoning-Based Relevance

Moreover, reasoning elements are embedded in some of the cognitive mechanisms, as shown in table 7-3.

To summarize, the cognitive mechanisms in comprehension and knowledge acquisition are not only closely related to the categories of the topical relevance typology, but also further enrich these categories by adding more specific sub-types.

Table 7-11 Mapping between Cognitive Mechanisms and Mode of Topic Reasoning

| Cognitive Mechanisms | Mode of Topical Reasoning[†] |
|---|--|
| Interpretation <ul style="list-style-type: none"> . Paraphrase . Translation . Representation . Clarification . Interpretation-2 | |
| Generalization-based mechanisms <ul style="list-style-type: none"> . Schema induction . Summary (Abstraction) . Definition | Generalization (Induction) |
| Specialization or Specification <ul style="list-style-type: none"> . Exemplification . . Illustration . . Instantiation | |
| Comparison-based mechanisms <ul style="list-style-type: none"> . Similarity-based <ul style="list-style-type: none"> . . Metaphor and analogy . . Classification . . Matching . . . Mapping . Differentiation or Discrimination <ul style="list-style-type: none"> . . Contrast | Comparison-based reasoning <ul style="list-style-type: none"> . Reasoning by analogy <ul style="list-style-type: none"> <i>Arguments from analogy</i> <i>Resemblance arguments</i> <i>Case-based reasoning</i> <i>Analogical reasoning</i> . Reasoning by contrast <ul style="list-style-type: none"> <i>Reasoning from opposites</i> <i>Contrast</i> |
| Inference [infer new data] <ul style="list-style-type: none"> . Conclusion . Extrapolation . Interpolation | Rule-based reasoning (Deduction) <ul style="list-style-type: none"> <i>Reasoning from classification</i> <i>Reasoning from principle</i> <i>Logical relevance</i> |
| <ul style="list-style-type: none"> . Prediction | Causal-based reasoning <ul style="list-style-type: none"> . Forward inference (Deduction) <ul style="list-style-type: none"> . . Reasoning from cause <ul style="list-style-type: none"> . . . Inferring an event from its cause . . . Inferring an event from earlier events . . . Inferring reaction from action . . Volitional cause . . Non-volitional cause |
| Explanation-based mechanisms <ul style="list-style-type: none"> . Constructing causal model | <ul style="list-style-type: none"> . Backward inference (Abduction) <ul style="list-style-type: none"> . . Non-volitional result |

[†] Blank indicates no correspondence to the reasoning facet.

Terms in italic are not sub-categories, rather, they indicate how the category is named differently in literatures.

Chapter 8. The Perspective of Medical Problem Solving

In cognitive research on medical expertise and clinical reasoning, there has been an important shift from the search for generic problem-solving skills toward a focus on *memory organization, problem representation, knowledge use*, and how they evolve with experience (Bordage, 1994; Schmidt, Norman, & Boshuizen, 1990). Accordingly, three kinds of knowledge structures from the perspective of medical problem solving are discussed in this chapter:

- *Illness scripts*: physicians' internal knowledge organization and representation of diseases, with an emphasis on memory organization;
- *PICO*: the clinical problem / question template promoted in the context of evidence-based medicine, with an emphasis on problem representation;
- *Clinical problem-solving frames*: developed from Florance's study in 1992, with an emphasis on knowledge use in different clinical tasks.

These knowledge structures highlight the important elements or facets of medical problem solving and clinical reasoning from different angles. Illness script is discussed in the context of medical expertise (Section 8.1), PICO is discussed in the context of evidence-based medicine (Section 8.2), and Florance's frames are discussed in the context of information gathering for medical problem solving and decision making (Section 8.3).

In the discussion, close mapping is found between the three knowledge structures and the topical relevance typology being developed. Taken together, they contribute important insights into how the relevance typology can manifest and adapt to a specific subject domain—medicine. Moreover, they contribute to further enriching and refining the typology as well.

8.1 Medical Expertise and “Illness Scripts”

8.1.1 Medical Expertise as Efficient Knowledge Organization

Supreme knowledge organization is the prerequisite to expertise (Bedard & Chi, 1992; Chi, Glaser, & Farr, 1988). Chi and colleagues carried out a series of studies to examine the nature of expertise with respect to a variety of tasks, such as mechanical system troubleshooting, decision making, chess matches, and medical diagnosis. They found out from the studies that the way in which knowledge is stored, used, and retrieved characterizes critical differences between novices and experts.

This also applies to the medical domain. As repeatedly confirmed by the literature, compared to medical students and novice physicians, medical experts neither possess more in-depth pathophysiological knowledge, nor do they master superior reasoning skills; instead, they stand out as experts because they are capable of structuring knowledge in such a way that is highly accessible, functional, and efficient for diagnosis and treatment in clinical practice (Bordage, 1994; Bordage & Zacks, 1984; Charlin, Tardif, & Boshuizen, 2000; Elstein, Shulman, & Sprafka, 1978; Feltovich & Barrows, 1984; Jones, 1992; Patel & Groen, 1991; Schmidt, Norman, & Boshuizen, 1990).

Research on clinical reasoning continues to affirm the importance of knowledge organization. Elaborated knowledge organization is proved to be “the key to successful diagnostic thinking” (Bordage, 1994: 883). According to the study, the most accurate diagnosticians organize symptoms and signs into coherent systems of higher-level relationships, have the most diversified sets of semantic axes, and demonstrate a broader and deeper *representation* of the problem; on the contrary, poor diagnoses rely on a long static list of material facts with far fewer recognized semantic connections. Experienced clinical experts differ from less experienced

clinicians, not because they possess a larger amount of factual medical knowledge, but because they possess *elaborated networks* of knowledge tailored to the clinical tasks.

These “elaborated knowledge networks” for clinical reasoning are called *illness scripts* or *scripts* (Charlin, Tardif, & Boshuizen, 2000; Feltovich, 1983; Feltovich & Barrows, 1984; Schmidt, Norman, & Boshuizen, 1990), as discussed further in the next section.

8.1.2 Illness Scripts: A Theory of Medical Expertise

Illness scripts are essentially physicians’ mental representations for diseases and patient cases. They start to emerge at the medical student’s first clinical encounters and continue to be refined and reinforced during life-long clinical practice (Bordage, 1994; Schmidt, Norman, & Boshuizen, 1990). Illness scripts help physicians structure their knowledge about diseases, including knowledge accumulated both from school and from practice. In fact, illness scripts can be seen as a fusion of both *causal-based* pathophysiological knowledge (as acquired from medical school) and *experience-based* clinical patterns (clinical manifestations of diseases, variability in signs and symptoms, etc.).

These scripts are simplified internal representations of diseases and patient cases developed through experience over time. As encountered with a specific patient problem, physicians retrieve and operate upon the appropriate illness scripts that are pre-stored in their memory to understand the problem. An example of such a script for endocarditis disease developed by a family doctor is shown in figure 8-1. Although quite succinct, the scripts are sufficient for carrying out effective diagnosis and treatment in clinical contexts. Also, illness scripts vary on a broad spectrum of generality: they can be as general as capturing the essence of a family of related

diseases, or they can be as specific as characterizing details of a particular patient with the disease.

Since illness scripts are developed from individual idiosyncratic clinical experience, for the same problem the scripts different physicians develop individually are likely to vary on details, but they are similar for the essential elements of the problem. Therefore, physicians are able to communicate efficiently about diseases or patients and reach the same diagnosis in similar scenarios.

| Enabling conditions | Fault | Consequences |
|---|--|--|
| <p>Personal features: age usually above 35; drug or alcohol addiction</p> | <p>[Problem] Sepsis: Infection of endocardium</p> | <p>[Signs] Onset: insidious, acute health condition; malaise; weight loss</p> |
| <p>Previous health condition: decreased resistance, malnutrition, tuberculosis, long period of infection</p> | <p>Causative agent: staphylococcus; streptococcus; gram-negative bacillus</p> | <p>[Complaints] Fever: remittent low-high, chills, night sweats, Cyanosis, anemia</p> |
| <p>Previous diseases: rheumatic fever, congenital heart disease, heart valve prosthesis, dental caries</p> | | <p>[Symptoms] Heart condition: failing heart (left), not responding to medication, collapsing pulse, exertional dyspnea alternating with resting dyspnea, tachycardia, overactive heart and pulse</p> |
| <p>Medication: corticosteroids</p> | | <p>Heart sounds: change in preexisting murmur; murmur of aortic insufficiency, mitral insufficiency or stenosis</p> |
| <p>Provoking factors: dental, urological, or gynecologic surgery; ulcerating skin lesions; osteomyelitis; monarthritis; contaminated invasive instruments or needles</p> | | <p>Lungs: inspiratory rales and expiratory wheezes</p> |
| | | <p>Optical field defect</p> |
| | | <p>Hematuria (red cells but no casts)</p> |
| | | <p>Small hemorrhages in conjunctivae, nails, fingertips, and toes</p> |
| | | <p>Spleen enlarged, painful</p> |
| | | <p>ESR: normal to high</p> |
| | | <p>WBC count: normal to high; increased proportion of young granulocytes</p> |
| | | <p>Renal failure: increased urea, creatinine</p> |

Figure 8-17 Endocarditis Script Derived from a Family Physician with Five Years' experience (adapted from Schmidt, et al, 1990: 616)

According to Schmidt et al (1990), a generic structure can be abstracted from specific illness scripts. The generic structure of illness scripts captures the central elements to be considered in medical diagnosis and treatment tasks. It can be also taken as a generic container for packaging and structuring disease information that is

essential for determining the disease and predicting its clinical manifestations. Based on the Schmidt's account (Schmidt et al, 1990: 615), a more elaborate version of the generic script structure is derived by the author and presented in figure 8-2.

| Script element | Description |
|---|--|
| Enabling condition: Predisposing factor: Previous health condition Previous disease Medication Substance use Provoking factor Boundary condition: Age Sex | Predisposing factors, boundary conditions, hereditary factors, etc. Compromised host factors, travel, drugs, etc. Age, sex, etc. |
| Fault: Problem Causative agent | Invasion of tissue by pathogenic organism, inadequate nutrient supply, inability of tissue to survive, etc. |
| Consequence: Complaint Sign Symptom | Complaints, signs, symptoms |

Figure 8-18 The Generic Structure of Illness Script
 (revised and elaborated from Schmidt, et al, 1990: 615)

Direct correspondence can be drawn between the generic illness script and the function-based facet of the topical relevance typology:

- “Fault” can be mapped to “Topic matching relationship / Direct relevance”, directly describing the problem and laying out its causative agents (e.g., tissue invasion)
- “Consequence” can be mapped to “Indirect relevance / Evidence”, in medical diagnosis, physicians are reasoning from signs and symptoms, evaluating differentials, and coming up with the best explanation for the observed signs and symptoms; it is an *abductive* reasoning process (see Section 5.3.4.2 Describing the Types of Topical Reasoning), in which physicians are reasoning backward to the

disease (cause) that causes the symptoms (consequence)

- Elements in the category of “Enabling condition” can be generally mapped to “Context relevance”; factors in this category do not directly *cause* the problem but certainly *relate* to it. For instance, being in a certain age-gender group can pose a higher risk for a particular disease.

Studies have demonstrated differential use of enabling-conditions information between clinical experts and novices. For the same cases, experienced physicians attended more closely to enabling conditions of the patient (sex, age, profession, previous diseases, medication, marital status, etc.) and they were more able to recall and use this information for accurate diagnosis. On the other hand, medical students and residents were likely to ignore the presented contextual information about a patient and tended to have a more restricted focus on signs and symptoms; they did not remember and use as much contextual patient information as the clinical experts and resulted in lower accuracy of performance. (P. P. Hobus, Schmidt, Boshuizen, & Patel, 1987; P. P. M. Hobus, Hofstra, Boshuizen, & Schmidt, 1989).

8.2 PICO-Based Clinical Problem Representation

8.2.1 Evidence-Based Medicine (EBM)

Evidence-based medicine (EBM) has emerged as a national priority to improve the quality of health care (Green & Ruff, 2005). Physicians are encouraged and trained to identify, appraise, and apply best evidence in their medical decision making and problem solving for specific patients.

EBM can be defined as “the conscientious, explicit and judicious use of current best evidence in making decisions about the care of the individual patient. It means

integrating individual clinical expertise with the best available external clinical evidence from systematic research.” (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996)

EBM integrates

- clinical expertise, i.e., the physician’s education, clinical skills, and accumulated experience,
- patient values, i.e., the patient’s personal concerns, expectations, and values, and
- the best evidence, i.e., clinically relevant findings derived by using sound research methodology

into the decision making process for patient care (Sackett, 2002).

The practice of EBM is usually triggered by patient encounters which generate clinical questions regarding etiology, diagnosis, therapy, or prognosis. EBM requires physicians to improve information searching skills and to apply formal rules of evidence in evaluating clinical findings. A typical EBM process includes the following six steps:

1. Start with a clinical problem or question that arises out of patient care
2. **Construct a well-built clinical question derived from the case** → the key
3. Select appropriate resource(s) and conduct a search
4. Appraise gathered evidence for its validity (closeness to the truth) and applicability (usefulness in clinical practice)
5. Apply findings to patient care—integrate evidence with clinical expertise, patient preferences, and apply it to practice
6. Evaluate performance with the patient

As indicated by the second bullet on the above list, a well-built clinical question is widely believed to be the key to finding the best evidence efficiently (Armstrong, 1999) and also the key to evidence-based decisions (Ebell, 1999; Richardson, Wilson,

Nisbikawa, & Hayward, 1995). An important focus of EBM is put on formulating structured “answerable” clinical questions from patient encounters.

8.2.2 PICO: A Structured Representation of Clinical Problems

Within the context of EBM, an explicit framework and guidance for formulating clinical questions has been proposed; this framework is commonly referred to as PICO. The PICO frame helps physicians articulate their vague information needs with *patient-specific, well-built, focused* clinical questions. According to PICO, a well-built clinical question is one that is focused and well articulated in four elements (also called *anatomy* of the question) (Richardson (Armstrong, 1999; Richardson, Wilson, Nisbikawa, & Hayward, 1995):

Problem/**P**opulation

Intervention

Comparison

Outcome

The PICO frame has since been widely promoted within the current practice of EBM for structuring clinical thinking and formulating clinical questions. Studies show that the PICO frame can also be used to facilitate information search for *precise* answers in question-answering (QA) systems (Demner-Fushman & Lin, 2005; Niu & Hirst, 2004).

More detailed definitions of the four PICO elements are provided in figure 8-3.

| |
|---|
| <p>1. Patient or Problem The primary problem, disease, or co-existing conditions. In PICO, this also involves defining the patient as a member of a population, in terms of sex, age, ethnic group, risk profile, and other characteristics judged to be clinically important. (See notes below)</p> <p>2. Intervention, prognostic factor, or exposure The main intervention, prognostic factor, or exposure to be considered, including therapy (drug prescription, surgery order, etc.); prevention; diagnostic testing; etiology; what factor may influence the prognosis of the patient (age? co-existing problems?); what was the patient exposed to (asbestos? cigarette smoke?); and so forth.</p> <p>3. Comparison Physicians may wish to look for a comparison of two or more interventions, to decide between two drugs, between a drug and placebo, or between two diagnostic tests. A clinical question does not always need a specific comparison.</p> <p>4. Outcomes A precise endpoint needs to be defined. Such an endpoint can be a particular desirable outcome; for example, what is to be accomplished, measured, improved, or affected. More specifically, such outcomes may be to relieve or eliminate the symptoms, to reduce the number of adverse events, to improve or recover function, to prevent disability, and to save time, money and effort, and so on. It also includes unwanted outcomes such as the probability of side-effects of drugs, adverse effects of treatment, and costs.</p> <p>Revised from http://www.aafp.org/fpm/20050700/37howt.html</p> <p>Note on the Patient/Problem element: The element combines information on patient population and patient problem. Patient problem refers the main medical condition or clinical problem that is of focus in the question. Patient population information includes demographic characteristic, symptoms exhibited, medical conditions which are not the main focus of the question including known diseases and treatments, among others.</p> |
|---|

Figure 8-19 Definitions of the Four PICO Elements

The PICO frame can be taken as a knowledge structure for representing clinical problems (Huang, Lin, & Demner-Fushman, 2006). PICO focuses on clinical tasks, i.e., diagnosis, treatment, prognosis, and etiology, whereas the illness script focuses solely on diseases. Illness scripts store and structure knowledge to better understand and diagnosis diseases; the PICO frame, on the other hand, is primarily a treatment-centered design, covering information about interventions that are not covered by illness scripts. In this sense, PICO is a more general structure, representing both diseases and interventions, as well as their (adverse) effects and outcomes. Another difference between illness scripts and PICO is that, illness scripts are *internal, implicit*

knowledge structures, whereas PICO is an *external, made-explicit* representation device.

Within a PICO representation, the four PICO elements are connected and organized around a clinical problem. These elements contribute to representing the central clinical problem from different perspectives. Their contributions are best characterized by the different *functional roles* they play in the structure. Functional role relationships constitute the function-based facet of the relevance typology being developed. Table 8-1 summarizes the mapping between the functional roles of PICO elements and those identified from Rhetorical Structure Theory (see details from Table 4-3).

Table 8-12 Mapping Functional Roles between PICO Elements and RST Relationships

| PICO element | Abbreviated PICO definition | Functional role (RST) |
|--------------------------------|---|--|
| Patient problem (P1) | The primary problem, disease, or co-existing conditions. | Matching relationship / Direct relevance |
| Patient background (P2) | Defining the patient as a member of a population, in terms of sex, age, ethnic group, risk profile, and other characteristics judged to be clinically important. | Context relevance |
| Intervention (I) | The main intervention, prognostic factor, including therapy (drug prescription, surgery order, etc.); prevention; diagnostic testing; etc. | Method / Solution Intervention |
| Comparison (C) | A comparison of two or more interventions, to decide between two drugs, between a drug and placebo, or between two diagnostic tests. | Comparison |
| Outcome (O) | A particular desirable outcome; for example, what is to be accomplished, measured, improved, or affected. More specifically, such outcomes may be to relieve or eliminate the symptoms, to reduce the number of adverse events, to improve or recover function, to prevent disability, and to save time, money and effort, and so on. | Goal Purpose |

8.3 Clinical Problem Solving

8.3.1 Clinical Problem Solving and Information Gathering

Since the seminal work by Elstein and collaborators, *Medical Problem Solving: An Analysis of Clinical Reasoning*, published in 1978 (Elstein, Shulman, & Sprafka, 1978), we understand that clinical problem solving is a *hypothetic-deductive* process characterized by the early generation of hypotheses, oriented data collection, and decision-making judgment, using collected data to confirm or reject hypotheses.

Consistent findings have shown that most diagnostic errors are due to data collection and data interpretation. As Gruppen et al (Gruppen, Wolf, & Billi, 1991) pointed out, the information-gathering process distinguishes clinical problem solving from problem solving in many other domains such as chess, physics, and mathematics, where all the relevant information is usually readily available and the

focus of these problems is to integrate them for an optimal solution. In clinical practice, physicians rarely start with all the necessary and relevant information to the case. They need to actively seek for clinically useful information from a variety of sources in a timely and efficient fashion. The quality and relevancy of collected information has a direct impact on the resulting diagnostic and therapeutic decisions. By comparing physicians' diagnostic performance under two experimental conditions: partial-information problem solving (physicians are asked to gather and select additional information for making diagnoses) and full-information problem solving (all relevant information is provided for making diagnoses), the study further suggests that information gathering and selection is a more frequent source of diagnostic errors as compared to information integration. Faulty diagnostic decisions are often related to difficulties in information gathering, knowing what is useful, and identifying and selecting diagnostically relevant information. The findings highlight the information gathering process as a crucial component of clinical reasoning and problem solving. Better information gathering leads to substantially better clinical decisions.

From discussions on information gathering for clinical decision making, two different stages of information gathering emerge: *exploratory* and *confirmatory* information gathering. This distinction is not made in the existing medical literature, with both types referred to as "information gathering" without differentiation:

- Exploratory clinical information search assists the physician to better formulate the clinical problem and generate initial hypotheses. It can be called *pre-hypothesis information gathering*, which is not guided by a fixed integration plan and thus is more exploratory in nature. Unlike confirmatory search, the process of exploratory information collection plays a more significant role in structuring the problem space and has a more profound impact on shaping up the following

strategies for information integration.

- On the contrary, confirmatory information gathering is not open-ended; instead, it has a rather fixed focus and little impact on the subsequent plan of information integration. Its goal is to evaluate the set of possible diagnostic hypotheses or therapeutic alternatives and ultimately to further narrow the candidate set down to the optimal decision. Most information gathering that happens after the physician arrives at one or a few hypotheses belongs to the category of confirmatory information collection, as illustrated by the above example (decision between two diseases).

In short, exploratory information gathering is open-ended and leading to initial hypotheses, whereas confirmatory information gathering is directed and focuses on confirming or ruling out hypotheses. Due to their differences, they are likely to put different emphases on types of evidence in the search. On the one hand, exploratory search may attend to broad-range evidence (context, etc.) more often, with a particular emphasis on avoiding early closure of reasoning and pre-mature conclusions; on the other hand, confirmatory search may put its emphasis on specific evidence (direct, indirect) for the purpose of precise reasoning and confirmation.

8.3.2 Clinical Problem-Solving Frames Identified From Clinical Questions

Clinical questions raised by physicians not only directly relate to information gathering, but also reveal physicians' thinking structure, as well as their subsequent plans for information integration.

Clinical questions frequently arise from physicians' daily practice and physicians need rapid access to precise answers relevant to their questions. According to published estimates, physicians ask 0.7 to 18.5 questions for every 10 patients cared

for (Ely, Burch, & Vinson, 1992; Timpka & Arborelius, 1990). The following provides some example questions typically posed by practicing physicians (Huang, Lin, & Demner-Fushman, 2006):

- What is the best treatment for ADHD in children?
- What is the diagnostic approach to a 1-year-old with chronic cough?
- Do TCAs or SSRIs have any effect on decreasing tinnitus, and if so, in what dosage?
- What are the causes of hypomagnesaemia?

The majority of clinical questions are driven by two types of information needs (Gorman & Helfand, 1995; Thompson, 1997):

1. to seek answers to patient-specific questions at the point of care, and
2. to stay current with new relevant developments in clinical medicine.

By analyzing 60 clinical questions raised by practicing physicians, Valerie Florance (1992) discovered a series of *frame-based* structures for clinical problem solving. In her analysis, she found that physicians' questions focused on four types of clinical tasks:

- prediagnostic assessment,
- diagnosis,
- treatment choice, and
- learning (etiology).

The first three clinical tasks give rise to patient-specific questions, or the type-1 information needs listed above; the learning task is identified with the type-2 information needs, with a purpose of staying abreast with the latest clinical developments but not necessarily related to a specific patient case. Each question was

first identified for the clinical task category it belongs to and then was assessed for evidence that could contribute to clinical decision making, a step called “evidential analysis” (Florance, 1992: 142). In the evidential analysis, a (functional) role was assigned to each phrase and clause of the question.

Compiled and abstracted from the analysis of questions, a generic clinical frame was derived for each task, that is,

- prediagnostic assessment frame,
- diagnosis frame,
- treatment choice frame, and
- learning frame.

In particular, the prediagnostic assessment frame applies to the pre-hypothesis stage of information gathering and thus is more *exploratory* in nature. Information sought for at this stage is more open-ended and general. On the other hand, the diagnosis frame and the treatment choice frame are focused and directed, falling into the scope of *confirmatory* information collection. Furthermore, both the diagnosis frame and the treatment choice frame have an emphasis on *procedural* rather than *declarative* information.

Table 8-2 to table 8-5 lay out the four frames respectively, as quoted from Florance’s study (Florance, 1992: 148-149). The fourth column on the right of each table indicates the mapping to functional roles already identified in the relevance typology. The mapping is based primarily on frame elements (slots), and secondly on facets, as also informed by the values applied.

Table 8-13 Prediagnostic assessment frame (from Florance, 1992: 148)

| Frame element (Slot) | Facet | Example of value | Functional role |
|-----------------------------|--------------------|-----------------------------------|-----------------------------|
| Condition | Status | past, chronic | Context |
| | Feature | cause, treatment options | Condition (enabling) |
| | Relationship | co-occurrence, cause-and-effect | Predisposing factor |
| | Prognosis | cure | |
| Evidence | Source | test | Evidence (Indirect) |
| | Interpretation | normal, toxic | Sign, symptom Test, exam |
| Treatment | Mechanism | inhibitor | Method / Solution |
| | Features | side effects, contraindications | Intervention |
| | Outcome | mortality / morbidity | |
| | <i>Alternative</i> | names of replacement options | <i>Comparison</i> |
| Process | Identify | find facts | |
| | Confirm | match to other examples, opinions | |
| | Predict | propose probable outcome | |

Table 8-14 Diagnosis frame (from Florance, 1992: 148)

| Frame element (Slot) | Facet | Example of value | Functional role |
|-----------------------------|--------------------------|---|--|
| Condition | Name | neutropenia | Topic matching (Direct) |
| | Feature | headache, depression | Problem |
| | Diagnostic clue | disease-specific evidence | Name |
| | Evidence source | Doppler test, observation | Elaboration |
| | Etiology | stroke, cardiac drug side effect | Feature |
| | Relationship | cause-and-effect, co-occurrence | Solution |
| | Treatment | surgery, antibiotic | Method (means) |
| Diagnosis | Certainty | confirmed, probable, unlikely | Topic matching (Direct) |
| | Epidemiology | occurrence, distribution | Problem Certainty |
| Evidence | Source | patient, observation, test | Evidence (Indirect) |
| | Type | material, fluid | Sign, symptom |
| | Measure | numeric value, image | Test, exam |
| | Decision weight | diagnostic, suggestive | |
| | Relationship | compatible, conflicting | |
| | Interpretation | normal | |
| Patient | Special feature | age, current treatment | Context Condition (enabling) Boundary factor |
| Process | Identify | find facts, values | |
| | Confirm | establish acceptable level of certainty | |
| | Verify | determine correctness | |
| | Compare | match to similar case or standard | |
| | Interpret | determine importance | |
| | Verify | determine correctness | |
| | Compare | match to similar case or standard | |
| | Explain | propose probable meaning | |
| | Infer | propose probable cause | |
| | Choose | select one option from two or more | |
| | Eliminate | exclude an option | |
| Predict | propose probable outcome | | |

Table 8-15 Treatment choice frame (from Florance, 1992: 148-149)

| Frame element (Slot) | Facet | Example of value | Functional role |
|-----------------------------|---|---|--|
| Condition | Name | neutropenia | Topic matching (Direct) Problem Name |
| Diagnosis | Certainty Status Feature | probably, future new, existing, future body changes, prognosis | Topic matching (Direct) Elaboration Feature Status Certainty |
| Treatment | Type Action Outcome Relationship Procedure Feature Application Usage Implementation Complication | surgery removal, suppression mortality / morbidity rate cause-and-effect, supplement steps of technique, dosage mechanisms, side effects condition it treats preferred, experimental, novel partial excision, implant other treatments, conditions | Method / Solution Intervention |
| Patient | Special feature Treatment history | age, existing condition or treatment unsuccessful | Context Condition (enabling) Boundary factor |
| Process | Identify Confirm Verify Compare Justify Compare Explain Choose Eliminate Weigh Weigh Compare Predict Predict | find facts, values establish acceptable level of certainty determine correctness match to similar case or standard provide rationale match to similar case or standard propose probable meaning select one option from two or more exclude an option assign value assign value match to similar case or standard propose probable outcome propose probable outcome | |

Table 8-16 Learning frame (from Florance, 1992: 149)

| Frame element (Slot) | Facet | Example of value | Functional role |
|-----------------------------|-----------------|---|---------------------------------------|
| Condition | Diagnostic clue | value of test evidence | Topic matching (Direct) |
| | Feature | cause, symptoms | Problem |
| | Evidence source | test, observation | Name |
| | Relationship | cause-and-effect, co-occurrence | Elaboration |
| | Prevention | technique | Feature Solution Method (means) |
| Substance | Source | thorn, environment | Topic matching (Direct) |
| | Effect | symptom, body change | Problem |
| | Toxicity | levels, standards | Active agent Feature |
| Treatment | Usage | novel, established | Method / Solution |
| | Procedure | steps, application | Intervention |
| Relationship | Nature | cause-and-effect, co-occurrence | Topic matching (Direct) |
| | Strength | statistical association | Problem |
| | Assurance | proven, accepted | Elaboration Attribute |
| Process | Identify | find facts, values | |
| | Confirm | establish acceptable level of certainty | |
| | Update | find most current information | |
| | Compare | match to similar case or standard | |

Chapter 9. The Perspective of Law and Evidence

This chapter consists of two main parts, Law of evidence, and, legal reasoning:

- Law of evidence explicates the abstract notion of *relevance* from juristic evidential perspective. Within this perspective, it further introduces two important concepts, *direct evidence* and *circumstantial (indirect) evidence*, which are closely related to the reasoning facet of the emerging relevance typology.
- Legal reasoning addresses the issues of argumentation and reasoning in the context of common law. Various types of reasons (rules) and different modes of reasoning applied in the legal process are discussed. Analogical reasoning, commonly considered as the distinct characteristic of legal reasoning, is emphasized.

9.1 Law of Evidence

“The law of evidence is the body of rules that determines what, and how, information may be provided to a legal tribunal that must resolve a factual dispute” (Posner, 1999: 1477). It governs the use of testimonies, physical exhibits, or other admissible material in a judicial proceeding.

9.1.1 Relevance

Evidence has long been regarded as being of central importance to law; in turn, relevance is the central benchmark of admissibility of evidence. In other words, evidence is only admissible if it is relevant or bearing on the issue.

The Federal Rule of Evidence 401 defines relevant evidence as follows:

“Relevant evidence” means evidence having any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence.”

In the context of law, relevance is defined as a tendency of making a proposition more or less likely. This definition addresses two major points:

First, relevance is proposition-specific; it exists only as a relation between an item of evidence and a fact in contention. Therefore, speaking of relevant evidence, we need to first decide “to what proposition it is supposed to be relevant.” It corresponds to *propositional relevance* (Walton, 1982) and is always linked to a specific proposition.

Second, the notion of relevance is defined as a cognitive effect: making a proposition more or less likely. Let us recall the relevance definition provided in *relevance theory* that is also effect-centered:

“Intuitively, an input (a sight, a sound, an utterance, a memory) is relevant to an individual when it connects with background information he has available to yield conclusions that matter to him” (Sperber & Wilson, 1995: §3.1-2; also see Section 4.1.1)

Compared to Sperber & Wilson’s definition, relevance (law) is more focused and specific. In this sense, relevance (law) is more in line with Wilson’s definition of *evidential relevance* (Wilson, 1973: 460; also see Section 6.2.1):

“An item of information I_j is relevant to a conclusion h in relation to premiss e if the degree of confirmation, or probability, of h on evidence e and I_j is greater or less than the degree of confirmation, or probability, on e alone.”

Essentially it says, by considering a particular piece of relevant information, the confirmation or probability of a conclusion is either increased or decreased.

Relevance is a necessary but not sufficient condition for evidence to be admissible for a case. Federal Rule of Evidence 403 states that,

“Although relevant, evidence may be excluded if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury, or by considerations of undue delay, waste of time, or needless presentation of cumulative evidence.”

In addition to relevance, the admissibility of evidence is also governed by “rules of evidence”, which are largely rules for excluding relevant evidence. Whereas relevance is defined based on its *effect*, the exclusion rules focus on its *cost*. If the cognitive cost is overloading, such as, causing “confusion”, “misleading the jury”, or other costs are too high, such as, “undue delay”, “waste of time”, relevant evidence will be rejected for the case (see detailed discussion in Posner, 1999).

9.1.2 Direct Evidence and Circumstantial Evidence

Depending on the type of inferences involved in backing the proposition, evidence falls into two broad classes (Wigmore, 1983):

Direct evidence, and

Circumstantial or indirect evidence

According to *State v Famber*, 358 Mo 288, 214 SW2d 40,

“*Direct evidence* is testimony or other proof which expressly or straightforwardly proves the existence of a fact. It is different from circumstantial evidence, which is evidence that, without going directly to prove the existence of a fact, gives rise to a logical inference that such fact does exist.

Direct evidence is evidence which, if believed, proves the existence of the fact in issue without inference or presumption. It is evidence which comes from one who speaks directly of his or her own knowledge on the main or ultimate fact to be

proved, or who saw or heard the factual matters which are the subject of the testimony. It is not necessary that this direct knowledge be gained through the senses of sight and hearing alone, but it may be obtained from any of the senses through which outside knowledge is acquired, including the senses of touch or pain.”

Note that this legal opinion confounds the logical relationship of what is being said to the facts of the case at hand with the source of evidence presented. Direct evidence may come from hearsay, even though hearsay may not be always admissible.

Circumstantial evidence, on the other hand, is evidence of an indirect nature, “from which the truth of the matter asserted is desired to be *inferred*.” (Wigmore, 1983: 955) Circumstantial evidence is usually a collection of collateral facts considered together to infer a conclusion on the matter. In criminal cases, it is often supplied as expert witnesses with forensic evidence, such as fingerprint, blood analysis, or DNA analysis. “Circumstantial evidence may also be testimonial, but even if the circumstances depicted are accepted as true, additional reasoning is required to reach the desired conclusion.” (Stong, 1999: 642) For example, if a witness testifies that hearing a gunshot near the crime scene and seeing the suspect run away with a gun, it constitutes circumstantial evidence; if a witness testifies that the suspect was seen shooting at the victim right on the spot, that is direct evidence. The *inferential* connection, near or remote, is the key of circumstantial (indirect) evidence.

In many court cases, direct evidence is preferred but often lacking; circumstantial (indirect) evidence plays a crucial role in establishing the critical truth. Although direct evidence is generally more powerful, it is not necessarily always more reliable.

Eyewitness testimony is infamously loaded with mistakes, easily biased by prejudice, and even intentionally fabricated. In contrast, circumstantial (indirect) evidence, if significant, is often established through objective methods and therefore more reliable in practice.

If taken in a medical diagnosis scenario, the so-called “direct evidence” of a disease hardly exists and is often problematic to define. Supposedly, if there is a straightforward, unambiguous, and one-to-one relationship between a certain set of symptoms and a disease, this set of symptoms can be thought of as the direct proof of the disease. However, such cases rarely exist. Due to the often large variety of clinical manifestations of diseases, physicians can rely only on circumstantial (indirect) evidence, i.e., signs, symptoms, tests, etc., to make inferences and to decide among diagnostic hypotheses. This reasoning process uses *abductive inference* or *reasoning from sign (evidence)* (refer to Section 5.3.4.2 for details).

9.1.3 Mapping to the Topical Relevance Typology

Evidence (RST) is a function-based category already identified from the topical relevance typology and naturally subsumes the present discussion of evidence (law). The category of evidence is now further specified as direct evidence and circumstantial (indirect) evidence:

- . Evidence (RST)
- . . Direct evidence (Law)
- . . Circumstantial (indirect) evidence (Law)

As mentioned above, evidence (law) corresponds to Walton’s *propositional relevance* (1983) and Wilson’s *evidential relevance* (1973). Evidence, as a relevance relationship type, is proposition-specific and always leading towards the conformation or disconfirmation of a specific conclusion, which makes this category quite special from the others.

In the context of information search, “direct evidence” or “direct testimony” largely overlaps with the category of *Topical matching relationships*, with details shown in Figure 9-1:

Figure 9-20 Detailed Typology of Topical Matching Relationships (Function-Based)

| |
|---|
| <p>Topical matching relationships (Green & Bean)</p> <ul style="list-style-type: none"> . Restatement (RST) . . Paraphrase (Revised Bloom), (Wittrock, 1989) . . Translation (Revised Bloom) . . Representation (Revised Bloom) . Reference (Green & Bean) . Elaboration (RST) . . Clarification (Revised Bloom), (Wittrock, 1989) . . Specialization or specification (Rumelhart & Ortony, 1977) . . . Exemplification (Revised Bloom) Illustration (Revised Bloom) <i>Example</i> (Wittrock, 1989) Instantiation (Revised Bloom) . Summary (RST), (Wittrock, 1989), (Revised Bloom) . . Abstraction (Revised Bloom) . Definition (Green & Bean), (Kavale, 1980) . Interpretation (RST), (Revised Bloom) |
|---|

By definition, circumstantial (indirect) evidence involves inferences and therefore it is better characterized by the reasoning-based facet of the typology (see Table 5-2). Among various modes of topical reasoning, circumstantial (indirect) evidence primarily applies *abductive* and *inductive* reasoning:

- Abductive reasoning, or reasoning from sign (evidence): It is a process of reasoning from the effect or consequence to the cause. Signs or evidence function

in such a way that they are *pointing to* a fact (cause) without *explicitly saying* it.

Reasoning from sign (evidence) thus comes with a degree of *implicitness*.

- Inductive reasoning, or generalization: It is a process of generalizing from individual cases or a sample to the entire population or inducing a general rule for all cases.

Both of them fall into the scope of backward inference, that is, reasoning in the opposite direction of deduction. Please refer to Section 5.3.4.2 for more detailed discussion of these two reasoning relationships.

9.2 Legal Reasoning

9.2.1 Legal Reasoning and Argumentation Structure

Legal reasoning “is the process of argumentation as a process of justification” (MacCormick, 1978: 19). Toulmin (1958) proposed a universal scheme that contains the essential elements of an argument: *data* (evidence, grounds), *claim* (conclusion), *warrant* (rules, principles), *backing*, *rebuttal*, and *qualifier*, as exemplified in Figure 5-1.

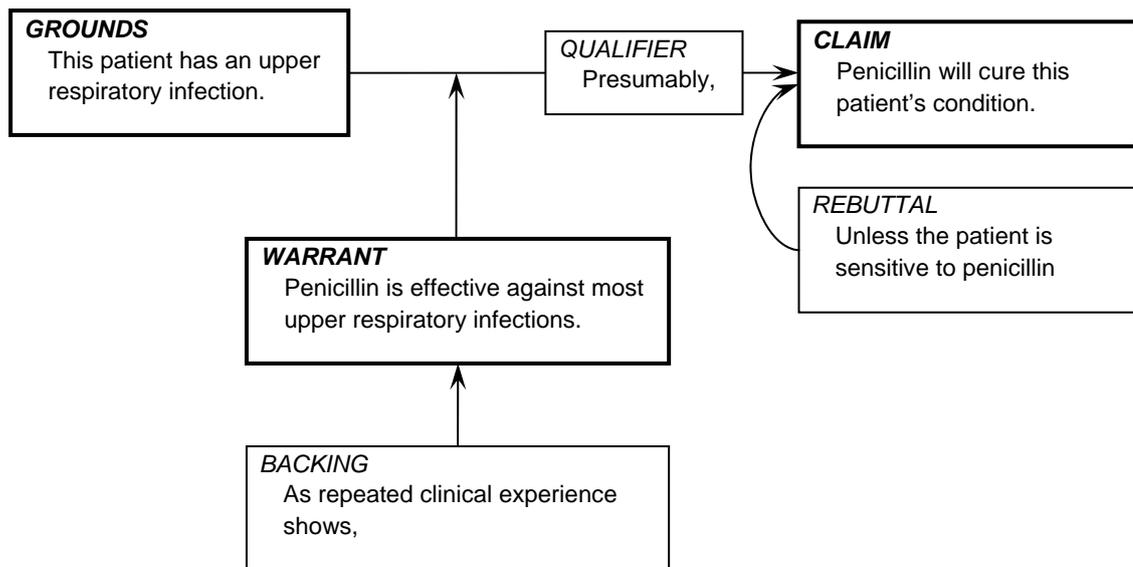


Figure 5-1 An Illustration of Toulmin's Model of Arguments (repeated from Section 5.3.1)

As bolded in the figure, *grounds*, *warrant*, and *claim* are central elements of the Toulmin's model: *Grounds* are data and evidence to support the *claim*, whereas the *warrant* justifies the movement from the *grounds* to the *claim*. (For a detailed discussion, refer to Section 5.3.1 Toulmin's Model of Argumentation)

Although Toulmin's model captures the regularities of argument structure across various domains and settings, it was first developed based on legal arguments. In legal reasoning, Hage (1997) also makes the distinction between the warrant and the grounds: the warrant is the *inference rule* and "in particular *not* a statement of facts" (Hage, 1997: 22). Further, *backing*, used to qualify a warrant, indicates the acceptability rather than the trueness of the warrant; it provides reasons and justifications to adopt a particular warrant, i.e., some rule of inference. *Rebuttals* to a claim refer to "exclusionary reasons" or "conflicting reasons" (Hage, 1997: 23), which specify special circumstances where the warrant would not hold.

Slightly apart from this conventional view, Freeman and Farley (1996) proposed a dialectic-based computational model for legal reasoning, in which grounds and warrant themselves are also seen as claims. They essentially removed any special

linkage between an information type and a particular element. A piece of information can play different roles in the model depending on the setting and the stage of reasoning. Nonetheless, warrants are somewhat different than other claims. It is represented as a relationship between the *antecedent* claim (grounds) and the *consequent* claim (conclusion). Two types of relationships are distinguished in their model: *explanatory* relationship and *sign* relationship. The former is often associated with a greater strength of reasoning than the latter. A typical explanatory relationship is cause/effect relationship where the antecedent “causes” and thus “explains” the subsequent. Other explanatory relationships include *definition*, *classification*, *diagnosis/symptom*, *enable/effect*, and *action/consequent* (Porter, Bareiss, & Holte, 1990). The sign relationship is associated with *reasoning from sign* (Toulmin, Rieke, & Janik, 1984) where the antecedent and the subsequent are associated and co-occurring but not necessarily one causing the other.

9.2.2 Types of Reasons and Rules

Hage (1997) differentiated four types of reasons applied to drawing / justifying legal conclusions: *classificatory reasons*, *deontic reasons*, *anankastic reasons*, and *epistemic reasons*, with details shown in Table 9-1.

Table 9-17 Types of Reasons in Legal Reasoning (Compiled from Hage, 1997: 59-77)

| Reason Type | Definition | Example |
|------------------------|--|---|
| Classificatory reasons | Classificatory reasons are reasons why a concept is applicable to a particular situation. Legal definitions and all other stipulative definitions provide a basis for classificatory reasons. (However, not all classificatory reasons need to be based on explicit definitions; prototypical effect applies to classificatory rules.) | The fact that John took Mary's purse is the reason why John is a thief. The fact that soldier X ran away as soon as the enemy appeared is a reason to consider/assume X is a coward. |
| Deontic reasons | Deontic reasons are reasons for the existence of duties and obligations, prohibitions, etc. The conclusions of deontic reasons are <i>facts</i> or particular deontic situations. <i>Deontic rules, goals, or norms</i> indicate under which circumstances something is prohibited, permitted, or obligated, or when somebody has a duty. | The fact that taking Mary's purse would be theft is the reason why John is legally prohibited to take the purse. The fact that Eric promised to visit Derek is the reason why Eric has a duty to visit Derek. |
| Anankastic reasons | Anankastic reasons are facts that make other facts necessary or (im)possible. Anankastic reasons also include reasons why something can happen, or why somebody has a particular <i>capability</i> or <i>power</i> . | The fact that I drop this stone is the anankastic reason why the stone <i>must</i> fall. The attribution of legislative power by the central government makes it possible that the municipal council makes by-laws. |
| Epistemic reasons | Epistemic reasons are first and foremost reasons to make inferences, or for holding beliefs. Epistemic reasons in the first instance do not deal with the world itself, but with our knowledge of the world. They are reasons why our knowledge should include this, but not include that. Viewed in this way, epistemic reasons are closely related to <i>rules of evidence</i> . | The fact that some masked person comes running out of a bank building, brandishing a gun, while the alarm system of the bank is working, is a reason (possibly even more than one) to <i>assume</i> that he is a bank robber. Of course these facts do not make him into a robber; they are only clues that allow the conclusion that he (tried to) rob the bank. The fact that Gloria's car is before her apartment is a reason to assume that Gloria is not to her work. |

In summary, different types of reasons provide bases for rules and principles in legal reasoning, respectively:

- Classificatory rules: definition of e.g. vehicle
- Deontic rules: prohibitive rules, such as norms, goals, and moral requirements

- Anankastic rules: power conferring rules
- Epistemic rules: rules of evidence, the examples shown in Table 9-1 are *circumstantial evidence* as discussed in Section 9.1

According to Hage (1997), a fundamental distinction is made between the first three types of reasons and the last one: classificatory, deontic, and anankastic reasons are *constitutive* in nature, namely, rules of determining how the conclusions are made, whereas epistemic reasons showing why the conclusions should be held true and believed.

The four types of reasons or rules are mapped under “rule-based reasoning”.

9.2.3 Modes of Legal Reasoning

Many works have studied the logic underlying legal reasoning and different reasoning models have been proposed. there is still no conclusive answer among the legal researchers. As suggested by different literatures, various modes of reasoning, including deductive reasoning (rule-based) (MacCormick, 1978), analogical reasoning, inductive reasoning (generalization), moral reasoning (Alexander & Sherwin, 2008), non-monotonic logic (from the Artificial intelligence perspective, Hage, 1996), etc., compete for the central status of the arena of legal reasoning. Discussions within this line of literature, although they do not directly contribute to refining the emerging typology, help to enrich our understanding of types of reasoning (analogical reasoning in particular) and their applications.

9.2.3.1 Legal Reasoning by Pure Deduction

In the early days, legal reasoning was considered pure deductive logic. The legal process simply involves stating and citing the appropriate rule(s) to the pending case. The rules and principles in common law were considered discoverable through

methods with scientific certitude (Stein, 2002). However, the rules and principles that govern human relations are unlike laws of natural science. These rules and principles are not descriptive in nature, and they are neither constantly held nor empirically verifiable. Instead, they are prescriptive and open to revisions or re-interpretations, being adaptive to a broad spectrum of social dynamics and evolving moral standards.

The pure deductive viewpoint has received numerous criticisms for its incapability of accommodating the large complexities involved in legal cases, as well as for leaving little room for adaptations and revisions. In particular, as argued by Hage (1997), strictly sticking to formal deductive logic (*modus ponens*), or the *legal syllogism*, needs to have all the premises and rules “pre-determined” before we can draw a valid conclusion. But in real-world legal context, rule conditions can not all be foreseen and determined before hand; there will always exist exceptions to rules, or exception to exceptions. The rules have to be constantly re-formulated by including additional conditions to cope with exceptional circumstances. “The rules change as the rules are applied” (Levi, 1948: 505). Every specific case, more or less, adds new subtleties and extra layers of meaning to the interpretation of a rule. Therefore, strictly speaking, new cases can not be decided by a “pre-determined” rule, because the exact content of a rule can only be known as hindsight (Hage, 1997).

9.2.3.2 *Legal Reasoning by Analogy*

The basic pattern of legal reasoning is rather *reasoning by example* (Levi, 1948: 501) or *reasoning by analogy* (Weinreb, 2005), which has become the prevailing view nowadays. Analogical reasoning is also believed to be the distinctive feature of legal argument (Weinreb, 2005). An important advantage of analogical reasoning is that it allows room for shaping the law with the evolving views and standards of the society.

It “brings into focus important similarity and difference in the interpretation of case law, statutes, and the constitution of a nation.” (Levi, 1948: 505)

As described by Levi (1948), legal reasoning is essentially a three-step process: the judge perceives the similarity between a past case (the precedent) and a pending case; next she announces the rule of law inherent in the past case; then based on the similarities and differences between the cases, she makes the rule of law applicable to the pending case. As such, legal decisions are made in a consistent fashion that conforms to prior adjudication. It is commonly known as the *doctrine* of precedent, or *stare decisis* (i.e., standing by things decided) (Lamond, 2006). Precisely speaking, only the first step of the three-step process is analogy and the latter two are basically stating the applicable rule and drawing conclusions through deduction (Weinreb, 2005).

Following is an exemplification for legal reasoning by analogy (revised from Alexander & Sherwin, 2008: 68):

| |
|--|
| <p>The judge is called on to decide a nuisance action against Karl, who is keeping an ocelot in his house. Surrounding homeowners point to a past case in which the court enjoined Edward to remove his pet bear from a residential neighborhood. An ocelot, they say, is like a bear, so the judge should likewise order Karl to remove it.</p> |
|--|

The tricky point is to determine the “important similarity and difference” between cases. Literally, an infinite number of points of comparison could be found between the ocelot and the bear, giving rise to countless similarities/differences (Alexander & Sherwin, 2008). To selectively attend to certain similarities, or to determine which ones are important enough to make a difference in the decision, is always somewhat arbitrary, more so in some cases than the others. This leaves holes for criticizing the logical validity of analogical reasoning (Levi, 1948, 1949).

According to Brewer (1996), the first step of an analogical argument is *abduction* (i.e., inference to the best explanation). Put in a legal context, it is to abductively reasoning about “how to legally classify some phenomenon—person, thing, event, or circumstance—with respect to the matter in question.” (Weinreb, 2005: 20) Through abduction, the judge or lawyer arrives at an “analogy-warranting rule”, which “contains in the generalized form of a rule the analogical connection between the source [past case] and the target [pending case] that inspired it.” (Weinreb, 2005: 24). For the above example, with the aid of generalization, an analogy-warranting rule “both ocelots and bears are dangerous wild animals” is acquired and subsequently justified (Alexander & Sherwin, 2008: 70). By doing so, the gap between the two cases is bridged and the doctrine of precedent is made applicable to the pending case. A decision can be deduced from the rule that “dangerous wild animals should not be kept in residential neighborhoods” (Alexander & Sherwin, 2008: 70).

The abductive process of establishing connections between cases lies at the heart of analogy. It is similar to the hypotheses-generating process in scientific discovery in which scientists select the most likely explanations to further explore. This is also a process not well articulated. Conventionally, abduction is considered a very weak form of inference, or not a proper logical inference at all. Therefore, Brewer (1996)

argues that the significance of analogy is neither logical nor justificatory, but rather epistemological and psychological; “it explains how the lawyer or judge happened to hit on that particular rule out of all the possible rules.” (Weinreb, 2005: 27)

Weinreb (2005) laid out the logical form of analogy (Figure 9-2):

(1) A (the source) has characteristics p , q , and r ;
(2) B (the target) has characteristics p , q , and r ;
(3) A has also characteristic s ;
(4) Therefore, B has characteristic s .

But propositions (1)—(3) do not sustain (4), without an additional premiss:

(3a) If anything that has characteristics p , q , and r has characteristic s , then everything that has characteristics p , q , and r has characteristic s .

With the addition of (3a), it is possible to construct a valid syllogism.

More simply stated:

(3b) Anything that has characteristics p , q , and r has characteristic s ;
(2) B has characteristics p , q , and r ;
(4) Therefore B has characteristic s .

Figure 9-21 The Logical Form of Analogy (Weinreb, 2005: 29)

As argued by Weinreb (2005), an analogy is an invalid inference if it embraces neither a proposition of the form (3a) nor a proposition of the form (3b).

Summary

To conclude, legal reasoning is an *iterative* process of abductive classification (analogy), deduction, and induction: through similarity-based comparison, the pending case is associated / classified with similar precedent, next the decision of the pending case is deduced from the rules of law inherent in the precedent, and at the mean while more inclusive rules are induced from the newly added case of the class (reinterpretation of the rule). Different types of reasoning play all have a place in the legal process but play different roles: analogy makes legal reasoning operational and efficient from case to case, deduction maintains the consistency and authority of the law, and induction keeps the law alive with social developments.

Chapter 10. The Visual Perspective

This chapter focuses on the visual perspective of topical relevance, which reveals a new angle of understanding this conceptual notion. The rich and complex relationships between “texts” and “images” are explored. The multimedia perspective of topicality (modeling topicality for paintings, photos, music, and art objects, etc.) becomes particularly meaningful as multimedia play an increasingly significant role in information access.

This chapter first proposes a three-dimension conceptual framework of modeling image topic:

- Dimension 1: Topic modeling by image content (Section 10.1)
- Dimension 2: Topic modeling by image meaning (interpretation) (Section 10.2)
- Dimension 3: Topic modeling by image user and use (Section 10.3)

Relationships are identified from these dimensions respectively. These relationships are mapped to the emerging relevance typology and further enrich it.

The discussion is primarily focused on art images (as opposed, for example, to technical drawings). Attributed to the inherent property of art, many of the issues discussed primarily in the realm of visual art analysis and art history may be generalized to other forms of art, such as fiction.

10.0 Image Topic Modeling: the Overall Framework

In the proposed overall conceptual framework, topicality of an image can be modeled on three dimensions:

- **Dimension 1:** topical indexing by the *visual content* of the image, in other words, by what is visually presented within the image. This dimension includes visual

elements (e.g., color, line, shape) and visual construct (i.e., relationships among visual components). Topical relationships on this dimension are explicit and straightforward. (Section 10.1)

- **Dimension 2:** topical indexing by the *meaning* and *interpretation* of the image. This dimension is often referred to as *image subject*, concerning Panofsky's (1939) three levels of meaning: *pre-iconographic*, *iconographic*, and *iconologic*. Compared to dimension 1, more implicit and sophisticated meaning is established for the image. Topical relationships on this dimension are established between the image and the creator's intention (topics); they are creator-oriented topical relationships. (Section 10.2)
- **Dimension 3:** topical indexing by the *use* and *function* of the image, in other words, by how the image is perceived and used by a particular viewer. This dimension focuses on the user's point of view and the contribution of an image to the user's topic or purpose. The interpretation and description of an image is no longer restricted to the meaning intended by the creator; new meaning is generalized for the image by present use. In contrast to dimension 2, topical relationships on this dimension are re-constructed between the image and the viewer's topic or purpose. Similarly, in the context of literacy, the interpretation from the receiver's point of view is thoroughly discussed in *reader-response theory* (Fish, 1980; Holland, 1975; Iser, 1978; Jauss, 1982). (Section 10.3)

Dimensions 1 through 3 range on a spectrum of increasing user / viewer engagement and subjectivity. Dimension 1 is very visual and basic; it has little to do with high-level meaning or topic, whereas Dimension 2 and dimension 3 follow different paradigms to establish meaning and topical relationships:

- Dimension 2 follows an *interpretive* paradigm of meaning, in which the viewer (user) plays a more passive role in interpreting and describing the image. The image is largely perceived and understood in the context in which it was created. Mostly, the purpose is to identify and approximate the meaning (topics) originally intended by the creator. Topical relationships are creator-oriented, established between the image and the creator's intention (topics).
- Dimension 3 follows a *constructive* paradigm of meaning, in which the viewer (user) plays a more active role in interpreting and describing the image. The image is perceived and given new meaning in the current context in which it is put to use. The intended meaning (topics) of the image is relaxed and deconstructed in a sense. The direction of topical relationships is turned around and becomes user- or use-centered, constructed between the image and the user's topic or purpose.

Rather than being mutually exclusive, the three dimensions overlap and merge into each other. Figure 10-1 provides a visual presentation of the proposed conceptual framework of image topic modeling and delineates the relationships between the three dimensions.

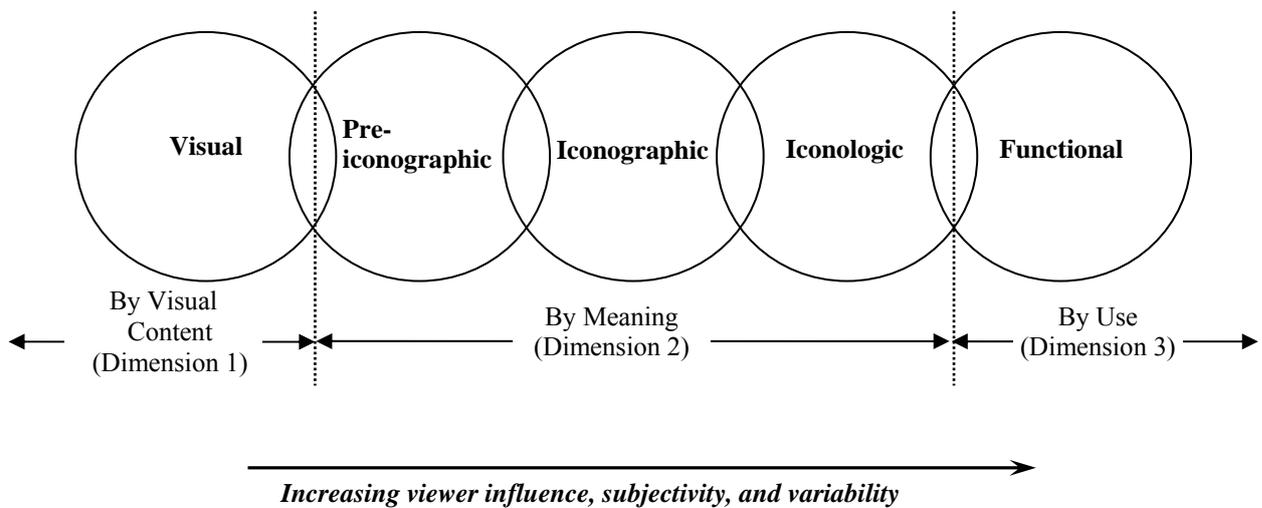


Figure 10-22 Overall Framework of Modeling Topicality of Images

10.1 Topic Modeling by Image Visual Content

Topic modeling on this dimension is based on visual elements and visual constructs. In particular, visual elements include “colors, shapes, forms, lines and styles” presented in an image (Bradley, 2007: 2); visual constructs refer to relationships held among visual elements in an image. “Techniques” used by the artist, such as pointillism, also fall under this dimension. Risatti (1987) proposed a four-level theory of image subject analysis: *descriptive analysis*, *formal analysis*, *internal analysis*, and *external analysis*. Analysis of visual elements and visual constructs roughly correspond to the first two levels, descriptive analysis and formal analysis, respectively.

The most basic subject analysis is carried out on this dimension, which is all explicit and straightforward. Since it has little to do with high-level meaning, unlike the other two dimensions, the analysis relies on minimal (if any) textual background information.

Nonetheless, this dimension contributes important topical substance for modeling an image; it is useful for describing and searching images. It is not unusual for the user to search images by querying particular shapes, colors, or patterns of composition presented. For example, “I am looking for artworks that contain many circles of varied sizes, with dark thin lines crossing in between.” Visual cues of the image can also be combined with high-level attributes (dimensions 2 & 3) in a search. In a study conducted by Westman and Oittinen (2006), 83% of user requests were formulated with visual constructs.

Automatic topic modeling by image visual content supports *content-based image retrieval*, which is by itself a lively, fast expanding discipline (see a comprehensive review by (Smeulders, Worring, Santini, Gupta, & Jain, 2000)). In typical content-based image retrieval, sample images expressing the desired visual elements / constructs serve as the seed in the search.

10.2 Topic Modeling by Image Meaning

10.2.1 Levels of Meaning

Dimension 2 delves in the semantic meaning and interpretation of an image. In 1939, art historian Erwin Panofsky published *Studies in Iconology*, a significant work in this area that has since profoundly influenced and shaped the thinking on this matter. In this work, Panofsky detailed three strata of subject matter or meaning of an image (artwork), with increasing sophistication:

- **Stratum 1:** Primary or natural subject matter (*Pre-iconography*): based on basic factual or expressional objects or events within an image that could be interpreted without any added cultural knowledge. For example, for a painting of *Adam and Eve*, the pre-iconographic interpretation is simply what is present within the

painting: a woman passing an apple to a man with a snake nearby.

- **Stratum 2:** Secondary or conventional subject matter (*Iconography*): cultural and iconographic knowledge is taken into account in the interpretation. *Internal analysis* (Risatti, 1987) of the inherent aspects of the work is required for this stratum.
- **Stratum 3:** Intrinsic meaning or content (*Iconology*): understanding the image within the personal, technical, ideological, psychological, political, and cultural history of the work. It draws on a broader context of knowledge, requires deeper synthesis of the knowledge, and arrives at a sophisticated interpretation. *External analysis*, (Risatti, 1987), that is, analysis of external information sources, such as (art) history texts, related religious or fictional works, critiques, personal documentation and diaries, are needed for this stratum.

With the increasing depth of meaning from stratum 1 to stratum 3, the subjectivity and variability of interpretation also increase. As incisively put by Keister (1994: 17) that, “It is not so much that a picture is worth a thousand words, ... The issue has more to do with the fact that those words vary from one person to another.” Viewers are most likely to agree on what they see on the basic, concrete, pre-iconographic level. Hardly any consistency could be found on indexing the iconologic level (Shatford, 1986); and, as later pointed out by Svenonius (1994), even the second level, iconography, is equally problematic. Therefore, Krause (1988) distinguished between “hard” indexing (what is seen in the image) and “soft” indexing (what the image is about), to highlight the substantial challenges of image indexing for higher-level meaning.

10.2.2 Facets of Meaning

As orthogonal to “levels”, the meaning of an image can also be analyzed by topical facets. Inspired by Ranganathan’s *colon classification*, which divides all knowledge into five fundamental facets: Personality, Matter, Energy, Space, and Time, Shatford (1986) suggested a scheme to analyze the image subject by: *Who? What? Where? When? Why and How?*, is well-known formula for journalism (Harcup, 2004). Shatford’s scheme adopts Panofsky’s three-level structure of image meaning and further explicates these levels in more specific terms (shown in Table 10-1).

Table 10-18 A Faceted Scheme of Image Subject Analysis (revised from Shatford, 1986: 49)

| Ranganathan | Facets | Generic (Pre-iconography) | Specific Of (Iconography) | About (Iconology) |
|-----------------------|---------------|---|--|--|
| Personality Matter | WHO? | Kind of person, animal, thing | Individually named person, animal, group, object, being, thing, (mythical or fictitious being) | Abstraction manifested or symbolized by objects or beings |
| Energy | WHAT? | Kind of event, action, condition | Individually named event, action, emotion | Emotion or abstraction manifested by actions or events |
| Space | WHERE? | Kind of place: geographic architectural | Individually named geographical location | Place symbolized (generic/specific), abstraction manifested by locale |
| Time | WHEN? | Cyclical time, season, time of day | Linear time: date or period | Emotion, abstraction symbolized by or manifested by time |

Taken together, these four facets provide a useful guidance for image subject analysis and indexing. The scheme can also be applied to analyze and characterize users’ image requests. User studies have shown that the majority of image queries address the specific (pre-iconographic) and the generic (iconographic) content of an image (Armitage & Enser, 1997; Choi & Rasmussen, 2003; Collins, 1998;

Cunningham & Masoodian, 2006; Goodrum, 2005; Jorgensen & Jorgensen, 2005; Westman & Oittinen, 2006).

Accordingly, faceted metadata and interface are designed for searching and browsing images. These designs characterize and organize images into facets such as media, location, date, places and spaces, people, themes, and nature (Yee, Swearingen, Li, & Hearst, 2003).

Among the three facets (function-based, reasoning-based, and content-based) of the relevance typology being developed, the topical facets of image subject analysis most closely relate to the content-based facet. These topical facets describe the inherent content of the information item (image in this case), rather than indicating how the information item relates to a particular user request, e.g., matching, contextualizing, or contrasting.

10.2.3 Modeling Image Topic through Textual Information

The third-level interpretation is most difficult and requires most external analysis of textual information. These texts provide information to contextualize our understanding and interpretation of the image. The iconological meaning of an artwork is established through a variety of contextual information, as put by Hermeren (1969: 14-20):

1. “Traditions of representation which are known to the artist and to the actual or intended beholders;
2. The pictorial context and location including both a specific visual design in context of the rest of the picture and the entire artwork in relation to other art or the building itself;
3. The social and political background including a historical knowledge of events contemporary to the painting;

4. The situation of the artist such as training, interests, emotional conflicts, attitudes, beliefs, economical and psychological relations to the patron and to the beholders;
5. The intentions of the particular artist as well as the intentions of most artists in a particular period; and
6. The responses of the beholders including the response of particular persons in particular situations and the response of normal people in normal situations.”

In short, various types knowledge fall into the scope of *context relevance*, including knowledge about the social, cultural, political, ideological, economical, and personal, psychological backgrounds regarding the artwork and its creator. They represent different types of context.

Studies have shown that associated text (captions, art history texts, etc.) helps significantly to describe, interpret and retrieve images (Bradley, 2007). Through modeling relationships between the image and the associated text, NLP (natural language processing) researchers explore computational methods to enhance image indexing through text mining. Under this context, the associated text is taken as a source of useful terms for indexing images (Martinec & Salway, 2005; A. Salway & Ahmad, 1998; A. Salway & Graham, 2003; Andrew Salway & Martinec, 2005). Specifically, Martinec and Salway (2005: 367) identified three types of textual information along with the roles they play in describing an image:

- (1) “information about what can be *seen* in this image;
- (2) information about what this image could *mean*; and
- (3) information about the *history* of this image.”

In terms of functional role for describing / interpreting images, the three types of textual information correspond to *elaboration*, *extension*, and *enhancement*,

respectively. These functional roles can be fitted under “Topic matching relationships (Direct relevance)”. However, the text types are still too generic for the purpose of indexing images in a meaningful manner.

Researchers associated with the CLiMB project further specified and refined seven semantic categories of art history passages, with each defining a different functional relation to depict the art image (Passonneau, Yano, Lippincott, & Klavans, 2008). (As described earlier in Chapter 3, the CLiMB project aims to improve metadata mining and subject access to visual collections, through the use of computational linguistic techniques.) The seven semantic categories are *image content*, *interpretation*, *implementation*, *comparison*, *biographic*, *historical context*, and *significance*, as detailed in Table 10-2. These function-based semantic categories are devised with the intention to maximize the coverage of a large variety of art history text passages on the one end, and to minimize the cognitive load of annotators on the other (that is, more easily agreed upon, less training required, fewer categories, fewer ambiguities between categories, and higher categorization consistency across different annotators).

**Figure 10-23 Semantic Categories for Labeling Art History Passages
(from Passonneau, Yano, Lippincott, & Klavans, 2008)**

| Semantic Category | Description | Functional Role From the Relevance Typology |
|---------------------------|---|--|
| Image Content | Text that mentions the depicted object, discusses the subject matter, and describes what the artwork looks like, or contains. | Topic matching relationships (Direct) Reference Elaboration, ... |
| Interpretation | Text in which the author provides his or her interpretation of the work. | Topic matching relationships (Direct) Interpretation |
| Implementation | Text that explains artistic methods used to create the work, including the style, any technical problems, new techniques or approaches, etc. | Method Approach / Method [Technique] [Style] |
| Comparison | Text that discusses the art object in reference to one or more other works to compare or contrast the imagery, technique, subject matter, materials, etc. | Comparison / Contrast |
| Biographic | Text that provides information about the artist, the patron, or other people involved in creating the work, or who have a direct and meaningful link to the work after it was created. | Context [Biographic information] |
| Historical Context | Text describing the social or historical context in which the depicted work was created, including who commissioned it, or the impact of the image on the social or historical context of the time. | Context [Historical context] |
| Significance | Text pointing to the specific art historical significance of the image. | Evaluation [Significance] |

Under this context, the image stays at the center of image-text relationships, in other words, texts are *subordinate* to image (which could be turned around as discussed in the following section). Using the RST's terminology, the image is the *nuclear* (N) and the associated text is the *satellite* (S). It is the text (satellite) that helps the viewer / user to better understand the image (the nuclear). The roles of associated texts (art history passages in this case) are functional roles. The right column of Table 10-2 shows the close matching between the semantic categories to

the functional roles already identified from RST and other sources. In addition, relationships in bracket are new sub-categories added to the typology, which were not identified previously. It remains to be seen from the later empirical data analysis whether some of the bracketed categories (such as, *style*, *biographic information*) are too particular to visual information and not meaningful for other information (e.g., textual).

10.3 Topic Modeling by Image User and Use

10.3.1 The Viewer's Perspective of Image Meaning

Dimension 3 (topic modeling by image user and use) is closely related to Dimension 2 (topic modeling by image meaning) and in many cases overlaps with it. What distinguishes Dimension 3 from Dimension 2 is that the interpretation and description of an image no longer center on the *original* context of its creation. The emphasis is on the viewer's perspective, i.e., her impression, understanding, and her own use and purpose for the image. The meaning intended by the creator is more or less diluted or deconstructed; new meaning is re-constructed by the *present* context in which the image is put to use. Topical relationships are looked at between the image and the viewer's topic rather than the creator's topic. Viewers are highly engaged in interpreting and constructing the meaning of an image. Taking the following Flickr picture as an example, regardless of the meaning originally intended by the artist, the viewer develops a new perspective by viewing the picture and tags (indexes) it with "A family portrait".



Topic indexing by image use is highly dynamic and constantly changes with the viewer's perspective. On this dimension, there is no such a thing as the single *legitimate* interpretation of an image. The meaning (interpretation) of an image is decided by and varies with the context of use. We can easily imagine another viewer comes along and tags the above picture completely differently, e.g., "Simple grace" or "The delicate". Given that the same image can be perceived very differently and used for many different purposes, the "one thousand words" of an image may very well differ from one person to another. This is what makes visual information so different from textual information where semantic meaning is much more confined. The increasing popularity of image social tagging projects, such as Flickr, Steve.Museum, provides a large amount of valuable data to better explore the viewer's perspective of image topic.

10.3.2 Types of Image-Text Relationships

As inspired by the logico-semantic and status analysis of image-text relationships by Martinec & Salway (2005), four types of image-text relationships are specified as follows:

Equal-status relationship:

- Type-1: Image & text independent

Little or no semantic connection or interaction exists between the image and the text; for example, an image is used in a long-prose passage for the purpose of decoration or changing pace (Levin, 1981)

- Type-2: *Image & text complementary*

The image and the text are interdependent semantically; the image adds new information to the text and vice versa. Also, the image and the text are equally important and neither takes an overt, central role. This is often seen in new-media products for children, advertisements, and other entertainment-related contexts (Martinec & Salway, 2005).

Unequal-status relationship:

- Type-3: *Image subordinate to text*

The text is at the center of the relationship, or is the nuclear. An example would be an image is used to illustrate the text.

- Type-4: *Text subordinate to image*

The image is at the center of the relationship, or is the nuclear. As discussed in the last section, art history passages are used to explicate and understand an artwork.

In Section 10.2, we have focused on image-centered relationships (Type-4). In the following, we will explore the others; the focus here is on how the image is used and what roles the image plays towards a better understanding of the text. The direction of image-text relationships is turned around but the functional roles or the ways of how the two connect with each other may stay the same or considerably overlap in both directions.

10.3.3 Functional Relationships of Images to Texts

The functions of images for an improved understanding of texts and messages is widely studied in different contexts, such as, children literature, instructional texts, advertisements, journalism, and dictionary development (Marsh & White, 2003). It is

also considered as a special kind of rhetoric, *visual rhetoric*, which focuses on visual arguments and studies the evidentiary force of images.

Marsh (2002) conducted a thorough review on functional relationships between images and texts and applied them to analyze 954 image-text pairs on the Web. As specified by Marsh, “The function of an illustration is defined as an image’s functional relationship to a relevant text string. It is a conceptual variable that refers directly to the way that ideas expressed within text are conveyed through a relevant illustration and is not related to physical characteristics, style, or file format.” (Marsh & White, 2003: 648). In other words, the functional relationship of an image to a text studies the question of how an image is related (relevant) to a text on a level of semantic meaning, rather than on a level of visual elements or visual content. Based on the review, *function-based* relevance relationships between images and texts are summarized in the following. Close mappings (indicated by *) can be observed between the image functional relationships and the emerging relevance typology. These relationships are incorporated into the relevance typology being developed. When the names of the same function do not exactly match with each other, the typology category is bracketed. Relationships without an existing match with the typology are indicated by underscore; these are added to the typology accordingly.

Topic matching relationship / Direct relevance

- Reiteration* [Restatement] (Brody, 1984; Levin, 1981; Nikolajeva & Scott, 2000; Schriver, 1997): images reinforce the text by essentially repeating its content in visual form; the image repeats substantial identical content presented in the text
 - Representation* (Berinstein, 1997): graphical representation of the textual information (concepts and numbers)
 - Translation* (Ilson, 1987; Marsh & White, 2003): converts form one form to

another

- Common referent* [Reference] (Brody, 1984; Marsh & White, 2003): the text and image share the same symbolic source of meaning
 - Humanization (Marsh & White, 2003; Stam, 1989): the image represents elements within the text in the form of a living being; thereby making the text more accessible
 - **Elaboration*** (Schwarcz, 1982; Schriver, 1997): the image reinforces, elaborates or instantiates the text, by adding supplementary information
- Amplification*** [Elaboration] (Nikolajeva & Scott, 2000; Schwarcz, 1982; Stam, 1989): the image goes into greater depth about something in the text than is explicitly stated
- Clarification* (Hancher, 1992): the standard purpose of illustration in dictionaries
 - Specification* (Schwarcz, 1982): the illustration brings out information about the story embedded in the text
 - *Exemplification** (Brody, 1984; Stam, 1989; Marsh & White, 2003): the image presents a paragon that captures the essential meaning of a concept
 - Extension (Schwarcz, 1982; Brody, 1984; Schwarcz, 1982): the image goes beyond what is presented in the text to advance a point, adding new information
- **Summarization*** (Brody, 1984)
- Reduction / condense*** [Summarization] (Schwarcz, 1982; Marsh & White,

2003): reduce to essential elements or ignore some aspects of the text in order to emphasize others

- **Definition*** (Ilson, 1987; Marsh & White, 2003): determine or identify the essential qualities or meaning
- **Interpretation*** (David, 1998; Hilderley & Rafferty, 1997; Levin, 1981): the image organizes the text difficult to understand and provides illustrations of complex ideas in concrete form
 - Organization (Brody, 1984; David, 1998; Levin, 1981; Marsh & White, 2003): images provide visual organization for the text, e.g., to illustrate procedures; the image forms into a coherent unity or functioning whole, including *advance organizers*
 - Concretization (Brody, 1984; Berinstein, 1997; Stam, 1989; Marsh & White, 2003): concretize abstract information, making the unseen visible, making explicit, used for captions especially
 - Transformation (Levin, 1981; David, 1998; Berinstein, 1997; Stovall, 1997): the image makes the text more coherent or comprehensible through recoding the text into concrete form, relating components to each other, and providing organization to facilitate recall
 - Modeling cognitive process (Brody, 1984; Marsh & White, 2003): provide visual representation of abstract process, using a description or analogy to help visualize something that cannot be directly observed
 - Modeling physical process (Marsh & White, 2003): provide visual representation of material or mechanical process, using a description or analogy to help visualize something that cannot be directly observed

- **Emphasis** (Brody, 1984; Stovall, 1997; Marsh & White, 2003): give a sense of the importance, bring the most critical information to the reader's attention, provide force or intensity of expression that gives impressiveness or importance to something
- **Draw attention** (Brody, 1984; Stovall, 1997): the image calls attention to a story

Context relevance

- **Stage-setting*** [**Preparation**] (Schriver, 1997): the image forecasts the content or theme of the text
- [**By time sequence**]* (Stovall, 1997): the image gives the time-based sequence of the event presented in text [journalism]
- **Scope** (Hancher, 1992): defined as the degree to which an image illustration shows a concept in a particular context, such as the way an object is used for a given function [dictionary design]
- **Instruction** (Berinstein, 1997)

Motivation (Brody, 1984; Marsh & White, 2003): the image engages the reader

Comparison relevance

- **Comparison*** (Brody, 1984; Ilson, 1987; Marsh & White, 2003): the image sets off similar or dissimilar information; making explicit intended elements of comparison between objects depicted in text; emphasize points of similarity between image and text

- Analogy* (Brody, 1984)
- Metaphor* (Ilson, 1987; Shklovsky, 2004): rhetorical strategies used to break through the sales resistance by providing novel and arresting ideas and images [advertising]
- **Contrast*** (Ilson, 1987; Marsh & White, 2003): the image makes explicit intended elements of contrast between objects depicted in text; emphasize points of difference between image and text
 - Contradictory (Nikolajeva & Scott, 2000): the text and image are in opposition for a rhetorical purpose
 - Juxtapositional (Schriver, 1997): the overall message is conveyed through a clash or tension between the image and text [advertising]

[Ungrouped functional relationships]

- **Elicit emotion** (Berinstein, 1997; Marsh & White, 2003): the image encourages emotional response from reader through display of content or style that is especially arresting or disturbing
- **Inspiration** (Schwarcz, 1982): the image illustration uses the text as a starting point, then veers away to introduce new content; the new content adheres to the spirit of the original story

The “ungrouped functional relationships” may be specific to images, which needs to be further explored in the empirical data analysis.

Chapter 11. A Unified and Theory-Grounded Typology of Topical Relevance Relationships

This Chapter gives a brief overview of and rationale for the unified typology derived by synthesizing the contributions from many disciplines. The full typology of theory-grounded topical relevance relationships annotated with the definitions extracted from the literature analyzed is found in Appendix H. The typology revised after the empirical analyses is found in Chapter 14.

11.1 The Three Facets of the Topical Relevance Typology

The topical relevance relationships identified from the literature can be characterized by three facets: By *functional or argumentational role*, by *mode of reasoning*, and by *semantic relationship or linguistic structure*:

- **The function-based facet** classifies topical relevance relationships by the functional role a piece of information play in illuminating the topic. Broadly speaking, a piece of information can be relevant to a topic by directly *matching the topic*, or providing *evidence, context, comparison, cause / effect, goal, method (solution)*, and *evaluation*. Each of these functional categories is further specified in the hierarchy.

The development of this facet is heavily influenced by rhetorical structure theory (RST). RST explains text coherence through *relations between text parts* and describes the relations *in functional terms*, in which “every part of a text has a role, a function to play, with respect to other parts in the text”. Education theories and visual rhetoric also contribute substantially to the function facet.

- **The argumentation-based facet**, an adjunct to the function-based facet lays out

the generic structure of an argument as specified by Toulmin (1958/1979): the *Grounds (Evidence / data)*, the *Warrant (Justification)* and its *Backing*, and the *Claim (Conclusion)* and its *Rebuttal*. Within this facet, different types of relevant information are differentiated by the roles (i.e., grounds, warrant, backing, claim, and rebuttal) they play in the argument. The argumentation facet guides and structures the search of relevant information for building arguments.

Argumentation role can be thought of as a special kind of functional roles. The major distinction is that, argumentation roles are tied to specific propositions and always involve making *explicit* arguments (claims), whereas functional roles are more general and do not involve an explicit argument in most cases. Therefore, the argumentation facet is also related to *propositional relevance* (Walton, 1982) in particular.

- **The reasoning-based facet:** It takes the logical approach in defining topical relevance or aboutness. The central concern of this approach is how the receiver (e.g., a reader, searcher, or user) constructs meaning and establishes relevance for a topic through inferences. Within this facet, topical relevance relationships are defined by different modes of reasoning, including *rule-based reasoning*, *induction*, *abduction*, *case-based reasoning*, etc.
- **The semantic-based or content-based facet:** This facet adopts Green & Bean's (1995) linguistic (semantic) approach in explicating topical relevance relationships. Instead of concerning the function or the role that a piece of information can play in fulfilling a purpose, it focuses solely on the *internal* semantic relations and structures. The facet includes both the more straightforward semantic relations (paradigmatic), such as *whole/part (partonomy)* and *class/subclass (taxonomy)*, and the frame-based structures (syntagmatic)

developed for a set of specific topics by Green & Bean (1995), such as the *Debt* frame subsuming the slots of *Debt*, *Debtor*, and *Payment*.

11.2 Types of Presentation as a Separate Facet

An important outcome of the literature analysis is to separate the orthogonal facet of “Presentation types” from the main topical relevance typology. Specifically, the presentation types are listed in Table 11-1. The presentation type indicates in what way a piece of information is presented, such as presented as a *Definition*, a *Summary*, or an *Example*; it does not address in what way the information is related to the topic. Therefore, they are not in themselves topical relevance relationship types, but they can be combined with different relevance types. For example, we can have a definition presenting topic-matching information, or delivering context, or suggesting comparative cases.

Table 11-19 Types of Presentation

- **Reference**
 - **Pointer**
 - **Definition**
 - **Restatement**
 - Paraphrase
 - Clarification
 - Translation
 - Representation
 - **Summarization**
 - Abstraction
 - **Elaboration**
 - Amplification
 - Extension
 - Specification or specialization
 - Example (Exemplification)
 - Illustration
 - Instance (Instantiation)
 - Elaboration through Class :: Subclass
 - Elaboration through Whole :: Part
 - Elaboration through Process :: Step
 - Elaboration through Object :: Attribute
 - Adjectival attribute
 - Frequency
 - Prevalence
 - Adverbial attribute
- **Interpretation**
 - Organization
 - Concretization
 - Humanization
 - Transformation
 - Model of cognitive process
 - Model of physical process
- **Emphasis / Drawing attention**

11.3 Interactions between the Facets

The three facets are orthogonal to each other but they may cross the same point from different angles. Taking **cause and effect** [functional role] vs. **causal-based reasoning** [mode of reasoning] as an example: **Cause and effect** is a relationship type identified within the function-based facet, whereas **causal-based reasoning** is identified within the facet of mode of reasoning. Cause and effect is a functional relationship independent of the participation of causal reasoning; a piece of information can function by simply pointing out the cause and/or effect of the topic, without necessarily involving causal inference at all.

Topic: Electricity outage in the city of Baton Rouge

Information item A: describes how the hurricane Hannah swept through the area and seriously damaged the electricity grids.

Information item A directly points out the cause (Hannah) for the topic (Electricity outage in the city of Baton Rouge), without reasoning involved.

- **Functional role:** Non-volitional cause

Mode of reasoning: Without reasoning

Only when either the cause or effect is unknown or unclear do we need to use causal reasoning to infer one from the other and thus establish the relevance connection.

Topic: Electricity outage in the city of Baton Rouge

Information item B: reports that the hurricane Hannah hit the area around the time when the electricity went down.

Information item B becomes relevant to the topic through reasoning from effect to cause, knowing that a hurricane has the capacity to severely damage electricity infrastructures.

- **Functional role:** Circumstantial (indirect) evidence

Mode of reasoning: Reasoning from effect to cause

Another example is **comparison by similarity (analogy)** [functional role] and **comparison-based analogical reasoning** [mode of reasoning]. This pair also looks alike but the elements do not necessarily intersect with each other. **Comparison by similarity (analogy)** simply points out the similarities, whereas **Reasoning from analogy**, or Case-based reasoning, goes one step further, in which the perceived similarity is used to make further inferences, i.e., given the considerable similarity between A and B and given that A has property x, we could infer that B also has the property x. The similarity pointed out through comparison surely has the potential to be used for analogical reasoning but whether or not it will be used for further inferences also depends on the specific case.

After clarifying that the facets are orthogonal in nature, we want to still emphasize the connections among facets and some close associations among categories across different facets. For example, **Circumstantial (indirect) evidence** [functional role] is a category that heavily involves inference and is usually further specified through types of reasoning from the reasoning-based facet. In the subsequent coding process, we expect to see different facets combined for specifications. Some categories are already "pre-combined" in the typology, for example, **Elaboration** [presentation type] and **Paradigmatic relationships** [semantic relationship] are pre-combined for sub-categories (Table 11-2):

Table 11-20 An Example of Combining Two Facets For Sub-Categories

| Functional role | Semantic relationship | Sub-category definition |
|------------------------|-------------------------------------|--|
| Elaboration | Set/member (taxonomy) | Elaboration of set (topic) by member (detailed information) |
| | Type/token | Elaboration of type (topic) by token (specific instances) |
| | Class/subclass (taxonomy) | Elaboration of class (topic) by subclasses (detailed information) |
| | Whole/part (partonomy) | Elaboration of the whole (topic) with the parts (detailed information) |
| | Process/step (partonomy) | Elaboration of the whole process (topic) with the steps (detailed information) |

11.4 The N-S Distinction for Characterizing Topical Relationships

“RST establishes two different types of units. Nuclei (N) are considered as the most important parts of a text, whereas satellites (S) contribute to the nuclei and are secondary. For instance, in an Elaboration relation, the nucleus is considered to be the basic information, and the satellite contains additional information about the nucleus. The nucleus is more essential to the writer's purpose than the satellite.” (Mann & Thompson, 1988) The distinction between the nucleus (N) and the satellite (S) lies at the heart of characterizing topical relevance relationships in this study, with the nucleus (N) corresponding to the search topic and the satellites (S) corresponding to items or pieces of information relevant to the topic. In other words, in a search, the user topic is *at the center* of attention and the relevant information functions to improve the user’s understanding on the topic.

Adopting this N-S distinction, the set of relationships used to organize inside a text or a discourse (i.e., discourse relationships, rhetorical structures, and semantic relationships) can easily be applied to organize search results. A coherent discourse is organized around a topic, different text parts play different roles but work together to improve the reader’s understanding of the topic. In information search, the process is quite similar: we first identify a list of search items that are related to a topic in many

different ways, e.g., some of them may contain direct answers to the user's request, some may provide circumstantial evidence for the user's argument, and some may supply background information or contrasting cases, accordingly we organize these different pieces of information in such a way that the searcher can easily make sense of. In terms of contributing to the receiver's (a reader, a searcher, etc.) understanding of a topic, the functional roles played by different parts of text and those by different pieces of relevant information are much the same.

The N-S distinction is borrowed and extended to characterize the notion of topicality discussed in the other disciplines. For example, in Chapter 10, the rich and complex **image-text relationships** are explored from two distinctive perspectives:

- **Image-centered perspective:** the image is at the center (N) and the associated text (S) is used to describe or interpret the image, e.g., art history texts. It is the perspective of image subject analysis. The derived topical relationships capture the functions of the text rather than the image, as indicated by [image meaning] in the typology;
- **Text-centered perspective:** the text is at the center (N) and the associated image (S) is used to illustrate or illuminate what is discussed in the text, e.g., images in a dictionary. It is the perspective of visual rhetoric. The derived topical relationships characterize the functions of the image rather than the text, as indicated by [image function] in the typology.

Part 3

Empirical Manifestation of Topical Relevance Relationships

Chapter 12. Empirical Data Analyses (1): Topic-Centric Manifestations

Chapter 13. Empirical Data Analyses (2): Type-Centric Manifestations: Function-
Based

Chapter 14. Empirical Data Analyses (3): Type-Centric Manifestations: Reasoning-
Based

Chapter 12. Empirical Data Analyses (1):

Topic-Centric Manifestations

The dissertation inquiry consists of two major components:

1. Phase 1: *Literature-based analysis* in multiple disciplines, resulting in a unified theory-grounded typology of topical relevance relationships across domains (see Chapter 11);
2. Phase 2: *Manifestation study*, which analyzes empirical data to understand how the topical relevance relationships identified in Phase 1 manifest themselves in various contexts and in different subject domains; also to further enrich and refine the typology.

The results of the manifestation study are summarized and discussed in Chapters 12 – 14. Following a brief description of the empirical analysis procedure, this chapter discusses how the topical relevance relationships identified manifest themselves in the three domains analyzed. By discussing the examples collected from the analyses, we not only develop a better understanding of the topical relevance relationships, but also observe how the typology evolved during the analysis.

The analytic results are presented and discussed first *by topic* (Chapter 12) and then *by relevance relationship type* (Chapters 13 & 14):

- **By topic**, i.e., *topic-centric* presentation and discussion. For each of several sample topics, various types of topical relevance relationships are illustrated with coding examples. This presentation helps us better understand what constitutes *direct (matching)*, *inferential (evidential)*, *contextual*, *conditional*, *causal*, *comparative*, *motivational*, and *methodological* information about a particular

topic. Piecing all kinds of relevant information together around a topic also helps to illustrate how different relevance types contribute to the user's understanding of the topic.

- **By relevance type**, i.e., *type-centric* presentation and discussion. Examples collected from multiple topics and from different datasets are used to illustrate and explicate the same relevance relationship type. The advantage of this presentation is that it provides a synthetic view on each relevance relationship type across topic, domain, and setting. It allows us not only to make parallel comparisons across datasets but more importantly, to develop a fuller view of each relevance relationship type.
 - Function-based topical relevance types (Chapter 13)
 - Reasoning-based topical relevance types (Chapter 14)

12.0 A Summary of the Empirical Data Analyses

Using *purposeful sampling*, three kinds of empirical relevance data were gathered to achieve considerable variations in “form”, “domain”, and “context”

(as illustrated in Table 3-2):

- Topical relevance assessment data from the MALACH project;
- Clinical questions and answers;
- Art images and subject descriptors describing the images.

The details of the data and the data collection were discussed in *Methodology* (Chapter 3, Section 3.2.3).

Qualitative content analysis (see discussion in Section 3.2.2) applied to the three datasets (using *saturation* as the stop point for coding) leads to rich insights into the nature of the relevance relationships and the structure of topics. The following is a summary of the analyses:

- From the MALACH topical relevance assessment data (see Section 3.2.3.2), 41 topic notes provided by eight relevance assessors (graduate students from history and information science) on a total of 40 topics were analyzed in depth. Nvivo 2.0 is the analytic tool used for recording the qualitative codes. The analysis of this Holocaust oral history dataset provides rich cases/examples on the *direct (matching topic)*, *indirect (circumstantial)*, *context*, and *comparison* relevance categories. Moreover, a variety of interesting inference types (the second facet of the relevance typology) emerges from the analysis.
- 26 clinical questions and associated answers collected from the two online QA resources (see Section 3.2.3.2) were analyzed: Therapy (8), Diagnosis (6), Prognosis (6), and Etiology (6), representing the four dominant question types in

clinical medicine. An important insight from this dataset is the *multi-level topical structure* which arises from analyzing the highly elaborative evidence-based clinical answers. Accordingly, coding of topical relevance relationships proceeded on multiple levels. Tracking and presenting this multi-level coding was facilitated by Mindjet MindManager v.8, a professional concept-mapping tool (see details at www.mindjet.com). For clinical questions and answers, the relevance categories of *matching topic/symptom*, *method/solution*, *cause/etiology*, *comparison/evaluation*, and *effect/outcome* are of particular importance.

- Given the relatively small number of art images being indexed, the full set of 11 art images indexed by 13 indexers (art librarians and art historians) was included in the analysis. Among the 11 art images, the number of unique tags (subject descriptors) assigned for each image ranges from 28 to 112. In total 768 *unique* tags (there are considerable overlaps among tags assigned by different indexers) were coded with the established relevance typology. The results establish a faceted display of the tag cloud surrounding an image. The qualitative coding was recorded in Microsoft Excel spreadsheet, as shown in Appendix F. As expected, the relevance categories of *matching topic/image content*, *method/style or genre*, *context/biographic info*, and *effect/reaction or feeling* are of particular interest to tagging (indexing) images.

In the following, for each of the three analyzed datasets, coding examples are organized by topic, i.e., different types of topical relevance relationships are presented for the same topic. This presentation highlights the large variety of relevant information to a topic and illustrates the specific role played by each relevance relationship in the overall topic structure.

Sections 12.1, 12.2, and 12.3 are dedicated to presenting coding examples of MALACH topical relevance assessments, of online clinical answer analysis, and of CLiMB image tagging analysis, respectively.

12.1 MALACH Topical Relevance Assessments

This section, in Tables 12-1 and 12-2, presents sample search results for two Holocaust oral history topics from the MALACH project. These tables provide vivid examples for many relevance relationship types and also illustrate how the relationship types can be used to structure search output in a meaningful way.

The findings from the MALACH data focus on the four relevance categories: *Direct (Matching Topic)*, *Indirect (Circumstantial)*, *Context*, and *Comparison*. This bears on both the inherent feature of the dataset and the MALACH relevance data collection plan. For details of the data collection, refer to the discussion in Section 3.2.3.1 and the assessment interface in Figure 3-3.

From the 41 coded topic notes, two notes by different assessors are presented and discussed in detail in the following:

- MALACH Topic-1: Nazi Theft in Eastern Europe (Table 12-1)
 - Topic description: Testimonies regarding the Nazi theft and expropriation of family property and assets in the countries of Eastern Europe;
 - 12 segment examples of various relevance types are listed for the topic.
- MALACH Topic-2: Wallenberg Rescues Jews (Table 12-2)
 - Topic description: Discussion of how Raoul Wallenberg protected and rescued Jews during the Holocaust;
 - 13 segment examples of various relevance types are listed for the topic.

The two facets of the typology, “Topical relevance type” and “Mode of reasoning”, are specified in the tables. Various modes of reasoning are involved for the relevance category of *circumstantial evidence*, as illustrated by the cases of *generic inference* and *backward inference* of Topic-1 (Table 12-1). Notes and reflections on the coding of an individual segment are inserted after the segment example, as indicated by “Note”. [] indicates a top-level categories in the typology of topical relevance relationships.

Table 12-21 MALACH Topic-1: Nazi Theft in Eastern Europe
 Testimonies regarding the Nazi theft and expropriation of family property and assets
 in the countries of Eastern Europe

| Topical relevance type Mode of reasoning <i>Type of presentation</i> | Example segment detail |
|---|---|
| [Matching topic] | |
| <i>Instance/Instantiation</i> (Instance/Instantiation is a presentation type under <i>Elaboration</i> , rather than a relevance type.) | Segments describing instances of Nazi Theft in Eastern Europe. PE speaks of the start of the war. He recalls that his father and other male Jews were rounded up and held for ransom by German troops. <i>Audio detail:</i> “In September 1939, the Germans came in, they stayed [for] a few days and then pulled out and the Russians came in. Russians and Germans split Poland and their home was 5 blocks from the border, the Germans picked up about 500-1000 Jews and demanded money after they locked them up in the synagogue. Money was raised.” JF recalls working as a shepherd outside of Wlodawa, Poland, in 1941. He notes that he returned to Wlodawa because his father was incarcerated. JF recalls that his father and other Jews were incarcerated by the Germans in order to extort valuables from the Jewish community. |
| [Evidence] Circumstantial evidence [Causal reasoning] Backward inference | |
| Inferring from reaction to action | Segments discussing Jewish efforts to hide property. Note: The fact that property needs to be hidden points to the fact that theft or confiscation is common. |
| Inferring from later events | Segments discussing forced labor of sorting and processing seized valuables. They describe the sorting labor or sorting process but do not specifically say that property/valuables were seized by Nazis. Note: From what happened later, sorting valuables, we infer what happened earlier, seizure of properties by Nazis. |
| [Generic inference] Without explicitly connecting | Segments discussing special certificates issued by Nazi to temporarily avoid being the subject to Nazi robbery. ES explains that her father had a special work permit. <i>Audio detail:</i> “Dad [was] still protected because worked for Aryzator [and] had certificate. They withdrew certificates. Often raids at night especially [on] Jewish holidays like Pesach, used Jewish holidays to terrorize.” Note: The segment discusses that her father worked for Aryzators. The fact that he needed a certificate suggests that he otherwise might have been subject to seizure of property by Nazi. With a certain level of uncertainty, we include this case into the class of Nazi Theft. |

Table 12-1 MALACH Topic-1: Nazi Theft in Eastern Europe, continued

| Topical relevance type Mode of reasoning <i>Type of presentation</i> | Example segment detail |
|---|---|
| [Context] Social background | <p>Segments discussing the role of the Swiss and other neutral countries in accepting the stolen property.</p> <p>Note: The segment fits the topic of Nazi theft into a broader social and political picture at the time.</p> |
| Policies and laws | <p>Segments discussing Nuremberg laws or other restrictive policies.</p> <p>Note: Nuremberg laws and other restrictive policies passed by Nazi Germany banished Jews from many professions and set up the legal justifications for appropriating Jewish businesses.</p> <p>Segments discussing restitution policies</p> <p>Note: These policies also contribute to a fuller picture surrounding Nazi theft.</p> |

Table 12-1 MALACH Topic-1: Nazi Theft in Eastern Europe, continued

| Topical relevance type Mode of reasoning Type of presentation | Example segment detail |
|--|---|
| [Comparison] Comparison by similarity; By factor that is different: | |
| Different country | Segments discussing seizure or restitution of property by Nazis in countries other than in Eastern Europe (Hungary, Latvia, Lithuania, Poland, or Romania). |
| Different time | Segments discussing seizure or restitution of property by Axis governments other than the Nazis, i.e., Hungary pre-1944 |
| Different type of situation | <p>Segments discussing seizure and destruction of non-family properties.</p> <p>ZE recalls that at the beginning of the war, the Germans expropriated a famous Lublin Hasidic university and states that they destroyed all of the books and Torahs housed there.</p> <p><i>Audio detail:</i> “There was a lot of anti-Semitism. ... Nice Jewish population in Lublin. We had a famous Hasidic University there. The Germans used it as a hospital for other Germans. It was a modern building. All books and torahs were burned. This was in the beginning.”</p> <p>Note: As specified by the topic, Nazi theft considers seizure of family properties and assets. The segment touches on seizure of non-family property. Not directly on topic, but similar.</p> |
| Different actor | <p>Segments discussing property seizure by gentile rather than by Nazi.</p> <p>SW reveals that her family was betrayed by the gentile girl who had been her best friend and discusses her feelings about this betrayal. She recalls how her family prepared to leave for the ghetto and describes the night Germans forced them out of their home.</p> <p><i>Audio detail:</i> “In their area, mostly poles. Heard Germans were coming to take them to ghetto. Came in the night. A day before, came Helena with a German officer to their apartment told officer that all the furniture, silver, cupboards, bedding, everything was hers. Not to touch. They were frightened, did not say a word... So horrible, was the shouting. Into big trucks, took them to ghetto. Could not believe her friend would do that to her. They were best friends. Was so down about it. Unbelievable. Came to her apartment at such a critical time, everything was hers. No shame, no morality. Could not till today could she betray her. Gave up so much for her friend, everything with her, was like a sister. So betrayed her.”</p> <p>Note: This is not directly Nazi theft; instead, it is theft by private citizens. However, in this instance, the Germans explicitly condoned the theft by the local Poles so the Germans role as an accomplice in the private citizens’ theft makes this segment relevant. It also provides context for showing the level of respect Nazi Germans had for Jewish property – certainly gives perspective on how little value they placed on Jewish ownership of property.</p> |

Table 12-22 MALACH Topic-2: Wallenberg Rescues Jews
 Discussion of how Raoul Wallenberg protected and rescued Jews during the Holocaust

| Topical relevance type Mode of reasoning <i>Type of presentation</i> | Example segment detail |
|---|--|
| [Matching topic] | |
| | <p>HF recalls receiving letters during the war from his friend Raoul Wallenberg informing him of his attempt to rescue Jews in Hungary. He heard from Wallenberg that he was working with the Swedish embassy in Hungary to try to save people by giving them Swedish passports. HF remembers his attempt in 1946 to bring attention to Wallenberg's imprisonment by the Soviets after war.</p> |
| <i>Instance/Instantiation</i> | <p>Copy of the Schutzpass which belonged to MS's mother and contained the signature of Raoul Wallenberg.</p> <p>Note: This segment directly matches the topic as an instance of being rescued.</p> <p>AB recalls hiding in Budapest in 1943. AB recalls being taken to a Swedish protected house in 1944 by Raoul Wallenberg.</p> <p>Note: This segment directly matches the topic as an instance of being rescued.</p> |
| <i>Elaboration</i> | <p>Found out about a house of Mr. Weiss who had relations with the Swiss embassy, he let people in who had connection with a Zionist organization, ...People from the Zionist organization needed young people who spoke several languages, selected in a group of 12, organized by Wallenberg of Sweden Swiss ambassador, Lutz, of Switzerland, organized ghetto in nice part of Budapest, an international Cartier, checking in people with a Schutzpass, passports issued by Sweden, the Vatican, and Spain, thousands of people were coming through.</p> <p>Note: This segment directly matches the topic by elaborating the method of Wallenberg's rescue plan. It describes Wallenberg's rescue in general rather than restricting to one individual's experience (<i>instance</i>).</p> |
| <i>Amplification</i> <p>[<i>Amplification</i> is a presentation type under <i>Elaboration</i> that provides in-depth details.]</p> | <p>WB states he delivered official and forged protection papers in Budapest for Raoul Wallenberg in 1944.</p> <p><i>Audio detail:</i> "He had joined the Underground and aided the refugees in getting to Romania and out of Eastern Europe to Palestine. ... Raul Wallenberg came to Budapest. The operation became strong when Wallenberg arrived. WB was able to copy Wallenberg's official papers for those who could not obtain real ones. Wallenberg set up the Swedish protective houses. Wallenberg used him and others to make and deliver the papers. They tried to get the Polish refugees out first because they could not speak Hungarian and were noticed."</p> <p>Note: This segment provides rich insider detail about the method and the strategy of Wallenberg's rescue activities.</p> |

Table 12-2 MALACH Topic-2: Wallenberg Rescues Jews, continued

| Topical relevance type Mode of reasoning Type of presentation | Example segment detail |
|---|--|
| <p><i>Extension</i></p> <p>[<i>Extension</i> is a presentation type that covers non-typical information on the topic]</p> | <p>WB continues to discuss his involvement with Raoul Wallenberg in Budapest. He tells of making and delivering false protection papers.</p> <p><i>Audio detail:</i> “No official list of people who were marked for help by Wallenberg. Many did not know that their papers were forged. A list would have identified people to the Germans and they would have been killed...no records, no proof. He helped in the printing and the delivery of the papers. He knew Hungarian. Had gentile papers with him if he was stopped. Knew the Budapest sewer system and could enter building through the sewers. Had specific assignments without knowing too much...just in case he was captured and tortured he could not divulge too much information. Always scared but it did not stop him from functioning. It was his choice to be involved with those activities.”</p> <p>Note: In addition to further reveal the process of Wallenberg’s rescuing activities, this segment presents a unique perspective as a rescuer: the challenges and dangers faced, the motivation behind, and the decision made.</p> |
| <p><i>Pointer</i></p> <p>[<i>Pointer</i> is another presentation type providing sources of relevant information]</p> | <p>Dr. Cha worked with Wallenberg closely in Hungary.</p> <p>Note: Dr. Cha is a pointer person worth researching on.</p> |
| <p>[Evidence]</p> <p>Circumstantial evidence [Generic inference]</p> | |
| <p>Without explicitly connecting</p> | <p>MS recalls that after she left the Swedish Embassy, she was taken by a Hungarian soldier to a protected house. She relates that her brother and his wife were living in the protected house.</p> <p>Note: This instance is most likely associated with Wallenberg’s organization. It sheds some light on methods, but it cannot be determined with absolute certainty that it was Wallenberg.</p> |

Table 12-2 MALACH Topic-2: Wallenberg Rescues Jews, continued

| Topical relevance type Mode of reasoning Type of presentation | Example segment detail |
|--|--|
| [Context] | |
| Preceding experience | <p>GP recalls how he and his grandmother posed as deaf non-Jews when they encountered the SS on their way to a Swedish protected house in Budapest in 1944.</p> <p><i>Audio detail:</i> “How did I get from my house to that Swedish protected house? My grandma whose background is Polish-Austrian spoke fluent Germany, she was born in an Austrian territory, she explained to me at time I was 6 yrs old, told me we had to go somewhere not allowed to in street unless we wore yellow stars, told me clearly not to say any word to anybody, that I was deaf, a sick boy - we had to go mile or mile and half from our place to Swedish place, had to take street car because every half block was police and SS asking for IDs, grandma was always nice elegant lady beautiful and we went in street car, in 1st stop SS German military people looking for Jews, asked for IDs, then they came to us grandma immediately spoke German well, I'm Mrs. Ring from Austria this is my sick grandchild, they believed her because accent and how she took was obvious she was not Hungarian, I remembered they were apologizing, she said one of officers actually kissed her hand goodbye.”</p> <p>Note: Personal experience before entering Wallenberg’s protected house. It supplements information about the surrounding environment at the time, e.g., how SS in street checking for Jews.</p> |
| Subsequent experience | <p>AB remembers being liberated in January 1945 while living in a protected house in Budapest. She recalls her interaction with Soviet troops. AB mentions searching for Raoul Wallenberg.</p> <p>Note: Experience afterwards. It also broadens the perspective of what happened to the protected house and to Raoul Wallenberg afterwards.</p> |
| Biographic information | <p>Wallenberg and his associates rescued Jews in Budapest, Hungary. Officially, Raoul Wallenberg died in a Soviet prison camp in 1947, but there are questions and some believe that he lived much longer or was killed even earlier.</p> <p>Note: It is not directly related to Wallenberg’s rescuing Jews, but it provides biographic information about the rescuer.</p> |

Table 12-2 MALACH Topic-2: Wallenberg Rescues Jews, continued

| Topical relevance type Mode of reasoning <i>Type of presentation</i> | Example segment detail |
|---|---|
| [Comparison] Comparison by similarity; By factor that is different: | |
| Different actor | NR recalls the process he went through to get false identification papers. He credits Fulop Freudiger with helping him obtain false papers. Note: Same kind of noble acts in Hungary but conducted by a different person. Hungarian Jewish leader who helped found the Relief and Rescue Committee of Budapest, and in 1944, he aided many refugees who had illegally entered Hungary in search of a safe haven. It provides some perspectives on rescuing Jews in Hungary. |
| | MF talks about her art teacher in Budapest who warned her that she should prepare to adjust to terrible living conditions. She notes that her art teacher helped to save many Jews during the war. MF tells of his fate. Note: Same kind of noble acts in Budapest but conducted by a different person. It provides some perspectives on rescuing Jews in Budapest. |

12.2 Clinical Questions and Answers

This section applies the relevance types to discern and present the structure of medical topics, especially “ADHD in children”. Two major points emerged from the many coding examples:

- The multi-level topical structure;
- The typology of topical relevance relationships is useful for clarifying the structures of the four types of clinical questions.

Before looking into the topical relevance relationships, we need to first decide what a *topic* is in the context of clinical question-answering data. Unlike MALACH, the clinical QA data have only “questions”, not “topics.” However, different questions could share the same “base topic,” for example,

Q1: What is the most effective treatment for ADHD in children?

Q2: Does maternal smoking cause ADHD?

Q3: Does a short symptom checklist accurately diagnose ADHD?

Q4: What are other diseases that have the similar symptoms of ADHD in children?

For Q1 to Q4, although the focus of the question varies from one another, the “base topic” remains the same: ADHD (in children). Instead of having each question (e.g., “the treatment for ADHD”) as a separate topic, the analysis concentrates on the “base topic.” The purpose is to demonstrate the full range of all possible topical relevance relationships brought in from different angles to the same central topic (see Figure 12-15 later in this chapter for a comprehensive illustration). Moreover, to keep the analysis consistent, the disease (etiology) or symptom, rather than medical

intervention (therapeutic or diagnostic) is treated as the base topic. As in the above example, the base topic is the disease, ADHD in children, not the treatment of ADHD.

Overview

- Section 12.2.1: Multi-level topical structure of analyzing clinical answers
- Sections 12.2.2-5: Applying the topical relevance typology to analyze clinical answers allows us to extract and investigate the high-level structural features of answers to different types of clinical questions. In turn, these structural features have important implications in automatic clinical question answering (QA) as well as in structural search of evidence-based medicine.
 - Section 12.2.2: Therapy question
 - Section 12.2.3: Diagnosis question
 - Section 12.2.4: Etiology question
 - Section 12.2.5: Prognosis question
- Section 12.2.6: A combined topical map of “ADHD in children” from incorporating clinical answers to therapy, diagnosis, and etiology questions on the same topic, “ADHD in children”

12.2.1 Coding Clinical Answers into a Multi-Level Topical Structure

This section first uses a coding example to illustrate how clinical data was analyzed and coded. Box 12-1 shows the original clinical answer collected from the online source to the therapy question, “What is the most effective treatment for ADHD in children?” and Figure 12-1 shows the top levels of the map that resulted from coding the answer text. The section then elaborates the same example to demonstrate the multi-level topical structure that emerged from the coding.

Figure 12-1 also shows that the topical structure of a clinical answer has multiple levels, which is an important and unique characteristic of the clinical data findings. Instead of contributing to the topic on the same single level, topical relevance relationships manifest themselves on multiple levels. Accordingly, instead of being coded on a single level, topical relevance relationships are analyzed on multiple levels.

The identified topical relevance relationship is level-specific. As shown in the example, the “Research design” (corresponding answer span: “The stimulant medication strategy included an initial dose titration period followed by monthly 30-minute visits...”) is not directly the “method” for the central topic of “ADHD in children”, but it is the methodological aspect for the level of “A large randomized trial”. Same for the “Evaluation” or the “Side effect”, they are not the evaluation or the side effect of “ADHD in children”, but of the treatment of ADHD. It is important to note that it is still the same set of topical relevance relationships, or the same typology, but applied on many levels respectively. In other words, the level can vary, but the relationship types stay the same on each level.

**Box 12-1 What is the most effective treatment for ADHD in children?
The Original Question and Answer Collected From the Online Source**

(ID 1002) *The Journal of Family Practice*, February 2005, Vol. 54, No. 2

What is the most effective treatment for ADHD in children?

http://www.jfponline.com/content/2005/02/jfp_0205_00166.asp

Evidence-Based Answer

Stimulant medication therapy (Table) is the most effective treatment for attention deficit/hyperactivity disorder (ADHD) in children, producing significant improvements in symptoms and modest improvements in academic achievement (strength of recommendation [SOR]: A, based on multiple randomized controlled trials [RCTs]). Nonpharmacologic therapies, such as behavior therapy, school-based interventions, and family therapy, are not as effective as stimulants but may add modest benefit to the effects of medication (SOR: B, based on 1 RCT).

While atomoxetine (Strattera) improves the symptoms of ADHD (SOR: A, based on multiple RCTs), stimulant medications other than methylphenidate offer no distinct short-term advantages (SOR: A, based on meta-analyses of multiple RCTs). Combination drug therapies offer no significant advantage to stimulants alone unless a comorbid condition is present (SOR: A, based on a meta-analysis of 20 RCTs).

The combination of methylphenidate and clonidine (Catapres) improves symptoms in children with both ADHD and tics (SOR: B, based on 1 RCT). Clonidine is less effective alone and has significant side effects (SOR: B, based on a meta-analysis of nonrandomized trials).

Evidence Summary

In numerous systematic reviews, RCTs, and meta-analyses, 70% of children responded to stimulant medications with short-term improvements in ADHD symptoms (inattention and hyperactivity/impulsivity) and academic achievement. A forty-year review looked at 135 trials and 413 RCTs of methylphenidate in over 19,000 children with an average age of 8.8 years (range, 8.3–9.4 years) for an average duration of 6 weeks (range, 3.3–8.0 weeks).¹⁻³

Study groups included mostly elementary school-aged male children, with few minorities represented. Comorbid conditions, present in 65% of children with ADHD, were often poorly controlled. Outcome measures varied among studies.³

The effect size from stimulant medication in these studies averaged 0.8 for symptom relief and between 0.4 and 0.5 for academic achievement. (Effect size is the difference between the means of the experimental and control groups expressed in standard deviations. An effect size of 0.2 is considered small, 0.5 is medium, and 0.8 is considered moderate to large.)

A large randomized trial of 579 children with ADHD (20% girls) aged 7 to 9.9 years compared outcomes of 4 treatment strategies: stimulant medication, intensive behavioral treatment, combined stimulant medication and behavioral interventions, and standard community care.⁴ All children met the DSM-IV criteria for ADHD Combined Type (the most common type of ADHD in this age group). The stimulant medication strategy included an initial dose titration period followed by monthly 30-minute visits. Intensive behavioral treatment involved child, parent, and school personnel components of therapy. Combination therapy added the regimens for medication and behavioral treatment together. Standard community care consisted of usual (nonsystematic) care, evaluated at 6 different sites.

Box 12-1 The Original Question and Answer Collected From the Online Source (Continued)

After 14 months of treatment, children in the medication group and the combined treatment groups showed more improvement in ADHD symptoms than children given intensive behavioral treatment or those who received standard community care. When combined with medication, those treated with behavioral therapy showed slight improvement in social skills, anxiety, aggression, oppositional behavior, and academic achievement over medication alone. At the conclusion of the study, 74% of the 212 children on medication were successfully maintained on methylphenidate alone, 10% required dextroamphetamine, and no children required more than one medication. This study found that higher doses of medication with more frequent office follow-up and regular school contact were important features of successful treatment. Only 40% of families were able to complete the intensive behavioral therapy.

Several short-term reviews and meta-analyses show that side effects from stimulant medications are mild and have short duration.⁵ More long-term studies are required to evaluate effects on growth. RCTs have limited power to detect rare adverse events that may be better detected by large observational studies.⁶

Atomoxetine, a specific norepinephrine reuptake inhibitor, is an FDA-approved alternative to stimulants for ADHD treatment in children and adolescents. Based on 3 RCTs⁷ of 588 children between the ages of 7 and 18 years, atomoxetine showed dose-related improvement in ADHD rating scales. Side effects of atomoxetine are similar to stimulants and include mild but significant increases in blood pressure and pulse.⁷

A meta-analysis of 11 non-randomized trials using clonidine for ADHD showed a smaller effect size compared with stimulants.⁸ One RCT of 136 children with ADHD and tics showed improvement of both problems with the use of methylphenidate and clonidine, particularly in combination.⁹ Second-line medications such as clonidine, pemoline (Cylert), and tricyclic antidepressants have more potential serious side effects and are not well studied.¹⁰

Recommendations from Others

The American Academy of Pediatrics recommends that clinicians: 1) manage ADHD as a chronic illness, 2) collaborate with parents, the child, and school personnel to define specific desired outcomes, 3) use stimulant or behavioral therapy to improve these outcomes; if one stimulant is not effective at the highest feasible dose, try another, 4) reevaluate the diagnosis, treatment options, adherence, and possible coexisting conditions if treatment is not achieving the desired outcomes, and 5) follow-up regularly with parents, child, and teachers to monitor for progress and adverse effects.¹¹

Lisa A. Johnson, MD, Providence St. Peter Hospital Family Practice Residency, Olympia, Wash;
Sarah Safranek, MLIS, University of Washington Health Sciences Library, Seattle

Clinical commentary

When patients, parents, and teachers are educated, we achieve better outcomes

Stimulants and atomoxetine improve symptoms of ADHD quite effectively, making office treatment of ADHD a gratifying experience. Like many other diagnoses, there are numerous medications available to treat ADHD. Becoming familiar with a few and regularly prescribing them makes the treatment of ADHD more comfortable for the physician.

Sometimes patients and parents are hesitant to take medication for ADHD. Education about ADHD, along with trials of behavioral therapy, often improves patient satisfaction and compliance with medication. Likewise, children and adolescents may resist medication because of stigma or feeling unfairly labeled with a disease. Because of this, it is helpful to choose a medication with a long duration, so school dosing can be avoided. Artful negotiation with the patient and parent is beneficial.

In my experience, when patients, parents, and teachers are well-educated about ADHD and use behavioral therapy along with medication, we achieve better outcomes. Useful information for physicians and parents regarding medication use and behavioral therapy are described in the American Academy of Pediatrics ADHD Toolkit available at www.nichq.org/resources/toolkit.

Jerry Friemoth, MD, University of Cincinnati

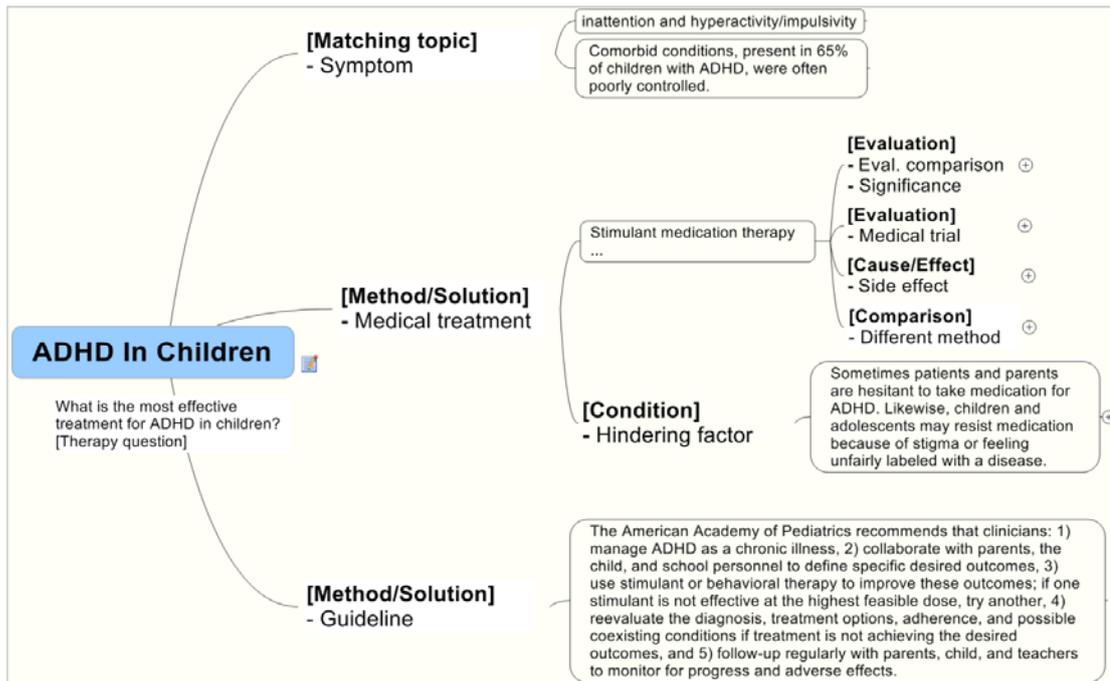


Figure 12-24 The Top-Level Coding Map For The Therapy Question: What Is The Most Effective Treatment For ADHD In Children?

Figure 12-1 shows the top-level coding of the answer, presented with Mindjet MindManager. The topic, “ADHD in children”, is shown on the very left. The answer to the question is broken down into analytic text spans, which are put in boxes in the figure, such as “Stimulant medication therapy...” Each of these analytic answer spans is analyzed using qualitative coding. The bolded texts in the figure present the codes assigned to the analytic answer spans, for example, the code assigned to “Stimulant medication therapy...” is “[Method/Solution] - Medical treatment”, which consists of two parts:

- the *top-level* topical relevance relationship category applied to the particular answer span: **[Method/Solution]**; and
- the *most specific* topical relevance relationship type applied to the answer span within the above broad topical relevance category: **- Medical treatment.**

Accordingly, the clinical answer shown in Box 12-1 is structured with three types of relevant information:

[Matching topic] – Symptom,

[Method/Solution] – Medical treatment, and

[Method/Solution] – Guideline.

These formatting conventions are followed in the presentation of all the clinical answer.

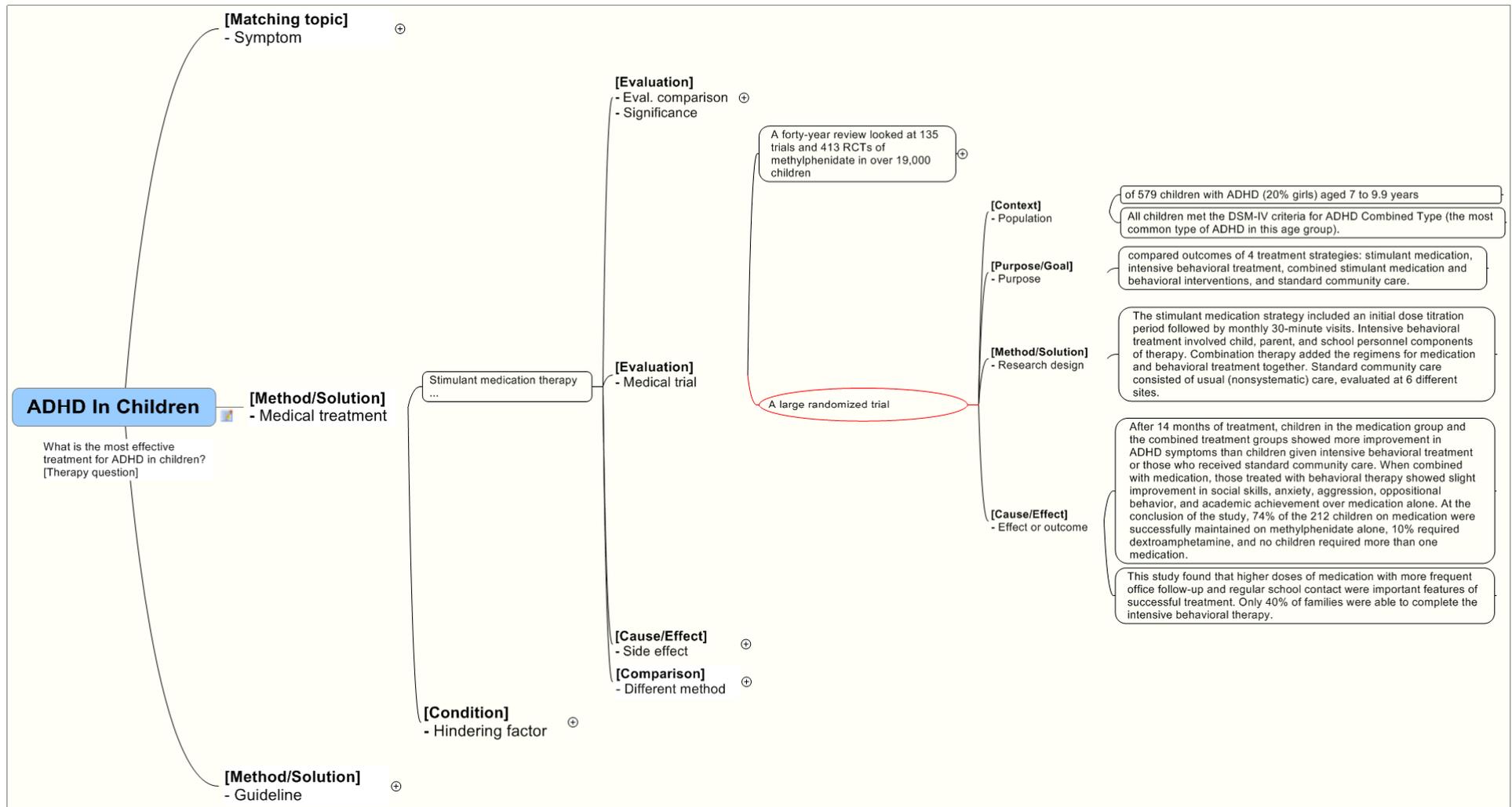


Figure 12-25 Zooming In On One Branch Of The ADHD Therapy Question: A Large Randomized Trial

To examine the *multi-level topical structure* in more detail, let us zoom in on one branch of Figure 12-1, “A large randomized trial” of “Stimulant medication therapy”, as circled in Figure 12-2, which collapses all other branches to clearly show the focus.

The following gives explanations on the figure.

- **Level 1:** on the first level, three types of topical relevant information are identified for the topic of “ADHD in Children”:
 - [Matching topic] - Symptom,
 - [Method/Solution] - Medical treatment, and
 - [Method/Solution] - Guideline.For each of them, the coding is carried on using the same typology and the analysis is carried on in the same fashion.
- **Level 2:** under “Stimulant medical therapy...” are four types of topical information:
 - [Evaluation] – Comparative evaluation; - Significance,
 - [Evaluation] – Medical trial,
 - [Cause/Effect] – Side effect, and
 - [Comparison] – Different method.

The detailed text information in the figure are shown in the following list:

1. [Method/Solution] - Medical treatment “Stimulant medication therapy...”

1.1 [Evaluation] - Comparative evaluation; [Evaluation] - Significance

“Stimulant medication therapy is the most effective treatment for attention deficit/hyperactivity disorder (ADHD) in children, producing significant improvements in symptoms and modest improvements in academic achievement”

1.2 [Evaluation] - Medical trial

- “A forty-year review looked at 135 trials and 413 RCTs of methylphenidate in over 19,000 children”;
- “**A large randomized trial**” (Focus)

1.3 [Cause/Effect] - Side effect

“Several short-term reviews and meta-analyses show that side effects from stimulant medications are mild and have short duration.”

1.4 [Comparison] - Different method

- “Nonpharmacologic therapies, such as behavior therapy, school-based interventions, and family therapy,”
- “Atomoxetine (Strattera)”
- “Combination drug therapies”
- “The combination of methylphenidate and clonidine (Catapres)”
- “Clonidine alone”

- **Level 3:** now let us focus on the details of the branch, “A large randomized trial” (as circled in Figure 12-2). The text details in Figure 12-2 are also shown in the following list:

“A large randomized trial”

1.2.1 [Context] - Population

- “of 579 children with ADHD (20% girls) aged 7 to 9.9 years”
- “All children met the DSM-IV criteria for ADHD Combined Type (the most common type of ADHD in this age group).”

1.2.2 [Purpose/Goal] - Purpose

“compared outcomes of 4 treatment strategies: stimulant medication, intensive behavioral treatment, combined stimulant medication and behavioral interventions, and standard community care.”

1.2.3 [Method/Solution] - Research design

“The stimulant medication strategy included an initial dose titration period followed by monthly 30-minute visits. Intensive behavioral treatment involved child, parent, and school personnel components of therapy. Combination therapy added the regimens for medication and behavioral treatment together. Standard community care consisted of usual (nonsystematic) care, evaluated at 6 different sites.”

1.2.4 [Cause/Effect] - Effect / Outcome

- “After 14 months of treatment, children in the medication group and the combined treatment groups showed more improvement in ADHD symptoms than children given intensive behavioral treatment or those who received standard community care. When combined with medication, those treated with behavioral therapy showed slight improvement in social skills, anxiety, aggression, oppositional behavior, and academic achievement over medication alone. At the conclusion of the study, 74% of the 212 children on medication were successfully maintained on methylphenidate alone, 10% required dextroamphetamine, and no children required more than one medication.”
- “This study found that higher doses of medication with more frequent office follow-up and regular school contact were important features of successful treatment. Only 40% of families were able to complete the intensive behavioral therapy.”

Figure 12-2a Explanation of Figure 12-2

The full coding map of the answer is displayed in the following (Figure 12-3).

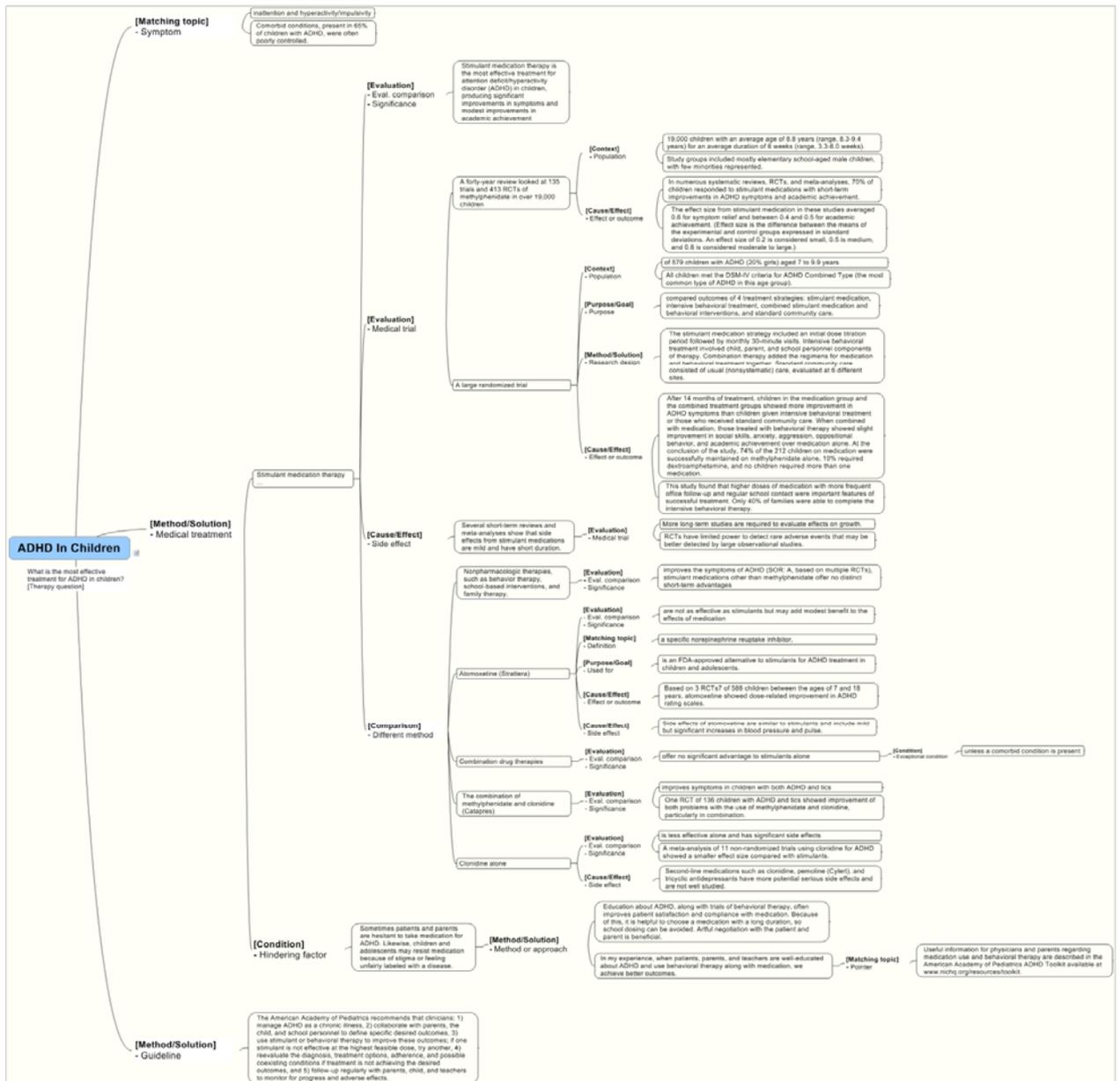


Figure 12-26 The Full Coding Map For The Therapy Question: What Is The Most Effective Treatment For ADHD In Children? (Please enlarge the image to see the textual detail in the figure)

Sections 12.2.2 - 5: Explain the high-level answer structure for each clinical question type (i.e., therapy, diagnosis, etiology, and prognosis) using the relevance typology.

12.2.2 Therapy Questions

The majority of clinical questions in practice are therapy-related, accounting for approximately one-third of clinicians' questions, followed by diagnosis questions (25%), and then by pharmacotherapy (15%) (Cheng, 2004; Ely et al., 2000).

The analyzed therapy questions are “treatment-centered”, asking for:

- the best intervention → [Method/Solution] – Medical treatment;
e.g., What is the most effective intervention for ADHD in children?
e.g., What are the best medications for panic disorder?
- the comparison of available interventions → [Comparison] – Different method;
e.g., First- or second-generation antihistamines: Which are more effective at controlling pruritus?
- the success rate or advances of intervention → [Cause/Effect] – Effect / Outcome.
e.g., What is the current success rate of electroconvulsive therapy (ECT)?
e.g., Are there any advances in the treatment of motion sickness?

As in the present case, the structural feature of “treatment-centeredness” is apparent when we examine the top-level topical elements of therapy questions. Figure 12-4 shows the top-level topical structure of the therapy question, “What is the most effective treatment for ADHD in children?” And Figure 12-5 shows the top-level topical structure of another coded therapy question, “Does quinine reduce leg cramps for young athletes?” The top-level topical structures of both therapy questions are

alike, by emphasizing the key topical element: [Method/Solution] – Medical intervention.

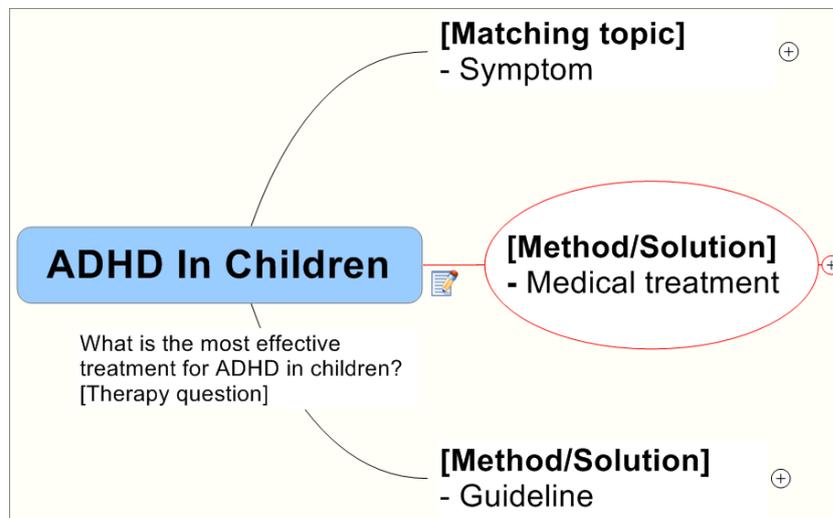


Figure 12-27 The Top-Level Relevance Categories of Therapy Question: What Is The Most Effective Treatment For ADHD In Children?
(See the full coding map in Figure 12-1)

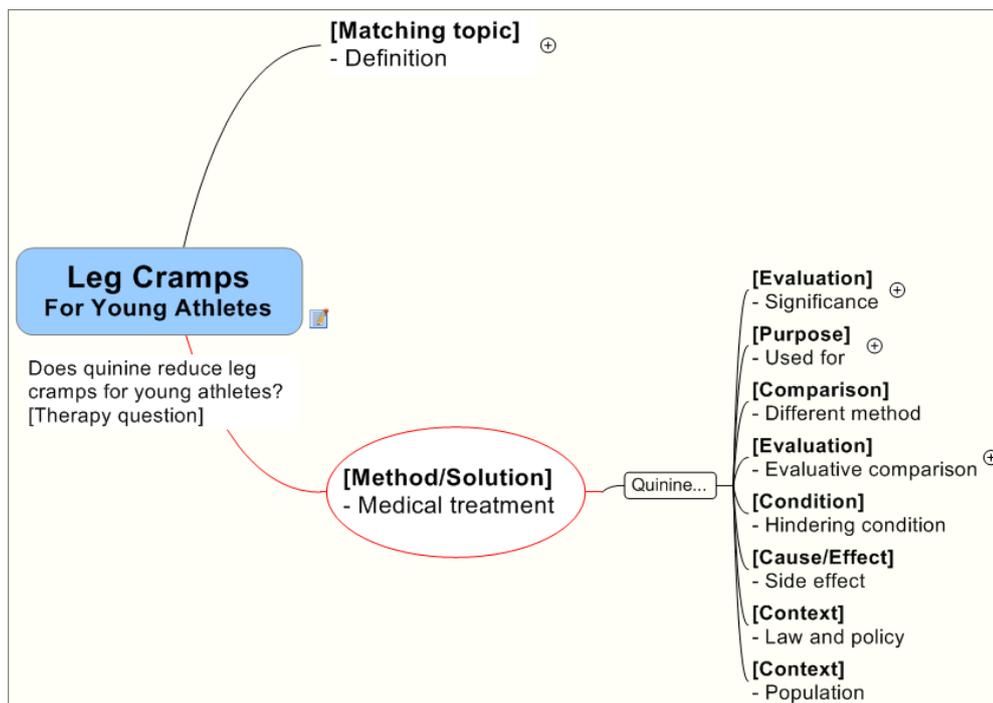


Figure 12-28 The Top-Level Relevance Categories of Therapy Question: Does Quinine Reduce Leg Cramps For Young Athletes?
(See the full coding map in Appendix E)

12.2.3 Diagnosis Questions

Compared to therapy questions, diagnosis questions demonstrate a larger variety of structural features. Three major types of diagnosis questions are identified based on the varying structures and emphases:

- *Diagnostic method–Centered* diagnosis question (Figure 12-6)
- *Symptom – Centered* diagnosis question (Figure 12-7)
- *Etiology – Centered* diagnosis question (Figure 12-8)

The section uses one selected sample answer coding to demonstrate the top-level relevance structure for each of the three diagnostic question types.

In addition, the analysis of diagnosis questions introduced many new sub-categories of topical relevance relationships, just to name a few,

- [Matching topic] – Rationale or mechanism,
- [Purpose/Goal] – Used for,
- [Evaluation] – Limitation,
- [Evaluation] – Criterion or standard,
- [Condition] – Constraint, etc.

These topical relevance categories are illustrated in the context of the ADHD diagnosis question (see the full coding map in Figure 12-9) with detailed codes.

- **Diagnostic method–Centered** diagnosis question, whose structure is most typical and straightforward, *e.g.*,

Does a short symptom checklist accurately diagnose ADHD? (Figure 12-6)

The focus of the question is “a short symptom checklist”, which is

[Method/Solution] – Diagnostic method.

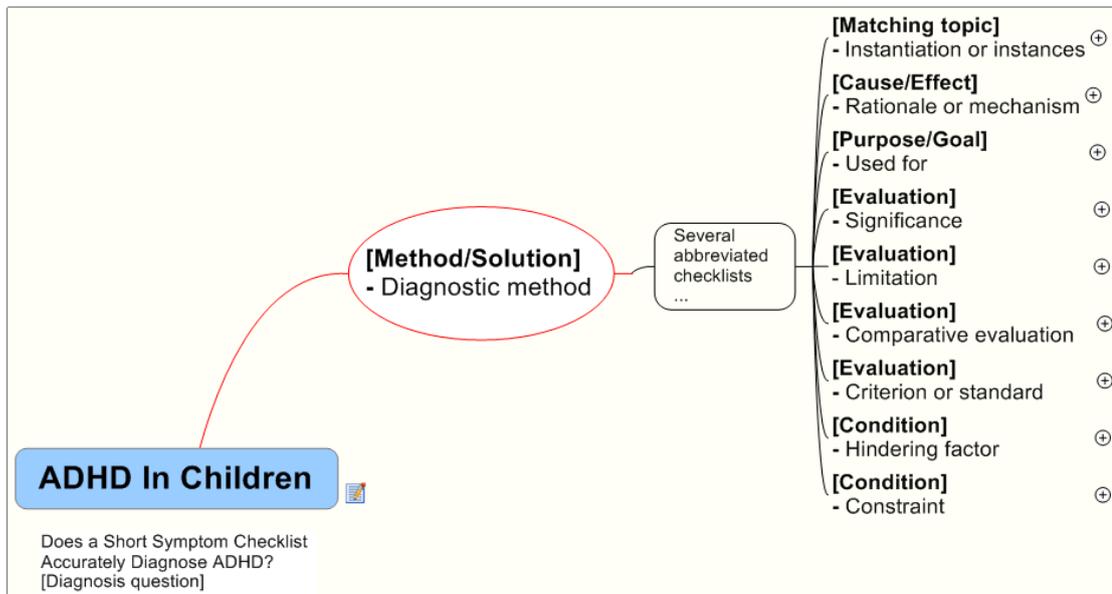


Figure 12-29 The Top-Level Relevance Categories Of Diagnostic-Method-Centered Diagnosis Question

(See the full coding map in Figure 12-9)

- **Symptom – Centered** diagnosis question, *e.g.*,

What are the indications for evaluating a patient with cough for pertussis?

(Figure 12-7)

The emphasis of the question is:

- symptoms → [Matching topic] – Manifestation/Symptom
- prevalence of a symptom for a disease → [Matching topic] – Prevalence
- evaluative indications → [Method/Solution] – Diagnostic indicator
- diagnostic method → [Method/Solution] – Diagnostic method.

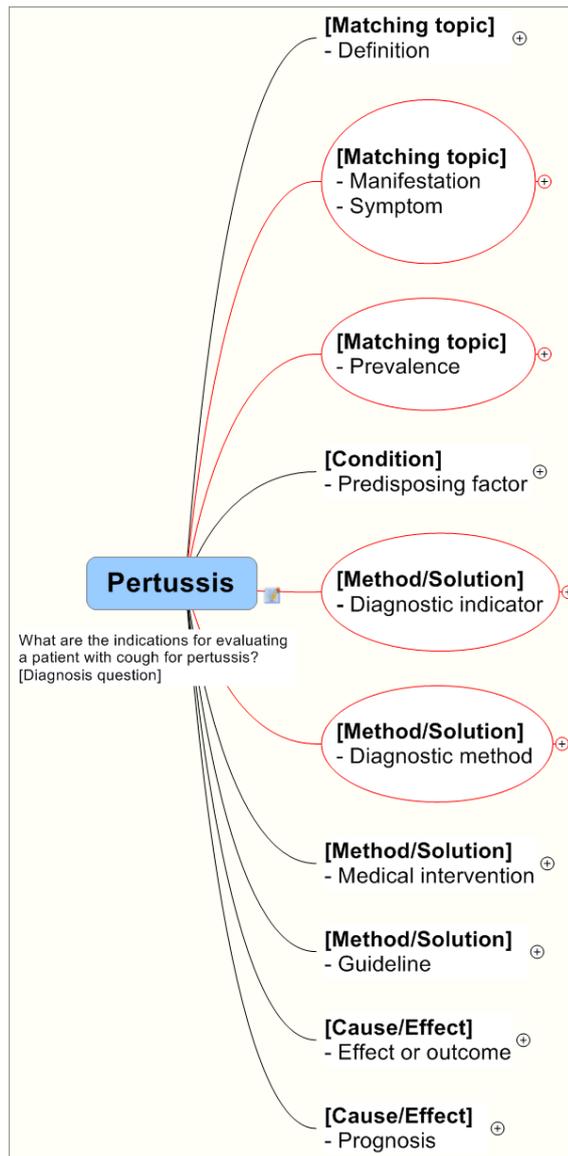


Figure 12-30 The Top-Level Relevance Categories Of Symptom-Centered Diagnosis Question

(See the full coding map in Appendix E)

- **Etiology – Centered** diagnosis question, e.g.,

What is the differential diagnosis of chronic diarrhea in immunocompetent patients? (Figure 12-8)

The focus of the question is

- differential diagnoses → [Cause/Effect] – Diagnosis or etiology
- prevalence of differential diagnoses → [Matching topic] – Prevalence.

To a large extent, this type of diagnosis question shares more structural similarities with etiology questions, which are discussed next.

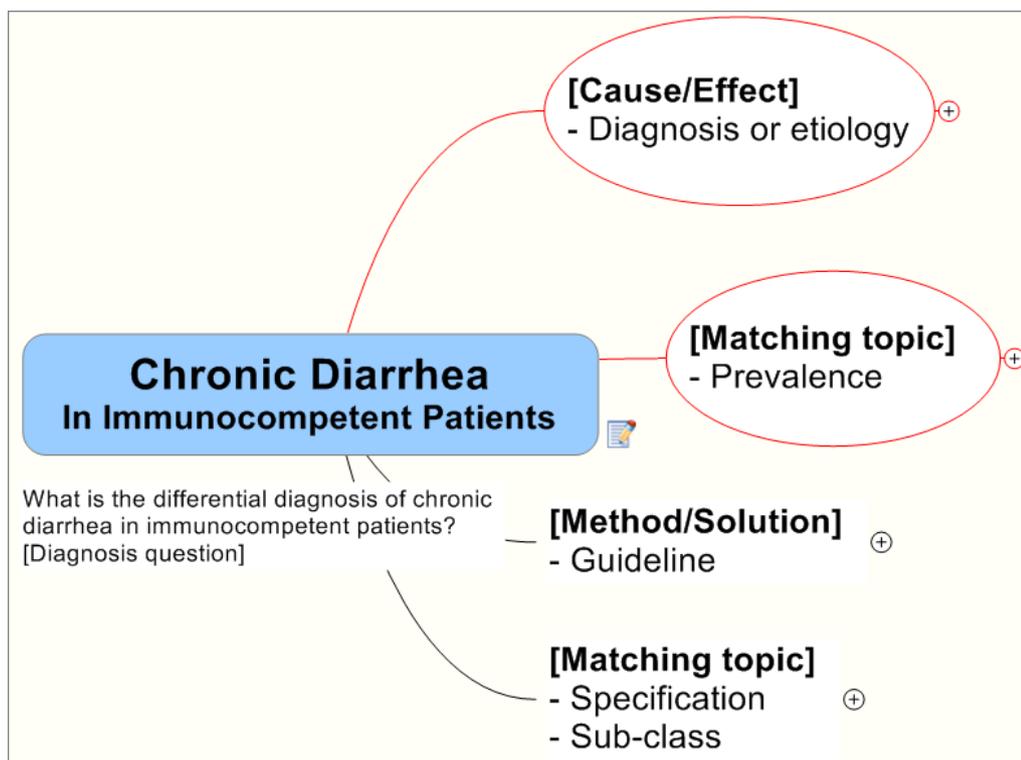


Figure 12-31 The Top-Level Relevance Categories Of Etiology-Centered Diagnosis

Question:

What Is The Differential Diagnosis Of Chronic Diarrhea In Immunocompetent Patients?

(See the full coding map in Appendix E)

Figure 12-9 displays the full coding map of the ADHD diagnosis question. The detailed codes in the figure are listed after this figure to illustrate the newly introduced relevance categories during the analysis.

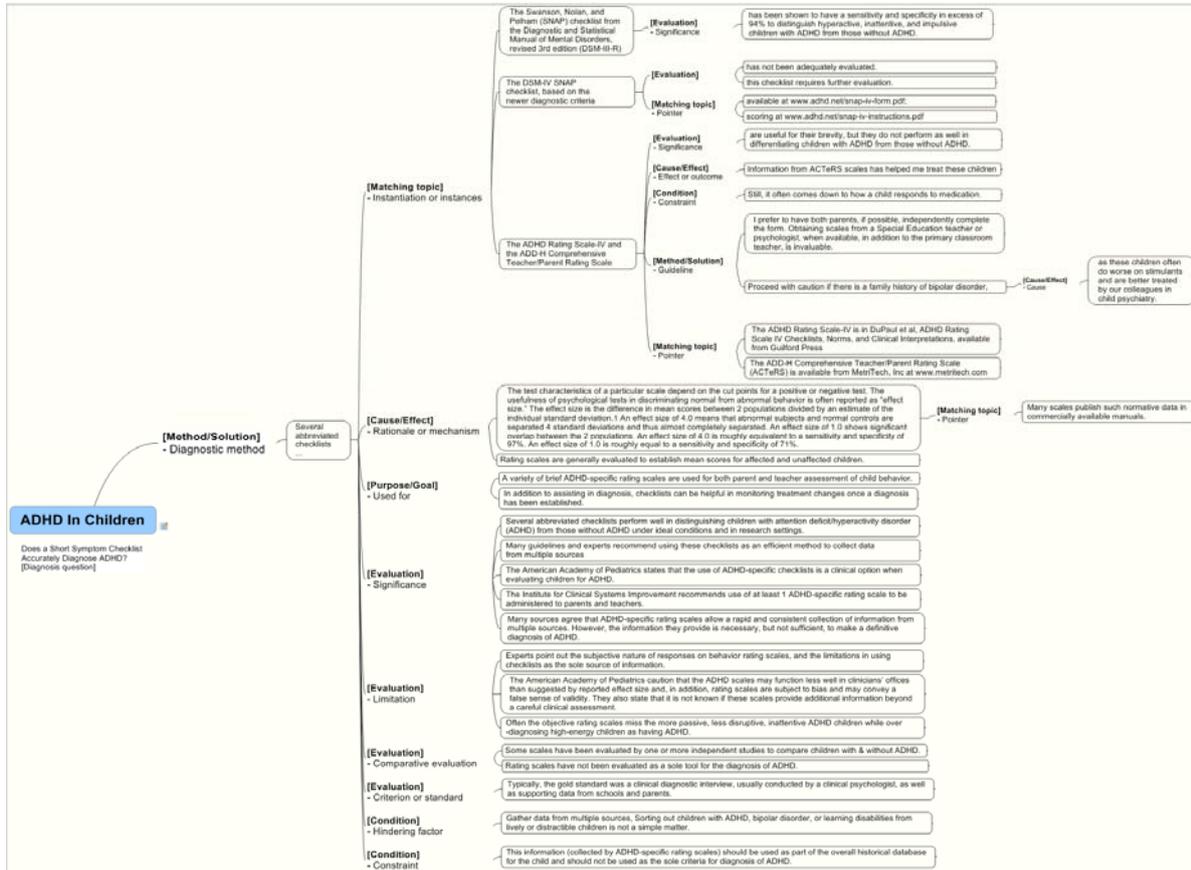


Figure 12-32 The Coding Map For The Diagnosis Question:

Does A Short Symptom Checklist Accurately Diagnose ADHD?

(Please enlarge the image to see the textual detail in the figure)

Coding details of Figure 12-9 are displayed in the following:

1 [Method/Solution] - Diagnostic method

“Several abbreviated checklists ...”

1.1 [Matching topic] - Instantiation or instances

- “The Swanson, Nolan, and Pelham (SNAP) checklist from the Diagnostic and Statistical Manual of Mental Disorders, revised 3rd edition (DSM-III-R)”
- “The DSM-IV SNAP checklist, based on the newer diagnostic criteria”
- “The ADHD Rating Scale-IV and the ADD-H Comprehensive Teacher/Parent Rating Scale”

1.2 [Matching topic] - Rationale or mechanism

- “The test characteristics of a particular scale depend on the cut points for a positive or negative test. The usefulness of psychological tests in discriminating normal from abnormal behavior is often reported as “effect size.”... An effect size of 4.0 means that abnormal subjects and normal controls are separated 4 standard deviations and thus almost completely separated. An effect size of 1.0 shows significant overlap between the 2 populations. An effect size of 4.0 is roughly equivalent to a sensitivity and specificity of 97%. An effect size of 1.0 is roughly equal to a sensitivity and specificity of 71%.”
- “Rating scales are generally evaluated to establish mean scores for affected and unaffected children.”

1.2.1 [Matching topic] - Pointer

“Many scales publish such normative data in commercially available manuals.”

1.3 [Purpose/Goal] - Used for

- “A variety of brief ADHD-specific rating scales are used for both parent and teacher assessment of child behavior.”
- “In addition to assisting in diagnosis, checklists can be helpful in monitoring treatment changes once a diagnosis has been established.”

1.4 [Evaluation] - Significance

- “Several abbreviated checklists perform well in distinguishing children with attention deficit/hyperactivity disorder (ADHD) from those without ADHD under ideal conditions and in research settings.”
- “Many guidelines and experts recommend using these checklists as an efficient method to collect data from multiple sources.”
- ...

1.5 [Evaluation] - Limitation

- “Experts point out the subjective nature of responses on behavior rating scales, and the limitations in using checklists as the sole source of information.”
- “Often the objective rating scales miss the more passive, less disruptive, inattentive ADHD children while over-diagnosing high-energy children as having ADHD.”
- “The American Academy of Pediatrics caution that the ADHD scales may function less well in clinicians’ offices than suggested by reported effect size and, in addition, rating scales are subject to bias and may convey a false sense of validity. They also state that it is not known if these scales provide additional information beyond a careful clinical assessment.”

1.6 [Evaluation] - Criterion or standard

“Typically, the gold standard was a clinical diagnostic interview, usually conducted by a clinical psychologist, as well as supporting data from schools and parents.”

1.7 [Condition] - Hindering factor

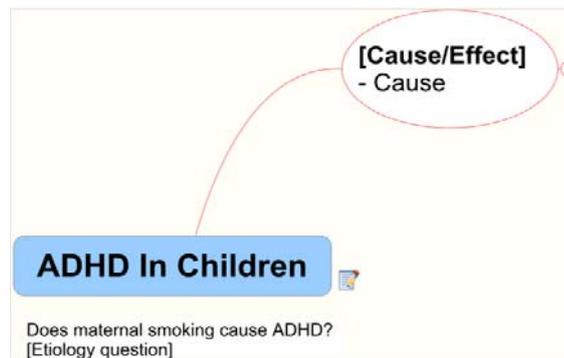
“Gather data from multiple sources, sorting out children with ADHD, bipolar disorder, or learning disabilities from lively or distractible children is not a simple matter.”

1.8 [Condition] - Constraint

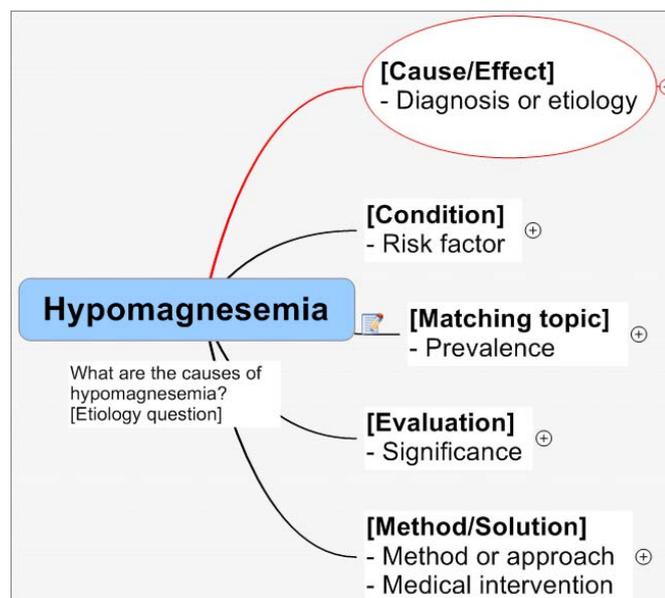
“This information (collected by ADHD-specific rating scales) should be used as part of the overall historical database for the child and should not be used as the sole criteria for diagnosis of ADHD.”

12.2.4 Etiology Questions

Etiology questions ask about the cause or etiology of a disease. The top-level topical structures of two analyzed etiology questions are shown in Figure 12-10 and Figure 12-11 respectively. As indicated by the figures, the central element of etiology questions is the cause or etiology, which is part of [Cause/Effect] relevance category.



**Figure 12-33 The Top-Level Relevance Categories Of Etiology Question:
Does Maternal Smoking Cause ADHD?**
(See the full coding map in Figure 12-12)



**Figure 12-34 The Top-Level Relevance Categories Of Etiology Question:
What Are The Causes Of Hypomagnesemia?**
(See the full coding map in Appendix E)

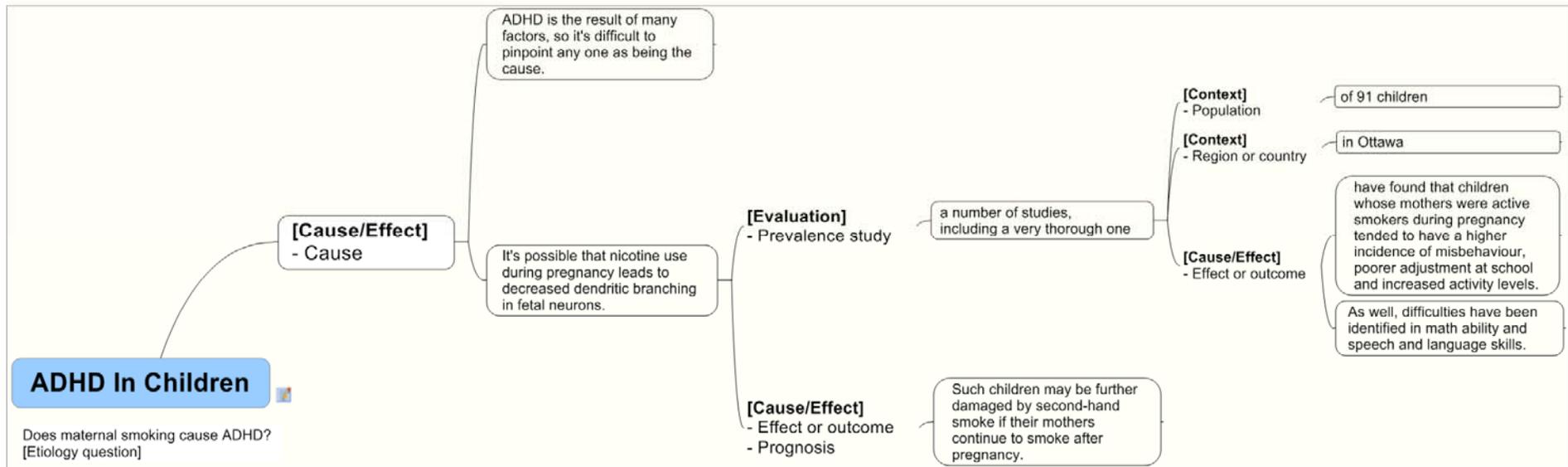
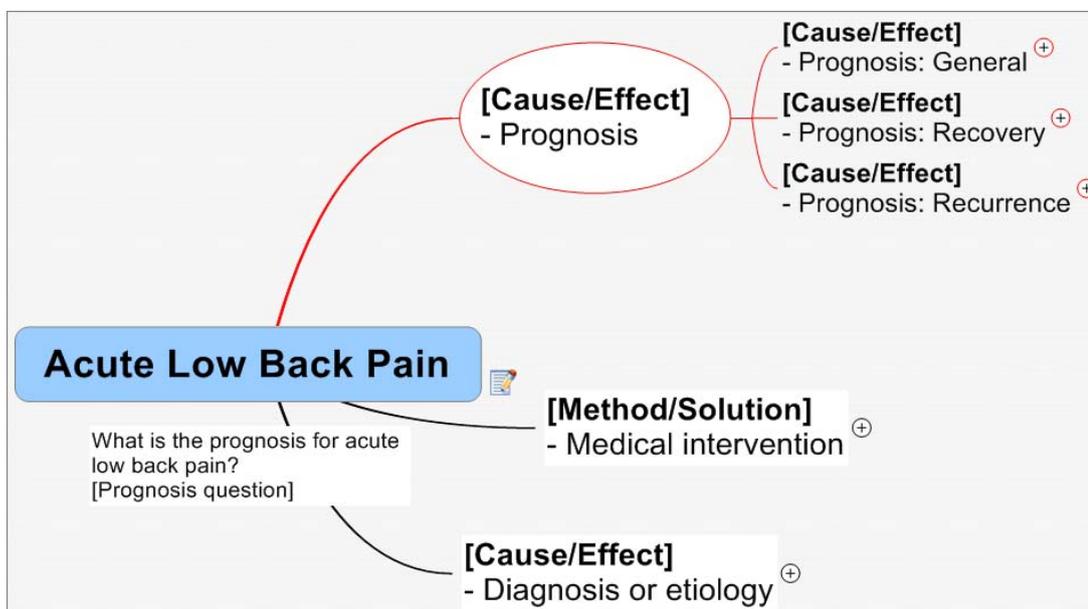


Figure 12-35 The Coding Map For Etiology Question: Does Maternal Smoking Cause ADHD?

12.2.5 Prognosis Questions

As indicated in Figure 12-13, prognosis questions emphasize the “prognosis” of a certain disease or condition.



**Figure 12-36 The Top-Level Relevance Categories Of Prognosis Question:
What Is The Prognosis For Acute Low Back Pain?**

(See the full coding map in Figure 12-14)

“Prognosis” is under “[Cause/Effect] – Prediction” on the functional facet of the relevance typology. Because making judgments on prognosis is both to predict from the present conditions and to deduce conclusions based on the disease progression (rule), it is also closely linked to “[Causal-based Reasoning] - Reasoning from cause” and “[Rule-based Reasoning (Deduction)]” on the reasoning facet of the relevance typology.

The relevance category of “Prognosis” is further enriched and specified by the following sub-categories:

- Prognosis: Recovery
- Prognosis: Complication

- Prognosis: Recurrence
- Prognosis: Mortality

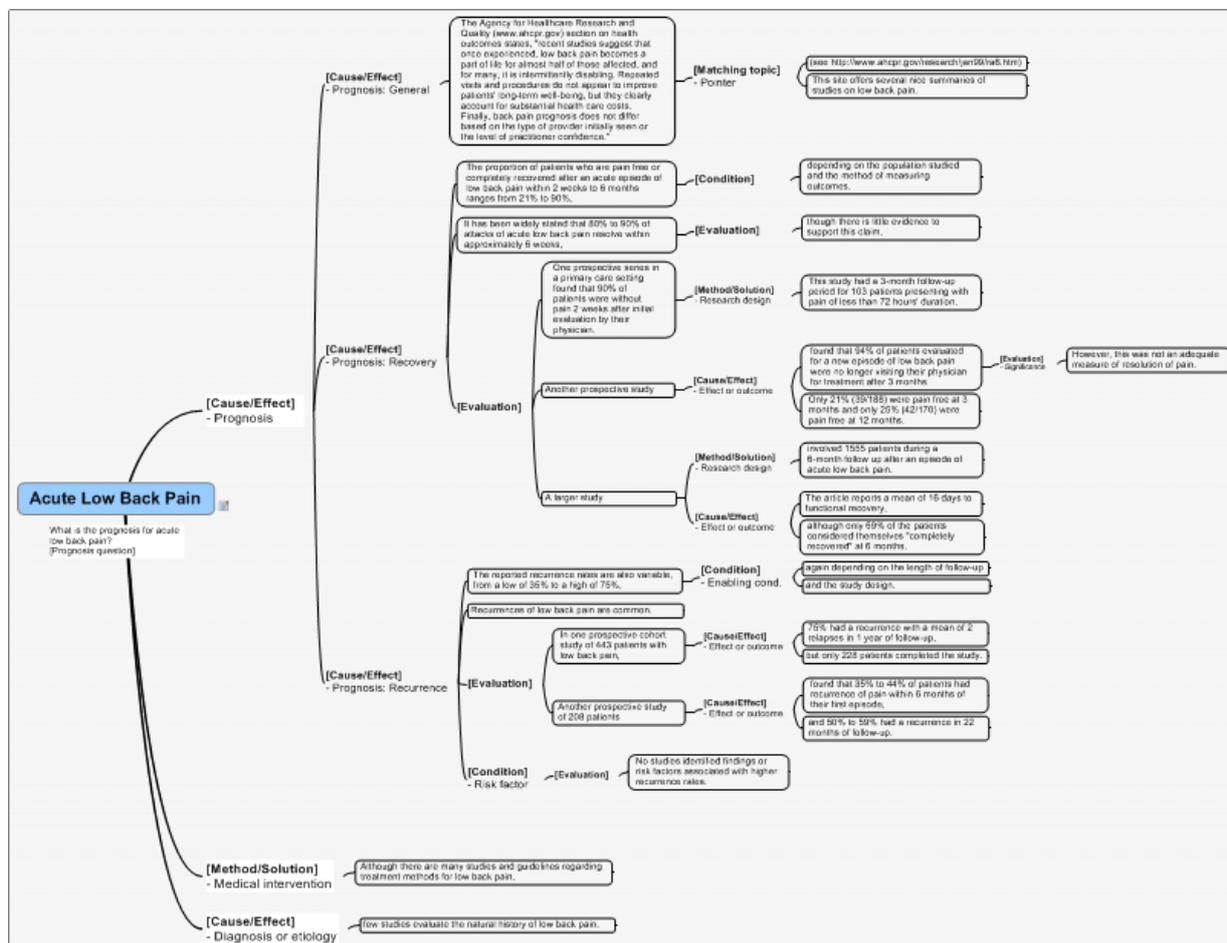


Figure 12-37 Coding Map For Prognostic Question:
What Is The Prognosis For Acute Low Back Pain?

12.2.6 A Combined Topical map of “ADHD in Children”

As discussed earlier, three clinical questions share the same “base concept” of *ADHD in Children* in the clinical QA dataset:

- Therapy question: What is the most effective intervention for ADHD in children? (Figure 12-1)
- Diagnosis question: Does a short symptom checklist accurately diagnose ADHD? (Figure 12-6)
- Etiology question: Does maternal smoking cause ADHD? (Figure 12-12)

In Figure 12-15, the three clinical questions are joined into a combined topical map of “ADHD in Children”. Due to the limited space, only the top-level topical relevance elements of the combined topical map are displayed in the figure.

Figure 12-15 illustrates the rich topical relevance relationships revolving around a topic, which play a highly important role in organizing and structuring the topic space. The combined topical map clearly shows how relevant information relates to the topic in many different ways as well as on many different levels. Every piece of the relevant information plays a special part in contributing to the user’s overall understanding of the topic.

Moreover, the topical map demonstrates a need to recognize and discern a variety of fine-grained topical relevance relationships. Simply saying the information is relevant but not specifying how it is related to a topic is of little assistance to the user under the current context of information overload. It would not help the user from getting overwhelmed and lost in the sea of relevant information. Topical relationships and topical structures built upon these relationships are essential for the user to quickly make sense of a topic space, particularly when the user is not familiar with the

topic. In this sense, the topical map structured with relevance relationships can serve as a useful navigation tool for the user to explore a new topic space more efficiently and more systematically; it also allows the user to easily pin down specific branches of information that are precisely tailored to his/her task. The implications of the relevance typology for organizing topical information will be further discussed in Chapter 15 “Conclusions and Implications”.

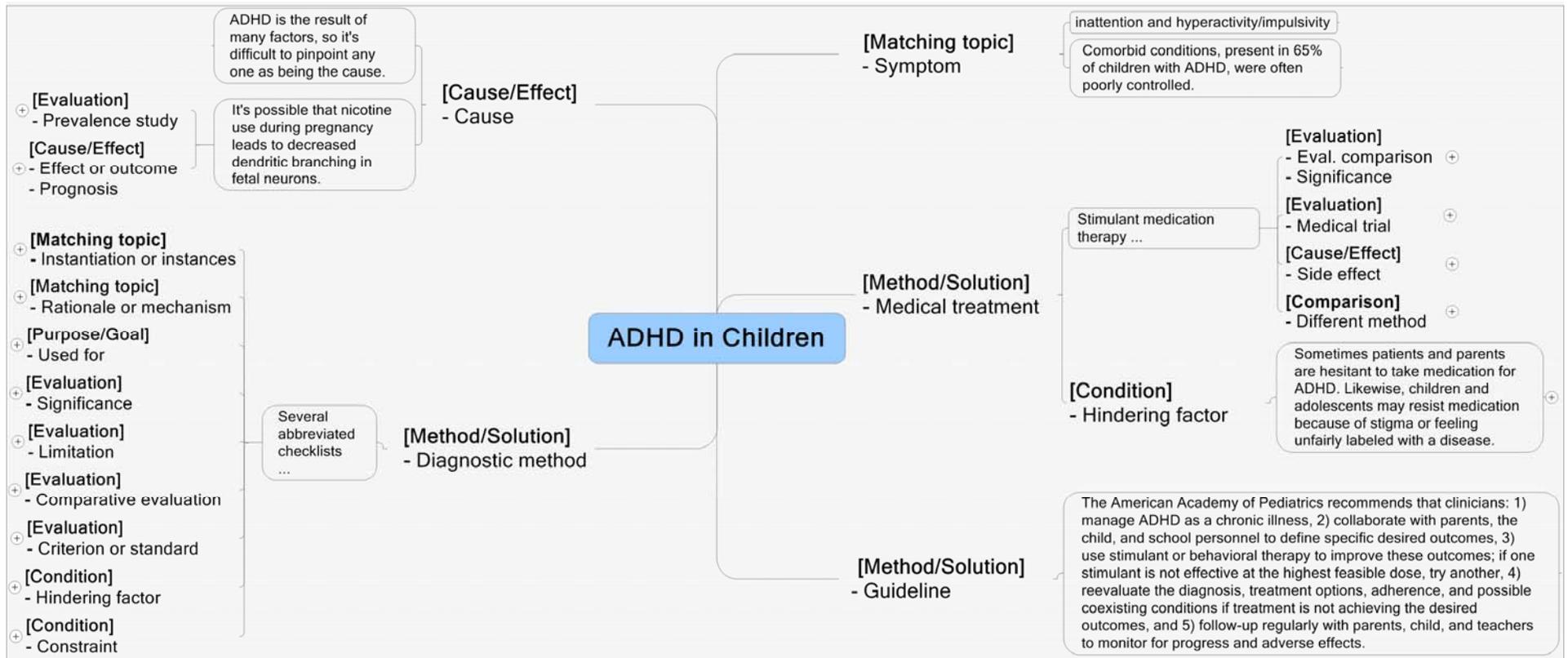


Figure 12-38 A Combined Topical map Of “ADHD In Children” From ADHD_Therapy, ADHD_Diagnosis, And ADHD_Etiology

12.3 CLiMB Image Tagging

The tags or subject descriptors assigned by 13 art librarians and art historians to 11 art images were collected in 2008 through the CLiMB project (see Section 3.2.3.3). In total, 768 unique tags are analyzed with the developed relevance typology. The coding of four images (Figure 12-16, 12-17, 12-18, 12-19) are discussed in this section as examples. To see the detailed coding of all 11 art images, please refer to Appendix F.

For images, topic/subject is a complex issue that warrants careful handling. As discussed in depth in Chapter 10, the subject analysis and topic modeling of images take place on three dimensions:

- Dimension 1: Topic modeling by image content (see Section 10.1)
- Dimension 2: Topic modeling by image meaning (interpretation) (see Section 10.2)
- Dimension 3: Topic modeling by image user and use (see Section 10.3)

Before applying the relevance relationship types from the typology to the images, we need to decide what constitutes an image topic in the first place. Three options and their associated coding implications are brought forth in the following:

1. Image topic = What is presented in the image (general);
Coding implications: everything depicted in the image is “matching” topic; only terms/tags devoted to things outside the image content are not “matching”, such as interpretation, purpose/use, method/style, evaluation, etc.
2. Image topic = What is presented as the focus of the image, e.g., the central person in a portrait represents the topic but the trees in the background of the portrait do not;

Coding implications: we need to first make a distinction between “focal” and “peripheral” image content; only terms/tags describing the focus of an image are “matching” topic, things that are depicted in the background would be “context” in this case. This could be an issue for non-representational art images which are often lack an explicit focus.

3. Image topic = The theme of the image, i.e., what the image tries to express or what the artist tries to convey through producing the image;

Coding implications: compared to image content, the theme of an image is more abstract and implicit; it is usually not directly depicted in the image and often involves a certain level of inference to get at. For a religious image, the theme (religious) now becomes the topic, it is “matching”. Strictly speaking, features directly depicted in the image are no longer “matching”, instead, they become specific manifestations of the theme (topic). This could also be an issue for non-representational abstract arts, for which it is highly subjective to determine what the theme is.

The analysis takes all these three perspectives into account, considering three kinds of image topics all at once while keeping the distinctions between them in the coding. Therefore we have

- [Matching topic]: Image content (Focal);
- [Matching topic]: Image content (Peripheral);
- [Matching topic]: Image theme.

These three types of image topics are illustrated with specific coding in Figure 12-16, 12-17, and 12-18. These examples demonstrate how the image tags could be organized into a meaningful topical structure based on the typology. They further explicate the followings:

- A distinction between *focal* and *peripheral* image content and its effect on image tagging and search;
- The application of presentation types, such as, *Reference*, *Elaboration* (both *Adj.* and *Adv.*), and *Abstraction*, to organizing image tags that fall in the category of [Matching topic];
- Special topical relevance relationships that apply to image tags, such as, *Style / Genre*, *Technique*, *Material / Medium*, *Design / Composition*, and *Detail*;
- Images are often associated with multiple time/space, such as, the time and place of events depicted in the image, creation time and place of the image; the typology is used to specify the tags and clarify the issue.

Together, the topic relevance relationships and presentation types devise a faceted structure for organizing image tags, which allows both the tagger and the seeker to specify images in a more effective way. The search and interface implications of this structure will be further discussed in Chapter 15 “Conclusions & Implications”.



Figure 12-39 A Young Woman and Her Little Boy. Artist: Agnolo Bronzino. 1540. Florentine.

(ID: 204)

Matching topic

- **Image content: Focal**
 - *Reference*
 - Boy,
 - Child {children},
 - Mother and child,
 - Woman {women},
 - *Elaboration (Adj.)*
 - Elegance,
 - Elongation,
 - Lavish,
 - Opulence,
 - Wealth,
 - *Elaboration (Adv.)*
 - Embraces,
- **Image content: Peripheral**
 - *Reference*
 - Costume,
 - Head coverings,
 - Gloves,
 - Textiles,
 - Jacquard,
 - Jewelry,
 - *Elaboration (Adj.)*
 - Red,

Effect

- **Reaction or feeling**
 - Cold,
 - Detached,
 - Hardness,

Method

- **Style or genre**
 - Figure,
 - Portrait {portraits, portraiture},
 - Group portraits,
 - Mannerism,
 - Florentine painting,
 - Italian art—16th Century {Italian art},

- **Style or genre: Detail**
 - Raking light,

Context

- **Biographic information: Artist**
 - Agnolo Bronzino {Bronzino},
- **Social background**
 - Medici court {Medici}

The distinction between *focal* and *peripheral* image content is deliberately made in the analysis, as shown in Figure 12-16:

- Image content/**Focal**: boy, child, woman, mother and child
- Image content/**Peripheral**: costume, head coverings, gloves, textiles, jacquard, jewelry

Taking the search scenario into consideration, it is easy to understand why this distinction is particularly important. Without this distinction, if a user enters an image query of “jewelry”, the above image (Figure 12-16), although not providing much detail on the item, will still come up in the search. This is likely to disappoint the user who expects a lavish close-up of jewelry. Essentially, it is a mismatch between “focal querying” and “peripheral tagging.” Conversely, if the user wants to appreciate jewelry being used in context, a close-up of jewelry in vacuum would not be satisfying, which is a mismatch between “peripheral querying” and “focal tagging”. To improve the match between image queries and image tags, it is very important to allow both the user and the tagger to specify the terms in relation to the image content.

A question may be raised: Making a two-level distinction (focal and peripheral) is better than making no distinction in the image content; why don't we devise three or more levels of finer distinction? Wouldn't that be even better and clearer? Finer gradations often lead to higher complexity both cognitively and operationally. We could arbitrarily devise 10 levels of differentiation for indexing the image content, but does that really benefit our users? The answer depends on how intuitive and useful the levels are. According to the image indexing literature, most people tend to make this focal/peripheral or foreground/background distinction when it comes to describing the content of an image. The two-level distinction is intuitive and practical in this case. In

terms of deciding the number of gradations or granularity for indexing image content or other topical aspects, we always have to consult the user and the use context. The magic number lies with practice which is in turn guided by the forever true cost-benefit principle.



Figure 12-40 The Martyrdom of Saint Bartholomew. Artist: Jusepe de Ribera. 1634. Spanish.

(ID: 207)

Matching topic

- **Image theme**
 - martyrdom {martyr},
 - mystical experience {mystical},
 - biblical,
 - religious,
- **Image content: Focal**
 - *Reference*
 - nude body,
 - old man {man, old},
 - Saint Bartholomew {St. Bartholomew, saint, saints},
 - executioner {executioners},
 - knife,
 - *Elaboration (Adj.)*
 - Bearded {beard, bearded man},
 - physical anguish {anguish},
 - profound emotion {emotional},
 - luminous {light},
 - *Elaboration (Adv.)*
 - expressive hands,
 - gestures,
 - confronts,
 - flayed alive {flayed, flaying},
 - torture,
- **Image content: Peripheral**
 - *Elaboration (Adv.)*
 - lurking,

Comparison

- **By similarity: Metaphor and analogy**
 - Christ's sacrifice and crucifixion {Christ metaphor},

Method

- **Style or genre**
 - Christian symbolism {symbolism},

- Realism {unremitting realism},
- Baroque art {Baroque},
- Spanish art—17th Century {Spanish art, Spain, Spanish},
- European,
- **Style or genre: Design or composition**
 - Symbolic use of light,
 - Dramatic lighting,
 - Deep shadows {shadows, dark},
 - Tenebrism,
 - Chiaroscuro {contrast},
 - Diagonal composition {diagonals},
 - Dramatic composition,
 - X-shaped composition {forms a cross, cross},
 - Bound figures {bound, figure},
 - Influence of Caravaggio's dramatic lighting {influence of Caravaggio, influence, Caravaggio, Caravaggesque},
- **Style or genre: Detail**
 - Raking light,
- **Technique**
 - painting {paintings},

Context

- **Biographic information: Artist**
 - Jusepe de Ribera {Ribera},
- **Biographic information: Time/period**
 - 1634,
 - 17th century,

Effect

- **Reaction or feeling**
 - Intensity,
- **Effect / Outcome**
 - Pulls the viewer into the scene,

The “Presentation” types (see detailed discussion in Section 11.2), subsuming *Definition*, *Reference*, *Restatement*, *Elaboration*, *Interpretation*, and *Summarization (Abstraction)*, turns out to be an important aspect for analyzing the image tags. Because the majority of tags fall into the direct relevance category, or [Matching topic], we often see a mixture of tags clutter under [Matching topic]. To sort out these clutters and to better organize the tags, the presentation types are analyzed for direct relevance as an orthogonal, subsidiary facet. Figure 12-17 illustrates the presentation types of *Reference*, *Elaboration (Adj.)*, and *Elaboration (Adv.)*. In this example, tags under *Reference* refer to the content depicted in the image; tags under *Elaboration* provide second-level details of the image content, which in turn is implemented through two types of attributes: adjectival attributes (feature-related) and adverbial attributes (motion-related).

Figure 12-18 shows the organized tags for a modern non-representational art image.



Figure 12-41 Red Rose Cantata. Artist: Alba Thomas. 1973. American. (ID: 224)

Matching topic

- **Image theme: Title**
 - Red Rose Cantata
- **Image theme**
 - *Reference*
 - musical composition {composition},
 - music,
 - song,
 - synaesthesia,
 - cantata,
 - visual cantata,
 - visual rhythm,
 - *Abstraction*
 - Nature,
 - childhood memories {childhood impressions},
- **Image content**
 - *Reference*
 - Color,
 - Red,
 - White,
 - Shape,
 - Spots,
 - Dots,
 - Lines,
 - Variations,
 - Pattern,
 - *Abstraction*
 - Petals,
 - *Elaboration (Adj.)*
 - Red punctuated by white intervals {intervals},
 - Vertical splashes of red {vertical splashes, vertical, splashes},

Comparison

- **By similarity: Analogy or metaphor**
 - leopard print,

Method

- **Style or genre**
 - Abstract arts {abstract, abstractions, Abstract Expressionism, Abstract Expressionist, abstract representation, abstract painting},
 - New York School,
 - American Art—20th Century,
 - Contemporary,
 - Modern,

- Post-modern,**Style or genre: Design or composition**
 - rhythmic arrangement,
 - lyrical repetition of color and shape {repetition},
 - wallpaper,
 - contrast,

- **Style or genre: Detail**
 - Brushstrokes,
- **Technique**
 - Painting {paintings},

Context

- **Biographic information: Artist**
 - Alma Woodsey Thomas {Alma Thomas, Thomas, Alba},
 - Regionalist,
 - Female artist {female artists, woman artist},
 - Washington DC, artists {Washington, DC artists},
 - African American artists,
 - Modernist,
- **Biographic information: Nationality or original area**
 - American,
 - Washington, D.C.,

Effect

- **Reaction or feeling**
 - Musical,
 - Rhythmic,
 - Harmony,
 - Tension.

Time/Space turns out to be a tricky issue for tagging art images. In particular, time/space depicted in the artwork is often different from the time/space when/where the artwork was created. For the purpose of effective image search, it is important to differentiate the associated time/space terms. An image could have many nationalities and time periods associated with it. Figure 12-19 is an example.



Figure 12-42 The Death of the Earl of Chatham.

Artist: John Singleton Copley. 1779. American. (ID: 219)

(See detailed coding in appendix F)

This art image has several geographical tags assigned to it, as summarized and classified in Table 12-3.

Table 12-23 Geographical Tags Assigned To the Image “The Death of the Earl of Chatham”

| Tags | Indication of the tags | Relevance code |
|---|---|--|
| English, London, House of Lords, ... | to describe the place where the historical scene depicted in the artwork happened (The tags are not directly from the image content but provide context for what is depicted in the image) | [Context] Environmental setting: Physical location |
| American, Boston, ... | to indicate the nationality of the artist and where the artwork was created | [Context] Biographic information: Nationality or origin |
| Europe {European} | to explain where the artist picked up his painting style in the early years | [Method/Solution] Style or genre |

The same applies to Time/Period, such as for the image, *The Martyrdom of Saint Bartholomew* (Figure 12-17), the time period depicted in the image is different from the time period when the artwork was created.

Chapter 13. Empirical Data Analyses (2):

Type-Centric Manifestations: Function-Based

Chapters 13 and 14 pull together coding examples from the three datasets and organize them by relevance type. It helps to develop a fuller view of the topical relevance relationships across domains.

As shown in earlier discussion, the first two facets of the relevance typology, *Functional role* and *Mode of Reasoning*, are the focus of the empirical analysis. This Chapter also focuses on these two facets and organizes the coding examples by the top-level relevance categories under each facet, specifically,

Chapter 13. Functional role / Function-based topical relevance relationships

- 13.1 Matching topic (direct relevance)
- 13.2 Evidence
- 13.3 Context
- 13.4 Condition
- 13.5 Cause / Effect
- 13.6 Comparison
- 13.7 Evaluation
- 13.8 Method / Solution
- 13.9 Purpose / Goal

Notes: Considering the large number of relevance categories in the typology and the many examples collected, it is overwhelming to discuss all the selected examples

for all the categories. Chapter 13 selects a few good examples for a more focused discussion; for a fuller version with more examples, please refer to Appendix D (Chapter 13 with more coding examples).

Chapter 14. Mode of reasoning / Reasoning-based topical relevance relationships

- 14.1 Generic inference
- 14.2 Causal-based reasoning: Forward inference
- 14.3 Causal-based reasoning: Backward inference
- 14.4 Comparison-based reasoning
 - 14.4.1 Reasoning by analogy
 - 14.4.2 Reasoning by contrast

Notes: *Rule-based reasoning, Generalization, Transitivity-based reasoning and Dilemma-based reasoning* are not sufficiently represented in the selected datasets of this study.

13.1 [Matching Topic (Direct Relevance)]

Exactly and explicitly on topic; it is the most straightforward and intuitive relevance relationship type, with minimal, if any, inferential reasoning involved.

Good direct evidence has a wealth of specific details about a topic and has the most significant impact on overall topical relevance.

[Matching topic] is the most recognized and emphasized topical relevance type in both research and practice. It has become the central meaning of topical relevance and is even mistaken as the only meaning of topical relevance. This misperception restricts the attention to a very narrow focus of topical relevance. The major goal of this inquiry is to broaden our vision to the often ignored non-matching topical relevance types.

Depending on the particular domain and the specific dataset being discussed, [Matching topic] can be defined differently. In other words, the definition of [Matching topic] is “contextualized”, which also applies to non-matching topical relevance types. Based on the current analysis, [Matching topic] has the following interpretations:

- **MALACH oral history:** mostly Holocaust survivors' experiences that directly match the user topic, for example,

| | |
|-----------------------|---|
| Topic | Strengthening Faith by Holocaust Experience |
| Matching topic | A survivor talks about how an elderly Salonikan Jew helped strengthen their religious faith during their incarceration; "we called him grandfather. He always said to us 'you must say Kaddish every night.' I was forced to dispose of corpses in the camp at the time. One day I came back from work and said to him 'Are you crazy?' He said: 'No, something good will happen one day after this. We have to pay a very dear price but we're gonna have our own state of Israel.' And it happened. I survived with my faith and went to Israel." |

- **Clinical questions & answers:** given the topic of the questions is disease- or symptom-centered (see discussion in Section 12.2.2), topic-matching information, by definition, refers to symptom descriptions and disease manifestations, for example,

| | |
|-----------------------|--|
| Question | What are the indications for evaluating a patient with cough for pertussis? |
| Topic | Pertussis |
| Matching topic | Cough longer than 2 weeks, inspiratory whoop, posttussive vomiting, coughing paroxysms, and absence of fever are commonly associated with pertussis... |

- **CLiMB image tagging:** refers to Image content (both focal and peripheral) and Image theme, see discussion in Section 12.2.3, for example,



Figure 12-17 The Martyrdom of Saint Bartholomew.

Artist: Jusepe de Ribera. 1634. Spanish. (ID: 207)

Matching topic

- **Image theme**
 - martyrdom {martyr},
 - mystical experience {mystical},
 - biblical,
 - religious,
- **Image content: Focal**
 - *Reference*
 - nude body,
 - old man {man, old},
 - Saint Bartholomew {St. Bartholomew, saint, saints},
 - executioner {executioners},
 - knife,
 - *Elaboration (Adj.)*
 - Bearded {beard, bearded man},
 - physical anguish {anguish},
 - luminous {light},
 - profound emotion {emotional},
 - *Elaboration (Adv.)*
 - expressive hands,
 - gestures,
 - confronts,
 - flayed alive {flayed, flaying},
 - torture,
- **Image content: Peripheral**
 - *Elaboration (Adv.)*
 - lurking,

The topic-matching examples gathered from the analyses are organized and discussed by *Presentation types* (see Chapter 11; Table 11-1) in the following.

In the analyses, the forms of presentation are analyzed primarily for the [Matching topic] relevance category for two reasons:

1. [Matching topic] is the utmost important topical relevance relationship that worth more attention and more in-depth analysis;
2. [Matching topic] has many pieces of information that can be better organized by using the presentation facet for further subdivisions.

However, it is important to note that in principle the presentation types can be applied to every relevance category in the typology, for example, *Definition* as a presentation type can deliver information that is matching topic, it can also be presenting context, or comparison, etc.

13.1.1 Reference

For the MALACH data, as opposed to Elaboration, the presentation form of Reference provides information that briefly mentions the topic without giving further detail. See the two MALACH examples with comments embedded in the following.

For the image data, *Reference* is straightforward and heavily used for tagging, by directly pointing out what is depicted in the image without much elaboration. *Reference* accounts for a large number of tags for “Image Content”, both focal and peripheral, as

shown in the earlier example (see Figure 12-16). The presentation type of *Reference* accounts for many (if not most) image tags collected for the study; it is very important for both describing and searching images.

Reference

| | |
|------------------|--|
| *Topic | Eichmann witnesses |
| Reference | Testimony of survivor who mentions briefly that she came into contact with Eichmann, but no specific description of the encounter. |
| Note | The segment refers to the encounter with Eichmann, but it provides minimal information on topic. |

| | |
|------------------|---|
| *Topic | Jewish children in schools |
| Reference | HF speaks of the schools which he attended. He recalls that anti-Semitism was present in the schools. |
| Note | Survivor HF touches on the topic of anti-Semitism in school; it is referring or mentioning without much detail. |



Figure 12-16 A Young Woman and Her Little Boy.

Artist: Agnolo Bronzino. 1540. Florentine. (ID: 204)

***Matching topic**

- **Image content: Focal**

- Reference
 - Boy,
 - Child {children},
 - Mother and child,
 - Woman {women},

- **Image content: Peripheral**

- Reference
 - Costume,
 - Head coverings,
 - Gloves,
 - Textiles,
 - Jacquard,
 - Jewelry,

13.1.2 Pointer

Pointer by itself gives minimal (if any) information directly on the topic but it points you to a publication, a person, a website, a place, etc. that may host a wealth of relevant information. Pointer is not the relevant information, but the source of relevant information.

***Topic** Wallenberg rescues Jews

Pointer Dr. Cha worked with Wallenberg closely in Hungary.

Note Dr. Cha is a pointer person worth researching on.

***Topic** Nazi Eugenics Policy (Dr. Mengele's medical experiments)

Pointer EK talks about her desire to found a museum dedicated to preserving the experiences of the Mengele's twins and mentions the organization of C.A.N.D.L.E.S.

Note Pointer as an organization. C.A.N.D.L.E.S. (Children of Auschwitz Nazi Deadly Lab Experiments) is an organization dedicated to the experiences of victims of cruel human medical experiments in Auschwitz.

***Question** What is the most effective treatment for ADHD in children?

Topic ADHD in children

Pointer Useful information for physicians and parents regarding medication use and behavioral therapy are described in the American Academy of Pediatrics ADHD Toolkit available at www.nichq.org/resources/toolkit

Note A pointer to a treatment method of ADHD; it is a pointer of [Method/Solution] rather than [Matching topic].

13.1.3 Definition

Definition is a highly formalized type of presentation which restricts its application to a formal context. Oral history is not formal; it is rare for a Holocaust survivor to provide some kind of formal definition in his reflection of life stories. Image tags, mostly 1~3 words in length, are too brief to define anything. On the contrary, in the highly specialized medical domain, definitions are very commonly used for defining a disease (condition), a medication, or other technical terms.

| | |
|-------------------|--|
| *Question | What are the indications for evaluating a patient with cough for pertussis? |
| Topic | Pertussis |
| Definition | The Centers for Disease Control and Prevention and the World Health Organization describe the clinical case definition for pertussis as a cough illness lasting at least 2 weeks with at least 1 of the following: paroxysms of coughing, inspiratory whoop, or posttussive vomiting, without other apparent cause. |
| Note | Defining a disease (condition): Pertussis |

The following two examples are definitions of relevance categories other than [Matching topic]. They demonstrate that the presentation facet can be applied to other relevance types as well.

| | |
|-------------------|---|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in Children |
| Definition | Atomoxetine , a specific norepinephrine reuptake inhibitor, is an FDA-approved alternative to stimulants for ADHD treatment in children and adolescents. |
| Note | Defining a medication for ADHD. It is a definition of [Method/Solution], instead of [Matching topic]. |

***Question** Does a Short Symptom Checklist Accurately Diagnose ADHD?

Topic ADHD in Children

Definition The **effect size** is the difference in mean scores between 2 populations divided by an estimate of the individual standard deviation.

Note Defining a technical term involved in the rationale/mechanism of ADHD diagnostic checklists. It is a definition of [Cause/Effect] – Rationale/Mechanism, instead of [Matching topic].

13.1.4 Summarization & Abstraction

Summarization captures the essence of the data by leaving out second-level details, whereas *Elaboration* supplements second-level details (as discussed next). *Abstraction* goes one step further than *Summarization* by even eliminating the material footprints from the data; it is often alleviated to a more abstract level (as shown in the image tagging examples). In many cases, there is only a thin line between *Summarization* and *Abstraction*. A major distinction between the two is, from *Summarization* we can still recover the original data to some extent, whereas from *Abstraction* we can hardly recover anything for concrete links to the data. This distinction is illustrated by the following image tagging example (Figure 13-1):



Figure 13-43 Still Life with Fruit and Carafe.

Artist: Pensionante del Saraceni. 1610/1620. Roman. (ID: 228)

***Matching topic**

- **Image content: Focal**
 - *Reference*
 - apples,
 - pear,
 - watermelon {melons},
 - wine, ...
 - *Summarization*
 - fruit,
 - foodstuffs,
 - *Abstraction*
 - still life,

The followings are examples for *Summarization*:

| | |
|----------------------|---|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in Children |
| Summarization | In numerous systematic reviews, RCTs, and meta-analyses, 70% of children responded to stimulant medications with short-term improvements in ADHD symptoms (inattention and hyperactivity/impulsivity) and academic achievement. |
| Note | An example of <i>Summarization</i> . |

| | |
|----------------------|--|
| *Topic | Death marches |
| Summarization | Most of the marches described by survivors were from Aushwitz-Birkenau, as the SS evacuated the camp as the Red Army approached, and led the survivors through Czechoslovakia and into concentration camps in central Germany, such as Belsen and Buchenwald |
| Note | This topic note summarizes individual descriptions on marches that took place during 1945 as a consequence of allied advances. |

The followings are examples for *Abstraction*:

| | |
|--------------------|--|
| *Question | Do TCAs or SSRIs have any effect on decreasing tinnitus, and if so, in what dosage? |
| Topic | Tinnitus |
| Abstraction | Therapy usually involves a multidisciplinary approach. It should include the effect of tinnitus on the patient, the investigation and treatment of any identifiable pathology, and, if the tinnitus is found to be idiopathic, to reassure the patient of its benign nature. |
| Note | The first sentence gives a high-level abstract statement; the following paragraph (in light grey) provides detail for the statement. |

| | |
|--------------------|---|
| *Topic | People making hard decisions during the Holocaust |
| Abstraction | SR reflects on the difficult choices people in the ghetto were forced to make in order to survive. |
| Note | A case of <i>Abstraction</i> , by abstracting the individual dilemmas to “difficult choices”. It states the point without specifying what the difficult choices were. |

13.1.5 Elaboration

Elaboration elaborates:

- by giving specific examples or instances,
- by discussing in depth as well as in breadth, and
- by providing second-level details.

In the following, the Elaboration coding examples are discussed in these three groups accordingly. These three groups have different emphases but they are not exclusive. In fact, in the analyzed data, it is often the case that we have instances describing a topic in depth or in breadth. In the coding, the same information can have multiple *elaboration* codes assigned to it. The coding examples here are used to illustrate their different emphases and should not to be taken exclusively.

| | |
|--------------------|---|
| *Topic | Wallenberg rescues Jews |
| Elaboration | Found out about a house of Mr. Weiss who had relations with the Swiss embassy, he let people in who had connection with a Zionist organization, ...People from the Zionist organization needed young people who spoke several languages, selected in a group of 12, organized by Wallenberg of Sweden Swiss ambassador, Lutz, of Switzerland, organized ghetto in nice part of Budapest, an international Cartier, checking in people with a Schutzpass, passports issued by Sweden, the Vatican, and Spain, thousands of people were coming through. |
| Note | This segment directly matches the topic by elaborating the method of Wallenberg's rescue plan. It describes Wallenberg's rescue in general rather than restricting to one individual's experience (<i>instance</i>). |

•

13.1.5.1 Elaboration: Instance (Instantiation)

Although differentiated in the theoretical literature analysis, the presentation types of *Example/Exemplification*, *Instance/Instantiation*, and *Illustration* are found to be considerably overlapping with one another in the empirical analyses and therefore grouped together in this discussion.

The level of detail makes a difference. A good *Elaboration* with rich detail and uncovering deeper issues makes it *Amplification*, as discussed in the following section.

| | |
|---------------------|---|
| *Topic | Wallenberg rescues Jews |
| Instance (1) | Copy of the Schutzpass which belonged to MS's mother and contained the signature of Raoul Wallenberg. |
| Note | This segment directly matches the topic as an instance of being rescued. |
| Instance (2) | AB recalls hiding in Budapest in 1943. AB recalls being taken to a Swedish protected house in 1944 by Raoul Wallenberg. |
| Note | This segment directly matches the topic as an instance of being rescued. |

13.1.5.2 Elaboration: Amplification & Extension

In terms of elaboration, *Amplification* tends to move into a greater “depth” whereas *Extension* tends to move into a broader “scope”. *Amplification* provides lots of detail, lays out the deeper thinking, and gives perspectives. *Extension* covers non-typical cases and thus broadens the perspective and enriches the understanding of a topic; it is used for information that deviates from the typical or the majority that is still directly on topic but not exactly in the thick of what is typically considered “direct”, in this sense, the scope of *Matching topic* is "extended". *Extension* provides unique information on a topic and has a more important value.

| | |
|----------------------|--|
| *Topic | Wallenberg rescues Jews |
| Amplification | WB states he delivered official and forged protection papers in Budapest for Raoul Wallenberg in 1944. <i>Audio detail:</i> “He had joined the Underground and aided the refugees in getting to Romania and out of Eastern Europe to Palestine. ... Raul Wallenberg came to Budapest. The operation became strong when Wallenberg arrived. WB was able to copy Wallenberg’s official papers for those who could not obtain real ones. Wallenberg set up the Swedish protective houses. Wallenberg used him and others to make and deliver the papers. They tried to get the Polish refugees out first because they could not speak Hungarian and were noticed.” |
| Note | An example of <i>Amplification</i> . This segment provides rich insider detail about the method and the strategy of Wallenberg’s rescue activities. |

***Topic** Wallenberg rescues Jews

Extension WB continues to discuss his involvement with Raoul Wallenberg in Budapest. He tells of making and delivering false protection papers.

Audio detail: “No official list of people who were marked for help by Wallenberg. Many did not know that their papers were forged. A list would have identified people to the Germans and they would have been killed...no records, no proof. He helped in the printing and the delivery of the papers. He knew Hungarian. Had gentile papers with him if he was stopped. Knew the Budapest sewer system and could enter building through the sewers. Had specific assignments without knowing too much...just in case he was captured and tortured he could not divulge too much information. Always scared but it did not stop him from functioning. It was his choice to be involved with those activities.”

Note An example of *Extension*. In addition to further reveal the process of Wallenberg’s rescuing activities, this segment presents a unique perspective as a rescuer: the challenges and dangers faced, the motivation behind, and the decision made, which makes it special compared to other Wallenberg’s rescue segments.

13.1.5.3 Elaboration: Adjectival Attribute & Adverbial Attribute

The given information elaborates the topic through providing second-level details, both *adjectival* and *adverbial*, which is best illustrated with the image tagging examples (see discussion and examples in Section 12.2.3 and Appendix F). One image tagging example is extracted in the following Figure12-17.

In the medical domain, “Manifestations/Symptoms”, “Prevalence” can be seen as *adjectival* attributes or qualifications of the disease (condition).

In addition to elaborate an “object” (topic) with adjectival or adverbial “attributes” (information), there are other means to elaborate, such as specifying a “class” (topic) with “subclasses”(information), or specifying a “set” (topic) with “set members” (information), or specifying “whole” (topic) with “parts” (information), or specifying a “process” (topic) with “steps” (information).



Figure 12-17 The Martyrdom of Saint Bartholomew.

Artist: Jusepe de Ribera. 1634. Spanish. (ID: 207)

***Matching topic**

• **Image content: Focal**

- *Reference*
 - nude body,
 - old man {man, old},
 - Saint Bartholomew {St. Bartholomew, saint, saints},
 - executioner {executioners},
 - knife,
- *Elaboration (Adj.)*
 - Bearded {beard, bearded man},
 - physical anguish {anguish},
 - profound emotion {emotional},
 - luminous {light},

○ *Elaboration (Adv.)*

- expressive hands,
- gestures,
- confronts,
- flayed alive {flayed, flaying},
- torture,

• **Image content: Peripheral**

○ *Elaboration (Adv.)*

- Lurking

***Question** What are the indications for evaluating a patient with cough for pertussis?

Topic Pertussis

Symptom Cough longer than 2 weeks, inspiratory whoop, posttussive vomiting, coughing paroxysms, and absence of fever are commonly associated with pertussis...
Elaboration (Adj.)

Prevalence Ten prevalence studies of adolescents and adults seeking medical attention for a prolonged cough (defined variously as >1~4 weeks) found acute pertussis in 12% to 32%.
Elaboration (Adj.)

13.2 [Evidence] – Circumstantial (Indirect) Evidence

Making inference about a topic is the central feature of indirect relevance.

Indirect evidence, or inferential or circumstantial evidence, is implicit information on a topic. While direct evidence *is* the answer, indirect evidence can be used to *infer* the answer; it is one or more inferential steps away from the answer. After “joining the dots” it contributes as much to understanding a topic as direct evidence. Indirect or circumstantial evidence is often used in court to establish facts. Both direct and indirect evidence are valid for establishing a fact but they may differ in the level of certainty: the inferential relationship between A and B may be subject to uncertainty, that is, given A we can infer that B with a given probability, also known as inferential strength (Kadane & Schum, 1996). To be recognized and further used to draw a conclusion, the inferential strength of indirect evidence needs to be sufficiently high.

Indirect relevance plays an important role in gleaning relevant information from the Holocaust survivor interviews. Survivors usually go into great detail of their personal experience and feelings, without clearly describing or even explicitly mentioning the events or phenomena asked by a topic (request). Direct discussion is rare for many topics, especially for those looking for information on particular phenomena rather than specific events. In these cases, indirect evidence, which is relatively more available, is usually very helpful for leading us to conclusive points.

Reasoning or inference is at the center of establishing “Circumstantial (indirect) evidence”; there is no way to separate the two. Therefore, in the coding, circumstantial evidence is always coded with the specific reference(s) involved in the case. It is true to claim that, specific modes of reasoning involved *define* specific types of circumstantial evidence. The coding examples of “Circumstantial (indirect) evidence” will be discussed under the *Reasoning* facet of the typology (Chapter 14).

13.3 [Context]

Contextual information helps us to better understand or describe a central event by seeing the general picture where the central event fits in. It can be the setting or environment, the factors or effects, something allowing or hindering an event, something happening behind the scene, etc. To conclude, context evidence is information not specifically *on* a topic, but *surrounding* the topic. Contextual evidence is something we use to backup an argument but not to base an argument on.

There are two major sense of “surrounding” a topic: by scope and by time/sequence.

- [Dimension 1] Context **by scope**: Doing research on a specific event is similar to using a camera to take pictures. If we focus only on the event, we collect directly or indirectly relevant information that is right on target. By adjusting the lens, we start to see the background and gain a broader view on the target event. In this sense, context evidence is something happening in the background that enriches our understanding of what is going on in the foreground. It sets up a big picture on both physical and social dimensions. Specifically, “Context by scope” includes the following sub-categories:

- Context as scope
- Context as framework
- Context as environmental setting
 - Physical location
- Context as social background
 - Political
 - Cultural
 - Religious

- These sub-categories are further broken down as adapted to the specific empirical data. They are explicated with coding examples in the following.
- [Dimension 2] ***Context by time and sequence***: This is the temporal dimension. It is concerned with the things that happened close to the target event in time; it is also concerned with giving an overall *sequence* within which the central event (topic) takes place. While the first dimension describes the background *at* the time, this dimension describes something that happened immediately *before* or *after* a target event. The preceding and following events link the isolated descriptions of events together to provide a more continuous view over the events' development. Unlike forward- and backward-inference evidence, their relations to a target event are certain and explicitly stated. Specifically, "Context by time and sequence" includes the following sub-categories:
 - Context as time/period
 - Context as sequence
 - Context as precedence
 - Preceding event (historical)
 - Preceding experience (personal)
 - Preceding status/stage
 - Preparation
 - Context as subsequence
 - Subsequent event (historical)
 - Subsequent experience (personal)
 - Subsequent status/stage
- Just as Dimension 1, these sub-categories are further specified in the data analyses, as shown in the examples.

13.3.1 Context by Scope

Context by scope provides broader information on a topic. Another way to think about broader-scope contextual information is that it is essentially the opposite of Elaboration or Specification: Whereas Elaboration specifies a “class”(topic) with “subclasses”(information), or specifies a “set”(topic) with “set members”(information), or specifies “whole” (topic) with “parts” (information), or specifies a “process” (topic) with “steps” (information), the Broader scope is reversed, it provides the “subclass” (topic) with broader “class” information, provides the “set member” (topic) with broader “set” information, provides the “part” (topic) with “whole” information, and provides the “step” with more holistic “process” information.

In fact, Context as environmental setting can be seen as a case of “part–whole”, with the topic or central event being the “part” and the “whole” being the environmental information surrounding it. Likewise, Context as social background can be seen as a case of “part–whole” as well (as illustrated by example below) or as “member–set” or as “subclass–class” depending on the context. Here is an example.

| | |
|-------------------|--|
| *Topic | Jewish children in schools |
| Population | <i>Audio detail:</i> “Once Olympics were over, anti-Semitism really blossomed. In 1938, in November, I got up in the morning took the metro. One man was reading the newspapers and ranting about what they are doing to Jews, burning synagogues, deporting Jews. Got off the trolley and saw burning synagogues, etc. Well-dressed people cheering, not just thugs. Shops destroyed and I'm walking to the school and no class.” |
| Note | The segment discusses anti-Semitism not particularly in schools but in general during the time period. It provides broader social political context. It is also a part–whole relationship, with “anti-Semitism” as the whole and “anti-Semitism in school” as the part. |

The specific context relevance types by scope, *Context as scope*, *Context as framework*, *Context as environmental setting*, and *Context as social background* are discussed respectively in the rest of this section.

13.3.1.1 Context as Scope

One specific type of Scope is Population. In the analyses, Scope: Population is widely used in various medical contexts, just to name a few,

- Indication of the population scope of certain prognoses:

| | |
|-------------------|--|
| *Question | What are the indications for evaluating a patient with cough for pertussis? |
| Topic | Pertussis |
| Population | Infants aged <6 months with pertussis are at particular risk for atypical presentations and serious complications. |

- Indication of the population scope of medical trials and research design:

| | |
|------------------------|--|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Population (1) | A forty-year review looked at 135 trials and 413 RCTs of methylphenidate in over 19,000 children with an average age of 8.8 years (range, 8.3-9.4 years) for an average duration of 6 weeks (range, 3.3-8.0 weeks). |
| *Population (2) | A large randomized trial of 579 children with ADHD (20% girls) aged 7 to 9.9 years compared outcomes of 4 treatment strategies: stimulant medication, intensive behavioral treatment, combined stimulant medication and behavioral interventions, and standard community care. |

- Indication of the applied or restricted population scope of specific medications:

| | |
|------------------------|---|
| *Question | Does quinine reduce leg cramps for young athletes? |
| Topic | Leg cramps |
| Population (1) | Quinine is better established as an effective treatment for nocturnal leg cramps in the general adult population. |
| *Population (2) | Of note, quinine is a category X drug and should not be used during pregnancy. |

•

13.3.1.2 Context as Framework

Context as framework in the typology can also be seen as a case of “part–whole”, which sets up a systematic framework (whole) within which a topic (part) functions. No specific manifestations are identified for Framework in the current analysis.

13.3.1.3 Context as Environmental Setting

Descriptions of the physical setting and environmental factors, such as the general camp life, living conditions, and medical conditions for the MALACH topic. It also includes things happening in parallel to the target event in the same environment, such as the type of labor performed by the survivor in the camp (MALACH); with this information, the reader is able to establish a fuller picture of what the environment was like for hosting the target event.

MALACH example:

| | |
|-----------------------------------|---|
| *Topic | Children's art in Terezin |
| Environmental setting (1) | EW describes in detail the hygienic and sanitary conditions in the camp of Terezin and how conditions were better for children. <i>Audio detail:</i> "...How they washed their underwear, they do not remember. How they washed something, because they remember that the big laundry once in a month or so. They would be called that they could give it to some big laundry and they would bring it back clean." |
| *Environmental setting (2) | They [authorities in the camp] allowed the children to play, sing and draw. So EW was preoccupied most of the day, they were not allowed to work, they were all age 11-12-13 years old. By age 13 they [authorities] put them to work. But also not 8 or 9 hours, only half a day work and most of the children worked in the gardens of Terezin. |
| Note | Although not immediately related to artistic performance (see the matching-topic amplification in Section 13.1.5 <i>Elaboration</i>), information about specific living conditions (hygiene, etc.) and daily activities (play, labor, etc.) in children's house in Terezin provides relevant context. |

Example collected from clinical questions and answers:

| | |
|--|---|
| *Question | What is the differential diagnosis of chronic diarrhea in immunocompetent patients? |
| Topic | Chronic diarrhea |
| Physical location: Country | A case series study from India evaluated 47 children over 6 months of age who had diarrhea for more than 15 days and were unresponsive to medications (mostly antibiotics) or relapsing after treatment. |
| Physical location: Type of location | Five case series of chronic diarrhea patients were identified. The largest adult study evaluated 193 patients referred to a tertiary-care center for diarrhea. |

CLiMB image tagging example:



Figure 12-19 The Death of the Earl of Chatham.
Artist: John Singleton Copley. 1779. American. (ID: 219)

| *Tags | Indication of the tags | Relevance code |
|--|---|--|
| English, London, House of Lords, London House of Lords, | To describe the place where the historical scene depicted in the artwork happened (The tags are not directly from the image content but provide context for what is depicted in the image) | [Context] Environmental setting: Physical location |

13.3.1.4 Context as Social Background

This subtype of context relevance addresses more intangible elements of social, political, and cultural aspects at the time when the target event happened. Most historical events did not happen in a vacuum; instead, they are better described as the highlights of some ongoing trend at the time. We better understand a historical event or phenomenon if we look at it in its broader social context.

MALACH examples:

| | |
|---|--|
| *Topic | Jewish-gentile relations in Poland |
| Social background: Political (1) | He discusses the rise of anti-Semitism in Poland after the death of Jozef Pilsudski. |
| Social background: Political (2) | He tells that all the government offices in Nowogrodek were staffed by non-Jewish Poles. |
| Policies and laws | MG discusses the separation of Jews and gentiles in Miechów. He recalls that Jews were not allowed to attend public high schools. |
| Social background: Religious | <i>Audio detail:</i> “Catholic teaching was permeated in the teaching everyday – no matter what the class, Catholic was ingrained in the education. Some kid would call me a ‘Christ killer’ – the Jews were blamed for killing the big guy – not a good thing for the Jews. I was 6/7 years old at the time, didn’t understand what a Christ killer was.” |
| Note | Social, political, and religious aspects come together to shed light on the Jewish –gentile relations in Poland. |

“Social background” also occurs in the clinical questions and answers:

| | |
|--------------------------|---|
| *Question | Does quinine reduce leg cramps for young athletes? |
| Topic | Leg cramps |
| Policies and laws | In 1994 the Food and Drug Administration (FDA) issued a statement banning over-the-counter sale of quinine for nocturnal leg cramps, citing lack of adequate data to establish efficacy and concern for potential toxicity. |
| Note | Related FDA policy of quinine for treating leg cramps. It is not directly describing the effect of quinine but it is closely related and important enough to inform readers of interest. |

Image taggers also assigned tags to indicate the social background associated with the image content, as shown in the following:



Figure 12-16 A Young Woman and Her Little Boy.
Artist: Agnolo Bronzino. 1540. Florentine. (ID: 204)

| *Tags | Indication of the tags | Relevance code |
|--------------------------|--|--------------------------------|
| Medici court, Medici, | <p>The opulence and impressive display of the portrait and the prestige of the sitters indicate that they must have been highly connected to <i>Medici circles</i>. [The Mèdici family was a powerful and influential Florentine family from the 15th to 18th century. The family had amongst its members, the likes of three popes - Leo X, Clement VII, and Leo XI, numerous rulers of Florence.]</p> <p>The tags provide social background related to the depicted sitters and hint on their prestige, coldness, and vulnerability.</p> | [Context] Social background |

13.3.2 Context by Time and Sequence

The second major dimension of [Context] is by *Time/Sequence*. It includes the indication of time/period for a central topic, the sequence of events, as well as the preceding and subsequent topic-related information.

13.3.2.1 Context as Time/Period

| | |
|--------------------|--|
| *Topic | Death marches |
| Time/Period | LF talks about her liberation by the Soviet army during a death march in January 1945. |

| | |
|--------------------|--|
| *Question | Urology after a renal biopsy. His creatinine has been stable for years, although slightly elevated at 1.37, and his blood pressure and proteinuria are normal while he takes his enalapril. What is his prognosis? |
| Topic | Urology |
| Time/Period | When IgA Urology was initially described in the 1970s it was thought to be a benign condition of recurrent hematuria typically accompanying upper respiratory infections. |
| Note | Gives the time/period for a misperception of the disease. |



Figure 12-19 The Death of the Earl of Chatham.
Artist: John Singleton Copley. 1779. American. (ID: 219)

| *Tags | Indication of the tags | Relevance code |
|---|---|---|
| 7th April 1778, 7 April 1778, C18th, 18th English, | The tags specify the date of the historical scene depicted in the image: On 7 April 1778, of William Pitt, the 1st Earl of Chatham, suffered a stroke in the midst of a debate about the colonial revolutionaries in London's House of Lords. | [Context] By time and sequence: Time/Period |

13.3.2.2 Context as Sequence

Context as sequence is also a case of “part – whole” relationship often along the temporal dimension. It provides a whole sequence of events (or statuses) of which the target event (or status) is part.

In the following example, the provided information gives the full sequence of how a specific disease progresses over time.

| | |
|------------------|---|
| *Question | Does acyclovir help herpes simplex virus cold sores if treatment is delayed? |
| Topic | Herpes simplex virus (HSV) cold sores |
| Sequence | Recurrent lesions progress quickly through several stages (prodrome, erythema, papule, vesicle, ulcer, crust, residual swelling, healed). |

13.3.2.3 Context as Precedence

This category is dedicated to the preceding events that happen immediately before the target event, i.e., the topical information preceding the topic in time. It includes the following sub-categories:

- Preceding event (historical)
- Preceding experience (personal)
- Preceding status/stage
- Preparation
- Patient history

Let us look at some MALACH examples:

| | |
|--------------------|--|
| *Topic | Nazi medical experiments |
| Preparation | The prisoner selections conducted by Dr. Mengele in concentration camps that are related to medical experiments. |
| Note | Dr. Mengele showed special interest on experimenting on twins, pregnant women, disabled, etc. These selection procedures provide a prelude to the notorious human experiments. |

| | |
|-----------------------------|---|
| *Topic | Liberation experience |
| Preceding experience | BS details how he hid as Auschwitz was being evacuated by the Germans. |
| Preceding event | SK recalls that the German SS guards in the camp fled as the British armed forces approached. She states that the camp was briefly under the control of Hungarian officials. SK remembers many women prisoners, including herself, who jumped over a fence to get some food and were shot at by the Hungarian officials. SK describes being liberated by the British and Canadian armed forces. |
| Note | The information helps me better understand what happened right before the Allied Army liberated the camps, such as German SS guards evacuated the camps and fled before the allied forces approached. |

Clinical example:

| | |
|-------------------------------|--|
| *Question | What are the indications for evaluating a patient with cough for pertussis? |
| Topic | Pertussis |
| Preceding status/stage | A case series of 9 infants aged <7 weeks requiring admission to an intensive care unit for pertussis found that 8 had been sick for less than 4 days at the time of admission. All 9 presented with poor feeding and cough, and 5 had experienced apnea. |
| Note | Preceding patient status |

13.3.2.4 Context as Subsequence

Context as subsequence provides follow-up information. In the following MALACH examples, the segments give an idea of what was going on in survivors' lives following the time the target event or phenomenon took place. To correspond to its counterpart, *Context as precedence*, the category consists of the following sub-categories:

- Subsequent event (historical)
- Subsequent experience (personal)
- Subsequent status/stage

| | |
|-------------------------------|---|
| Topic | Liberation experience |
| *Subsequent experience | HB remembers returning to Warsaw to search for family members after liberation. HB notes she went to a Warsaw organization which registered Jewish survivors. She mentions leaving the city to find work. |
| Note | From this passage, we get to know how the survivors' rolled out their life right after the liberation, e.g., family reunion, migration to a new country, finding jobs, , registered as survivors, etc. |

13.3.3 Context as Other Supplemental Information

In addition to the two major context relevance types, *Context by scope* and *Context by time/sequence*, there are other contextual information supplementing topic-related background, such as,

- *Assumption/expectation*: the shared believes, both spoken and unspoken, behind the decision-making process.
- *Biographic information*: it is especially important to tagging art images; it provides information not directly related to the image topic but associated with the image creation and distribution, such as its *creator/artist*, *sponsor*, *nationality/origin*, and *time/period*. Although often having nothing directly to do with the image topic, biographic information may provide background for us to better understand an image in its historical context. Also note that *nationality/origin* and *time/period* are different from *Context by scope/ Environmental setting/ Physical location* and *Context by time and sequence/ Time or period*, which are topic-related location and time. The *nationality/origin* and *time/period* discussed here are part of biographic information and not related to the topic per se. See more discussion on this distinction in Section 12.2.3.

| | |
|-------------------------------|--|
| *Topic | Experience of Jewish People in Nazi Hospitals |
| Assumption/Expectation | NM remembers his physical condition in Gross Rosen and talks about his stay in the camp's hospital. He explains why he decided to leave the hospital and tells the fate of those who remained. NM relates general impressions camp inmates had of hospitals, the widespread belief that those who went to a camp hospital did not survive, or were immediately selected for the gas chamber. |
| Note | NM decided to escape from the camp hospital which is related to a shared belief among the camp inmates that Nazi hospitals were not to cure but to torture and kill. |

***Topic** Wallenberg rescues Jews

Biographic information Wallenberg and his associates rescued Jews in Budapest, Hungary. Officially, Raoul Wallenberg died in a Soviet prison camp in 1947, but there are questions and some believe that he lived much longer or was killed even earlier.

Note It is not directly related to Wallenberg's rescuing Jews, but it provides biographic information about the rescuer.

As evident in the CLiMB data analysis, biographic information is important for tagging art images to indicate details associated with the creation of the art work. As shown in the following example, various types of biographic information, such as information about the artist, the sponsor, the time period, and the place associated with the creation of the art work.



Figure 13-44 Enthroned Madonna and Child.
Artist: Byzantine. 13th Century. Byzantine. (ID: 203)

| *Tags | Indication of the tags | Relevance code |
|---|-----------------------------------|---|
| Greek | Nationality of the artist | [Context] Biographic information: Creator/Artist |
| Western patron | For whom was the art work created | [Context] Biographic information: Sponsor |
| Italy | Where was the art work created | [Context] Biographic information: Nationality/Origin |
| c13th, thirteenth century, late medieval, | When was the art work created | [Context] Biographic information: Time/Period |

13.4 [Condition]

[Condition] lays out influential factors behind an event or phenomenon, both helping and hindering, that are not sufficient to cause the event to happen or not to happen, but are important enough to affect the development of the event. To a large extent, [Condition] is a weaker version of [Cause/Effect] (discussed next).

[Condition] and [Cause/Effect] can be seen as another dimension of [Context], which suggests another way of “surrounding” the target event through causal relations. If the second dimension of [Context] is by time sequence, this dimension is by causal sequence. It situates our understanding of a target event into a causal network which helps illuminate relationships among events. Depending on the domain, for disciplines such as medicine, science, and engineering, [Condition] and [Cause/Effect] are important and rich enough to become a topic relevance category of their own, rather than being subsumed under [Context].

The detailed scheme of [Condition] is:

- . **Condition** (M³)
- . **Helping or hindering factor/condition**
 - . . Helping factor/condition
 - . . . Predisposing factor
 - . . . Boundary factor
 - . . Hindering factor/condition
 - . . . Protective factor
 - . . . Constraint (M)
- . **Unconditional**
- . **Exceptional condition**

³ M: Indication of new relevance categories introduced through analyzing *medical* dataset; H: Indication of new relevance categories introduced through analyzing oral *history* dataset; I: Indication of new relevance categories introduced through analyzing *image* tags.

13.4.1 Condition

Indications of “dependencies”.

| | |
|---------------------------------|---|
| *Question | What’s the prognosis for a Stevens-Johnson syndrome conjunctival bullous eruption? |
| Topic | Acute low back pain |
| Helping factor/condition | The prognosis for Stevens-Johnson conjunctival bullous eruptions depends on a number of factors. These include whether or not the inciting factor is removed, whether or not secondary infection occurs, and the extent of the inflammation and scarring that result. |
| Note | Condition of making prognosis about a disease. |

13.4.2 Helping Factor/Condition

Factors or conditions that increase the likelihood of the happening of the central topic or target event.

MALACH example:

| | |
|--|--|
| *Topic | Expropriations of Jewish businesses |
| Helping factor/condition; <i>Policies and laws</i> | Nov 38 occupied by Hungarians the whole world changed. Anti-Jewish laws instituted certain professions taken away; monopolies had been given to Jews before but in 38 taken away. AP recalls that Jews were not allowed to own businesses and had to perform manual labor. |
| Note | It is not a direct discussion of seizure of particular Jewish businesses, but excluding Jews from certain professions and from owning their own businesses by law sets up the justifications for the appropriation that conducted widely later on by both Nazi and gentiles. The passage is double-coded both as <i>Helping factor/condition</i> under [Condition] and as <i>Policies and laws</i> under [Context]. |

Clinical example:

| | |
|---------------------------------|---|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Helping factor/condition | In my experience, when patients, parents, and teachers are well-educated about ADHD and use behavioral therapy along with medication, we achieve better outcomes. |
| Note | Better educated patients, parents, and teachers as well as combining behavioral therapy with medication help the treatment of ADHD in children. |

Image tagging example:



Figure 12-17 The Martyrdom of Saint Bartholomew.
Artist: Jusepe de Ribera. 1634. Spanish. (ID: 207)

| *Tags | Indication of the tags | Relevance code |
|---|---|---|
| influence of caravaggio's dramatic lighting, influence of caravaggio, influence, caravaggio, caravaggesque, | The artist's exposure to Caravaggio's Chiaroscuro and Tenebrism is an influencing factor to the style of this painting. | [Condition] Helping factor/condition |

Within the relevance category of *Helping factor/condition*, the medical data suggested two medicine-specific sub-categories: *Predisposing or risk factor* and *Boundary factor*, as illustrated in the following examples:

| | |
|---|---|
| Question | I have a 40-year-old male patient with a 19% spontaneous pneumothorax of his right upper lobe without oxygen desaturation, hemoptysis, or effusion. His only symptom is pleuritic chest pain." He would like to know: "Is it safe to follow him conservatively? What is the chance of a recurrence? Is pleurodesis likely in the future?" |
| Topic | Pneumothorax |
| *Predisposing or risk factor (1) | the risk increases in those who continue to smoke or patients with underlying lung disease. |
| Predisposing or risk factor (2) | if the patient has an occupation or hobby that puts him or her at higher risk, such as flying airplanes or deep sea diving. |
| Note | Smoking and extreme occupations/hobbies are risk factors of severe pneumothorax that would require thoracoscopy or open thoracotomy. |

| | |
|------------------------|---|
| *Question | What are the indications for evaluating a patient with cough for pertussis? |
| Topic | Pertussis |
| Boundary factor | Pertussis should be considered early in the evaluation of young infants with cough. In a case-control study comparing 15 fatal cases of pertussis with 32 who survived (infants aged <6 months), the mean number of days from symptom onset to hospital admission were 5.3 (fatal) and 8.6 (survivors). |
| Note | Young infants, aged < 6 months, is a boundary factor for fatal pertussis. |

13.4.3 Hindering Factor/Condition

Factors or conditions that reduce the likelihood of or prevent the happening of the central topic or target event. Some hindering factors or conditions manifest as *Constraint*.

| | |
|---|---|
| * Topic | Stories of Varian Fry and the Emergency Rescue Committee who saved thousands in Marseille |
| Hindering factor/condition; <i>Social background: Political</i> | A survivor details the political situation in France in 1940-1941 regarding refugees and explains the changes in emigration regulations that made fleeing France difficult. |
| Note | The passage is double-coded both as <i>Hindering factor/condition</i> under [Condition] and as <i>Policies and laws</i> under [Context]. |

| | |
|-----------------------------------|---|
| *Topic | Stories of children hidden without their parents and of their rescuers |
| Hindering factor/condition | Mentions of factors hindering hiding, such as “the authorities often raided the convent”; some children were hidden in convents during the war. |

| | |
|-----------------------------------|---|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Hindering factor/condition | Sometimes patients and parents are hesitant to take medication for ADHD. Likewise, children and adolescents may resist medication because of stigma or feeling unfairly labeled with a disease. |
| Note | Negative response of patients and parents can be a significant hindering factor for ADHD treatment to achieve desired outcomes. |

13.4.4 Exceptional Condition

***Question** What is the most effective treatment for ADHD in children?

Topic ADHD in children

Exceptional condition Combination drug therapies offer no significant advantage to stimulants alone unless a comorbid condition is present.

13.5 [Cause / Effect]

Whereas [Condition] only tells us what affects or what is affected in a broad way and thus does not necessarily lead to *one* answer or any conclusive argument at all, causal relationships provide a restrictive evidential space that leads to a specific answer (or fact).

Causal relationships are also closely tied to *Causal-based reasoning* on the second facet.

- . **Cause**
 - . . Etiology / Diagnosis (M)
- . **Effect / Outcome**
 - . . Side effect (M)
 - . . Reaction / Feeling (H⁴) (I)
- . **Explanation (causal)**
 - . . Rationale / Mechanism (M)
 - . . Constructing causal model
 - . . Explanatory relationships
- . **Prediction**
 - . . Prognosis (M)
 - . . . Recovery (M)
 - . . . Complication (M)
 - . . . Recurrence (M)
 - . . . Mortality (M)

⁴ M: Indication of new relevance categories introduced through analyzing *medical* dataset; H: Indication of new relevance categories introduced through analyzing oral *history* dataset; I: Indication of new relevance categories introduced through analyzing *image* tags.

13.5.1 Cause

Typically, the most commonly mentioned “cause” in the clinical question answering data is the etiology or diagnosis of a condition.

| | |
|----------------------------------|---|
| *Question | What is the differential diagnosis of chronic diarrhea in immunocompetent patients? |
| Topic | Chronic diarrhea |
| Cause: Etiology/Diagnosis | Case series from tertiary-care centers report toddler’s diarrhea, cow’s milk sensitivity enteropathy, infection, celiac disease, and idiopathic chronic diarrhea as the most common etiologies in the pediatric population. |
| Note | The common causes/etiologies for chronic diarrhea. |

MALACH example:

| | |
|---------------|--|
| *Topic | People making hard decisions during the Holocaust |
| Cause | <i>Audio detail:</i> “MV explains why many Jews did not escape from the ghetto and explains that young people often decided not to escape because they did not want to leave their older family members behind. Sometimes if one goes away from the family will suffer for it, maybe killed. Some younger people left, not many. After massacre of 2,500 I realized that we will be shot sooner or later and I looked for way out. One day I gave someone 5 rubles of gold for a paper that you fill in the name, had a stamp on it, like a false passport. Some Jews were working in the print shop selling it. To write a name would be easier but I didn't know where to go, felt safer in the ghetto. When I speak Polish or Russian they can tell by my R that I'm Jewish. I didn't pursue it.” |
| Note | People desired to maintain status quo because making a decision for change would be too difficult. The reasons underlying the decision to stay within the ghetto and what made these decisions difficult. |

13.5.2 Effect / Outcome

Effect or outcome indicates the logical *consequence* of the topic.

| | |
|-----------------------|---|
| *Topic | Descriptions of Nazi medical experiments |
| Effect/Outcome | A survivor describes his long-term conditions related to the medical experiments in which he was forced to participate. |
| Note | Long-term effects on the survivor resulted from the cruel medical experiments. |

| | |
|-----------------------|---|
| *Question | What's the prognosis of and treatment for human papillomavirus of the throat? |
| Topic | Human papillomavirus (HPV) of the throat |
| Effect/Outcome | Human papillomavirus (HPV) can cause lesions in the oral cavity that take the form of either verruca vulgaris (common warts) or condyloma accuminata (genital warts). |
| Note | The physiological consequence of Human papillomavirus (HPV). |



Figure 12-17 The Martyrdom of Saint Bartholomew.

Artist: Jusepe de Ribera. 1634. Spanish. (ID: 207)

| *Tags | Indication of the tags | Relevance code |
|----------------------------------|---|----------------------------------|
| Pulls the viewer into the scene, | Indicate the effect of the dramatic composition on the viewer | [Cause/Effect] Effect/Outcome |

In the clinical context, Effect/Outcome can be used to refer to the effect of specific medication or the outcome or result of medical studies.

Assertion of the effect of specific medication:

| | |
|----------------------------|--|
| Question | Does a short symptom checklist accurately diagnose ADHD? |
| Topic | ADHD in children |
| *Effect/Outcome (I) | The Swanson, Nolan, and Pelham (SNAP) checklist from the Diagnostic and Statistical Manual of Mental Disorders, revised 3rd edition (DSM-III-R) has been shown to have a sensitivity and specificity in excess of 94% to distinguish hyperactive, inattentive, and impulsive children with ADHD from those without ADHD. |
| Note | The example is a statement approving the effect of ADHD-specific rating scales in general. |

The outcome or result of medical studies:

| | |
|-----------------------|--|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Effect/Outcome | The effect size from stimulant medication in these studies averaged 0.8 for symptom relief and between 0.4 and 0.5 for academic achievement. |

13.5.2.1 Side Effect

Undesirable side effect of specific medications:

***Question** What is the most effective treatment for ADHD in children?

Topic ADHD in children

Side effect (1) Side effects of atomoxetine are similar to stimulants and include mild but significant increases in blood pressure and pulse.

Side effect (2) Several short-term reviews and meta-analyses show that side effects from stimulant medications are mild and have short duration.

13.5.2.2 Reaction / Feeling

Another form of “effect” is the reaction or feeling caused. Compared to other effects described above, this category focuses on psychological and emotional effects rather than physical consequences:

| | |
|-------------------------|--|
| *Topic | Sonderkommando Uprising |
| Reaction/Feeling | MV outlines the plan for the Sonderkommando Uprising in Birkenau. He compares the reactions of the Greek and Polish prisoners to the plan. He recalls the signal that was to start the uprising. |

| | |
|-------------------------|--|
| *Topic | Cultural programs in ghettos and camps |
| Reaction/Feeling | Accounts of the authorities' reactions to such programs. |



Figure 12-18 Red Rose Cantata. Artist: Alba Thomas. 1973. American. (ID: 224)

| *Tags | Indication of the tags | Relevance code |
|---|---|--|
| harmony, tension, musical, rhythmic, | Verbalized reactions/feelings of the viewer towards the art image. Note the completely opposite reactions from viewing the image: “harmony” vs. “tension”; both are valid reactions since different viewers have different perspectives. | [Cause/Effect] Effect/Outcome: Reaction/Feeling |

13.5.3 Explanation (Causal)

Whereas the relevance categories, *Cause* and *Effect/Outcome*, have an explicit emphasis either on the cause or on the effect, *Explanation (causal)* focuses on the full causal chain that is constructed by both cause node(s) and effect node(s). It encompasses two sub-categories:

- *Rationale/Mechanism*: Explain the rationale or mechanism behind certain methods; explain “how it works”
- *Constructing causal model*: Propose a causal theory or hypothesis to extricate a phenomenon or effect
- *Explanatory relationships*: Other explanatory relationships involved

| | |
|----------------------------|---|
| *Question | What protective effects do vitamins E, C, and beta carotene have on the cardiovascular system? |
| Topic | Cardiovascular system health |
| Rationale/Mechanism | The theory behind antioxidant therapy is that LDL cholesterol must be clinically transformed or oxidized to cause atherosclerosis, so that vitamins may be able to prevent this step. |
| Note | Give an explanation of how vitamins as antioxidant therapy help to protect cardiovascular system. |

| | |
|----------------------------------|--|
| *Question | What are the causes of hypomagnesemia? |
| Topic | Hypomagnesemia |
| Constructing causal model | Some authors have proposed a higher range for normal serum magnesium, asserting that dietary magnesium deficiency is endemic in developed countries where acid rain reduces the magnesium content of crops and food processing causes further large reductions in the magnesium content of the diet. |
| Note | Propose a theory (hypothesis) of hypomagnesemia due to dietary magnesium deficiency in developed countries. |

13.5.4 Prediction

All the examples of *Prediction* collected from the empirical analyses are *Prognosis* from the clinical dataset. Medical prognosis delivers predictions on patient outcomes; it involves both causal reasoning, making predictions based on the patient's current conditions, and rule-based reasoning, making deductions based on the disease's progression. *Prognosis* can be further specified by:

- Prognosis: Recovery
- Prognosis: Complication
- Prognosis: Recurrence
- Prognosis: Mortality

| | |
|-----------------------------|--|
| *Question | What is the prognosis for acute low back pain? |
| Topic | Acute low back pain |
| *Prognosis, general | The Agency for Healthcare Research and Quality (www.ahrq.gov) section on health outcomes (see http://www.ahrq.gov/research/jan99/ra6.htm) states, "recent studies suggest that once experienced, low back pain becomes a part of life for almost half of those affected, and for many, it is intermittently disabling. Repeated visits and procedures do not appear to improve patients' long-term well-being, but they clearly account for substantial health care costs. Finally, back pain prognosis does not differ based on the type of provider initially seen or the level of practitioner confidence." |
| *Prognosis: Recovery | It has been widely stated that 80% to 90% of attacks of acute low back pain resolve within approximately 6 weeks, ... |

| | |
|--------------------------------|--|
| *Question | What's the prognosis of and treatment for human papillomavirus of the throat? |
| Topic | Human papillomavirus (HPV) of the throat |
| Prognosis: Recurrence | Like warts and HPV lesions elsewhere in the body, relapse or recurrence is common. |
| Prognosis: Complication | These growths sometimes undergo malignant transformation, particularly in patients who've had radiation therapy. |

13.6 [Comparison]

Comparison relevance is driven by perceived similarity, identifying both analogous and contrasting persons, places, events, phenomena, interventions, causes, etiologies, etc. that can help in understanding the central topic; it is related to analogical reasoning. It is not *on inferring* nor *surrounding* the target event or phenomenon; it *is* another event or phenomenon. That is why we do not use comparative evidence as valid proof in court cases. Its evidential value in terms of establishing a fact is even fainter than contextual evidence, which is at least remotely related to the *exact* event. But when it comes to justify a judicial decision, comparison relevance becomes useful in identifying comparable precedents.

To recognize similarity among seemingly discrete facts is at the heart of human thinking and reasoning; it establishes connections, inspires thinking, generates perspectives, and improves distinction among similar facts. On the one hand, by looking at similar cases (Code: *By similarity*), we obtain supplemental details, develop a comprehensive view on the same sort of events, and know better of something *unique* about the target event; on the other hand, by looking at contrasting cases (Code: *By difference*), we see the other side of the coin and gain alternative perspectives about the target event. Moreover, in cases where little material on the *exact* topic (event) is available, comparable cases can also *induce* some arguments but just not as strong and conclusive.

[Comparison] can be defined as information about a topic that shares characteristics of the topic but differs from the topic by one or more factors. A topic is usually characterized by many factors. A typical MALACH topic can be described by three major factors: external factors (time and place); participants; and the act/experience. Varying values of one or two of these factor, we obtain similar or

contrasting cases. Varying all three at once leaves no similarity or basis for comparison. Varying values of the first two topical facets, we often get the same or comparable event/experience/phenomenon happening in a different place, at a different time, in a different situation, or with a different person; varying values of the last factor, we get an opposite event/experience/phenomenon happening in the same time-space or involving the same participant(s).

The coding in this study differentiates whether the comparative information emphasizes the *similarities* (such as analogy or metaphor) or the *differences*. At the mean while, the coding also indicates by which factor that is different in the comparison. Therefore, the two facets of *By similarity vs. By difference* and *By factor that is different* are always coded simultaneously.

- . **By similarity vs. By difference**
- . . Comparison by similarity
- . . . Metaphor and analogy
- . . . Classification
- . . Comparison by difference (Contrast)
- . . . Contradictory contrast
- . . . Juxtapositional contrast
- . **By factor that is different**
- . . Difference in external factor (H⁵)
- . . . Different time (H)
- . . . Different place (H)
- Different country (H)
- . . . Different type of situation (H)
- . . Difference in participant (H)
- . . . Different actor (H)
- . . . Different experiencer (H)
- . . . Different population (group) (M)
- . . Difference in act or experience (H)
- . . . Difference in act (H)
- Different act (H)
- Different attitude (H)
- Different purpose (H)
- Different method (H)
- Different medical intervention (M)
- Different degree of intensity (H)
- . . . Difference in experience (H)
- . . . Difference in etiology (M)

⁵ M: Indication of new relevance categories introduced through analyzing *medical* dataset; H: Indication of new relevance categories introduced through analyzing oral *history* dataset; I: Indication of new relevance categories introduced through analyzing *image* tags.

13.6.1 Comparison by Similarity

| | |
|---|--|
| *Topic | Nazi Theft in Eastern Europe |
| Comparison by similarity; <i>By factor that is different:</i> Different type of situation | <p>ZE recalls that at the beginning of the war, the Germans expropriated a famous Lublin Hasidic university and states that they destroyed all of the books and Torahs housed there.</p> <p><i>Audio detail:</i> “There was a lot of anti-Semitism. ... Nice Jewish population in Lublin. We had a famous Hasidic University there. The Germans used it as a hospital for other Germans. It was a modern building. All books and torahs were burned. This was in the beginning.</p> |
| Note | <p>As specified by the topic, Nazi theft considers seizure of family properties and assets. The segment touches on seizure of non-family property. Not directly on topic, but similar.</p> |
| Comparison by similarity; <i>By factor that is different:</i> Different actor | <p>SW reveals that her family was betrayed by the gentile girl who had been her best friend and discusses her feelings about this betrayal. She recalls how her family prepared to leave for the ghetto and describes the night Germans forced them out of their home.</p> <p><i>Audio detail:</i> “In their area, mostly poles. Heard Germans were coming to take them to ghetto. Came in the night. A day before, came Helena with a German officer to their apartment told officer that all the furniture, silver, cupboards, bedding, everything was hers. Not to touch. They were frightened, did not say a word... So horrible, was the shouting. Into big trucks, took them to ghetto. Could not believe her friend would do that to her. They were best friends. Was so down about it. Unbelievable. Came to her apartment at such a critical time, everything was hers. No shame, no morality. Could not till today could she betray her. Gave up so much for her friend, everything with her, was like a sister. So betrayed her.”</p> |
| Note | <p>This is not directly Nazi theft; instead, it is theft by private citizens. However, in this instance, the Germans explicitly condoned the theft by the local Poles so the Germans role as an accomplice in the private citizens’ theft makes this segment relevant. It also provides context for showing the level of respect Nazi Germans had for Jewish property – certainly gives perspective on how little value they placed on Jewish ownership of property.</p> |

| | |
|---|--|
| *Topic | Jewish-gentile relations in Poland during the war |
| *Comparison by similarity; <i>By factor that is different:</i> Different time | <p>MG talks about the postwar killing of Jews by Poles.</p> <p><i>Audio detail:</i> “went back to Poland to look for family. Came to Miechow and found a cousin had been in camp with MG. he told MG they couldn't go out in the evenings because might be killed by Poles. Mg had thought that after what the Poles had seen they might now feel differently about Jews but no; heard about a man who was hidden in Miechow, Aron Berger, had hid the whole war in Miechow and then after wars end was killed by Poles; along with cousin and few others MG crossed borders back to Germany...”</p> |
| Note | <p>An informative comparison that provides a richer perspective. It reveals something deep: the hatred towards Jews did not stop with the war.</p> |

13.6.1.1 Metaphor and analogy



Figure 12-17 The Martyrdom of Saint Bartholomew.
Artist: Jusepe de Ribera. 1634. Spanish. (ID: 207)

| *Tags | Indication of the tags | Relevance code |
|---|---|---|
| Christ's sacrifice and crucifixion, Christ metaphor, | Comparing the martyrdom of Saint Bartholomew to Christ's sacrifice and crucifixion. | [Comparison] By similarity: Metaphor/Analogy |

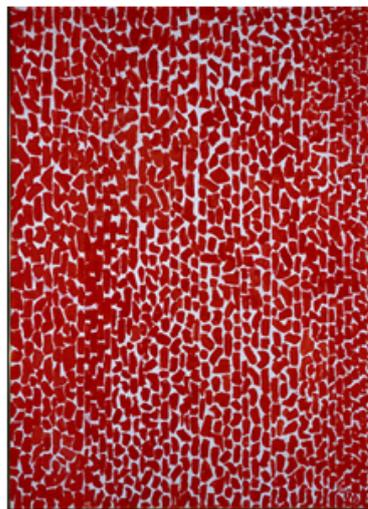


Figure 12-18 Red Rose Cantata. Artist: Alba Thomas. 1973. American. (ID: 224)

| *Tags | Indication of the tags | Relevance code |
|----------------|--|---|
| Leopard print, | Comparing the pattern of <i>Red Rose Cantata</i> to leopard print. | [Comparison] By similarity: Metaphor/Analogy |

13.6.1.2 Classification

Classification is a special type of *Comparison by similarity*. It is based more on the inherent similarities, such as similar rationale or similar cause (etiology). Both the topic and the given comparative case belong to the same broader class.

| | |
|-----------------------|---|
| *Topic | Muselman in concentration camps |
| Classification | Segments describing prisoners in poor physical condition or those that were avoided by their fellow inmates. EK describes people in the infirmary at Auschwitz as "living dead". <i>Audio detail:</i> "Barrack filled with those so weak that could do nothing but scream. Trucks would come take them away twice a week and the screams were horrifying..." |
| Note | All segments describing an individual that fits the characteristics of a Muselman, though not specifically branded as such, are classified into the category of "Muselman." |

| | |
|-----------------------|---|
| *Question | What's the prognosis of and treatment for human papillomavirus of the throat? |
| Topic | Human papillomavirus (HPV) of the throat |
| Classification | Recurrent respiratory papillomatosis involves the larynx and is most common in young children (with a median age of three years), but it's occasionally seen in adults as well. It's caused by the same types of HPV that cause anogenital warts, which are probably transmitted at the time of delivery through an infected birth canal. |
| Note | Based on the same cause (etiology), Recurrent respiratory papillomatosis and anogenital warts are classified together. |

13.6.2 Comparison by Difference (Contrast)

| | |
|-----------------|--|
| *Topic | Survivor's impact on their children and grandchildren |
| Contrast | SR recounts the wartime experience of his wife and mother-in-law. He discusses the effort he and his wife make to avoid dwelling on their experiences. He names his children and grandchildren. |
| Note | Segments in which survivors make a point of not discussing their holocaust experiences; they note that they have kept it from their children and grandchildren. These segments indicate interviewee's intentions of trying not to impact their children and grandchildren, thus providing important comparative relevance. |

13.6.2.1 Juxtapositional Contrast

| | |
|---------------------------------|---|
| *Question | What are the causes of hypomagnesemia? |
| Topic | Hypomagnesemia |
| Justapositional contrast | A study of 11,000 white urban Americans aged 45 to 64 years (probability sampling) found 2.5% with magnesium <0.7 mmol/L and 5% with magnesium <0.75 mmol/L; rates for 4000 African Americans were twice as high. |
| Note | Justapositional contrast of the disease prevalence rates between the white and black ethnic groups. |

13.6.2.2 Contradictory Contrast

| | |
|--------------------------------|--|
| Topic | Abusive female personnel |
| *Contradictory contrast | TF talks about the tattoo she received in Auschwitz II-Birkenau. She shows her tattoo. She focuses on the woman who gave her the tattoo and instructed her on how to prevent swelling. <i>Audio detail:</i> “remembers when tattooed her, young woman hands shaking, looked at TF AND told her she'd give her a small number so it wouldn't be noticeable after war, took time to talk to her, told her to memorize it, would be called by number and not name, told her how to take care of tattoo.” |
| Note | The segment provides contrasting examples in contradictory to the topic of “Abusive female personnel”. |

13.7 [Evaluation]

The empirical data analyses of the clinical dataset introduced sub-categories of *Limitation*, *Criterion/Standard* used as baseline for evaluation, and *Comparative evaluation* studies in clinical medicine.

[Evaluation] is based on comparison either to a standard or to an alternative, e.g., *Medical trial*, a type of *Comparative evaluation*, is an evaluation between optional treatments or between treatment and placebo/no-treatment; likewise, *Significance* or *Limitation* is concluded on comparing the effect of current solution to alternative or certain standard or baseline which may not be explicitly stated.

- . **Significance**
- . **Limitation** (M⁶)
- . **Criterion/Standard** (M)
- . **Comparative evaluation** (M)
 - . . Medical trial (M)
 - . . Prevalence study (M)

13.7.1 Significance

| | |
|---|---|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Significance | Stimulant medication therapy (Table) is the most effective treatment for attention deficit/hyperactivity disorder (ADHD) in children, producing significant improvements in symptoms and modest improvements in academic achievement. |
| Significance; Comparative evaluation | Nonpharmacologic therapies, such as behavior therapy, school-based interventions, and family therapy, are not as effective as stimulants but may add modest benefit to the effects of medication. |

⁶ M: Indication of new relevance categories introduced through analyzing *medical* dataset; H: Indication of new relevance categories introduced through analyzing oral *history* dataset; I: Indication of new relevance categories introduced through analyzing *image* tags.

13.7.2 Limitation

Question Does a Short Symptom Checklist Accurately Diagnose ADHD?

Topic ADHD in children

***Limitation** Gather data from multiple sources, Sorting out children with ADHD, bipolar disorder, or learning disabilities from lively or distractible children is not a simple matter. Often the objective rating scales miss the more passive, less disruptive, inattentive ADHD children while over-diagnosing high-energy children as having ADHD.

13.7.3 Criterion / Standard

| | |
|---------------------------|--|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Criterion/Standard | The effect size from stimulant medication in these studies averaged 0.8 for symptom relief and between 0.4 and 0.5 for academic achievement. (Effect size is the difference between the means of the experimental and control groups expressed in standard deviations. An effect size of 0.2 is considered small, 0.5 is medium, and 0.8 is considered moderate to large.) |

13.7.4 Comparative Evaluation

| | |
|---|--|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Significance; Comparative evaluation | Nonpharmacologic therapies, such as behavior therapy, school-based interventions, and family therapy, are not as effective as stimulants but may add modest benefit to the effects of medication. |
| Medical trial; Comparative evaluation; Research design | <p>A large randomized trial of 579 children with ADHD (20% girls) aged 7 to 9.9 years compared outcomes of 4 treatment strategies: stimulant medication, intensive behavioral treatment, combined stimulant medication and behavioral interventions, and standard community care. All children met the DSM-IV criteria for ADHD Combined Type (the most common type of ADHD in this age group). The stimulant medication strategy included an initial dose titration period followed by monthly 30-minute visits. Intensive behavioral treatment involved child, parent, and school personnel components of therapy. Combination therapy added the regimens for medication and behavioral treatment together. Standard community care consisted of usual (nonsystematic) care, evaluated at 6 different sites.</p> <p>After 15 months of treatment, children in the medication group and the combined treatment groups showed more improvement in ADHD symptoms than children given intensive behavioral treatment or those who received standard community care. When combined with medication, those treated with behavioral therapy showed slight improvement in social skills, anxiety, aggression, oppositional behavior, and academic achievement over medication alone. At the conclusion of the study, 74% of the 212 children on medication were successfully maintained on methylphenidate alone, 10% required dextroamphetamine, and no children required more than one medication. This study found that higher doses of medication with more frequent office follow-up and regular school contact were important features of successful treatment. Only 40% of families were able to complete the intensive behavioral therapy.</p> |

13.8 [Method / Solution]

This category addresses the methodological aspects regarding a topic. It covers *Method/Approach*, *Instrument*, and *Technique/Style*. *Solution* is more generic, which can be a Method, a technique, or an instrument.

[Method / Solution] is a relevance category whose definition is highly domain-specific. In other words, this relevance type applies to various subject domains meaning different things. In clinical medicine, “method” is often referred to *Medical treatment* (e.g., “Stimulant medication therapy”, “topical acyclovir 5% cream applied 5 times a day”) or *Diagnostic method* (e.g., “ThinPap”, “ACTeRS scales”); whereas in fine arts, “method” is often defined by *Style or Genre*, as further discussed with illustration later in the section.

. **Method or instrument**

- . . Method / Approach
 - . . . Guideline (M⁷)
 - . . . Research design (M)
 - . . . Medical treatment (M)
 - . . . Diagnostic method (M)
 - Diagnostic indicator (M)
- . . Instrument
 - . . . Material / Medium (I)

. **Technique or style**

- . . Technique
- . . Style / Genre (I)
 - . . . Design / Composition (I)
 - . . . Detail (I)

. **Solution**

⁷ M: Indication of new relevance categories introduced through analyzing *medical* dataset; H: Indication of new relevance categories introduced through analyzing oral *history* dataset; I: Indication of new relevance categories introduced through analyzing *image* tags.

13.8.1 Method / Approach

| | |
|------------------------|---|
| *Topic | Survivors' impact on their children and grandchildren |
| Method/Approach | MV reflects on her wartime experiences and remembers anti-Semitic epithets directed against her by Ukrainians in Mogilev-Podol'skii. She explains that she is giving her testimony for the benefit of her children and grandchildren. |
| Note | Giving testimony is a method/approach to affect or benefit her children and grandchildren (topic). |

| | |
|------------------|---|
| *Question | Does a Short Symptom Checklist Accurately Diagnose ADHD? |
| Topic | ADHD in children |
| Guideline | Information from ACTeRS scales has helped me treat these children, but I prefer to have both parents, if possible, independently complete the form. Obtaining scales from a Special Education teacher or psychologist, when available, in addition to the primary classroom teacher, is invaluable. |

| | |
|------------------|--|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Guideline | The American Academy of Pediatrics recommends that clinicians: 1) manage ADHD as a chronic illness, 2) collaborate with parents, the child, and school personnel to define specific desired outcomes, 3) use stimulant or behavioral therapy to improve these outcomes; if one stimulant is not effective at the highest feasible dose, try another, 4) reevaluate the diagnosis, treatment options, adherence, and possible coexisting conditions if treatment is not achieving the desired outcomes, and 5) follow-up regularly with parents, child, and teachers to monitor for progress and adverse effects. |

***Question** What is the most effective treatment for ADHD in children?

Topic ADHD in children

Medical trial; A large randomized trial of 579 children with ADHD (20% girls) aged 7 to 9.9 years compared outcomes of 4 treatment strategies: stimulant medication, intensive behavioral treatment, combined stimulant medication and behavioral interventions, and standard community care.
Comparative evaluation;

Research design All children met the DSM-IV criteria for ADHD Combined Type (the most common type of ADHD in this age group). The stimulant medication strategy included an initial dose titration period followed by monthly 30-minute visits. Intensive behavioral treatment involved child, parent, and school personnel components of therapy. Combination therapy added the regimens for medication and behavioral treatment together. Standard community care consisted of usual (nonsystematic) care, evaluated at 6 different sites.

After 15 months of treatment, children in the medication group and the combined treatment groups showed more improvement in ADHD symptoms than children given intensive behavioral treatment or those who received standard community care. When combined with medication, those treated with behavioral therapy showed slight improvement in social skills, anxiety, aggression, oppositional behavior, and academic achievement over medication alone. At the conclusion of the study, 74% of the 212 children on medication were successfully maintained on methylphenidate alone, 10% required dextroamphetamine, and no children required more than one medication. This study found that higher doses of medication with more frequent office follow-up and regular school contact were important features of successful treatment. Only 40% of families were able to complete the intensive behavioral therapy.

13.8.2 Technique or Style

The topical category of “Style or genre” is heavily used in the analysis of image tags, which further enriched the category by introducing two sub-categories of “Design/Composition” and “Detail”. The following image shown in Figure 12-17 is a good example to illustrate the different emphases of these style-related categories:

- **Style or genre:** the emphasis is *general*, broad, and inclusive
 - **Design or composition:** emphasize the *global* features of an image
 - **Detail:** focuses on the *local* features of an image, e.g., raking light



Figure 12-17 The Martyrdom of Saint Bartholomew.
Artist: Jusepe de Ribera. 1634. Spanish. (ID: 207)

| *Tags | Indication of the tags | Relevance code |
|---|---|---|
| Christian symbolism, Baroque art, Spanish art –17 th Century, European, | General style or genre of the artwork | [Style or Genre] |
| X-shaped composition, Diagonal composition, Chiaroscuro, | The global design or composition of the artwork | [Style or Genre] Design or Composition |
| raking light | The local stylish feature of the artwork | [Style or Genre] Detail |

13.9 [Purpose / Motivation]

Motivation and *Purpose/Goal* correspond to *Cause* and *Effect*. In a sense, *Motivation* gives the volitional cause for the topic or event, whereas *Purpose/Goal* provides the effect or end result to achieve.

- **Purpose**

- • Used for (M)

- • Goal

- **Motivation**

13.9.1 Purpose

| | |
|----------------|---|
| *Topic | Sobibor death camp |
| Purpose | JF remembers that he avoided being selected for transfer to Sobibor with the help of Bernard Falkenberg. JF recalls how he found out that Sobibor was built for extermination purposes. |

| | |
|--------------------------|---|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Purpose: Used for | Atomoxetine, a specific norepinephrine reuptake inhibitor, is an FDA-approved alternative to stimulants for ADHD treatment in children and adolescents. |

13.9.2 Motivation

| | |
|-------------------|--|
| *Topic | Children removed from their parents |
| Motivation | <i>Audio detail:</i> “There was a whole organization with students who helped to bring the children to safe hiding places, volunteers who wanted to hide Jewish children during the war, really dangerous because they could have been killed. People had mixed motives. There were quite a few couples who didn't have children. It was different in those days to get an adopted child. It was a good opportunity, if they were some Jews children and hopefully or not if the parents didn't return they could keep the child. They wanted as young as possible very often. They didn't always get what they wanted. There was a big demand for big girls, they fitted very well, certainly in the North of Holland people were blond and blue eyed and it would be less obvious if you mixed them with the rest of children; also dark little Jewish boys hidden, boys were more dangerous because of circumcision.” |
| Note | This passage reveals the motivations for adopting Jewish children during the war. |

Chapter 14. Empirical Data Analyses (3):

Type-Centric Manifestations: Reasoning-Based

Mode of reasoning is the second facet of the topical relevance typology. It characterizes how a piece of information (evidence) establishes its relevance to a topic through inferences and how it contributes to the user's reasoning and drawing conclusions about a topic. This facet explores the evidential perspective of topical relevance. The MALACH relevance data provide rich examples on various modes of reasoning.

This chapter discusses the following reasoning-based relevance types in detail:

► **Generic inference** (Section 14.1)

- Assignment into a class (H)
- Without explicitly making the connection (H)
- Inferring from part to whole (I)

► **Causal-based reasoning**

- Forward inference (Deduction) = Inferring from the cause (Section 14.2)
 - • Inferring from earlier events
 - • Inferring from action (situation) to reaction (H)
- Backward inference (Abduction) = Inferring from the consequence (Section 14.3)
 - • Inferring from later events
 - • Inferring from reaction to action (situation) (H)

► **Comparison-based reasoning** (Section 14.4)

- Reasoning by analogy
- Reasoning by contrast

At the end of the chapter, Section 14.5 summarizes the improved typology of topical relevance relationships.

14.1 Generic Inference

This category is almost like direct evidence or matching topic but missing only a specific piece of information. The argument stays implicit and uncertain only because a survivor's description is not precise enough or the survivor does not explicitly "connect the dots". However, everything else said in the segment strongly points at a fact that is right on topic. It is characterized by high inferential strength.

| | |
|--------------------------|---|
| Topic | Stories of Varian Fry and the Emergency Rescue Committee who saved thousands in Marseille |
| Generic inference | The survivor mentions obtaining a false name and being rescued from France but does not specifically mention Fry. |
| Note | Varian Fry created an underground operation to smuggle over 2000 Jews out of France from 1940-1941. Using a false name and being in France constitute strong hints for smuggling associated with Fry. |

| | |
|--------------------------|---|
| Topic | Wallenberg Rescues Jews |
| Generic inference | MS recalls that after she left the Swedish Embassy, she was taken by a Hungarian soldier to a protected house. She relates that her brother and his wife were living in the protected house. |
| Note | From typical locations where Raoul Wallenberg actively carried out his rescue activities, this instance is most likely associated with Wallenberg's organization. It sheds some light on methods, but it cannot be determined with absolute certainty that it was Wallenberg. |

| | |
|--------------------------|---|
| Topic | Survivor guilt |
| Generic inference | WB explains how he could not help a friend on a death march to Dachau. Friend had injured knee, WB was holding him but German soldier put a gun to his head and told him to drop the friend, so WB did. Haunted by nightmares for years. |
| Note | Not explicitly mentioning “guilt” in the testimony, but we could infer that WB felt guilty abandoning his friend during the death march. |
| Topic | Survival by Previous Professional Identity |
| Generic inference | DGB tells of being recruited to work for Dr. Mengele to paint portraits of Gypsies in the camp. |
| Note | It can be assumed that since she was contracted by Mengele specifically, she was given special treatment and was treated better. |
| | Many survivors discuss how a particular skill or talent changed their life in some way, i.e., got them a different job, brought them to the attention of leading Nazi officials, etc. In many of these cases, the survivor does not explicitly say that the change in their life improved their chance of survival. However, if an individual was able to avoid manual labor and was given an office job, for instance, one can assume that this improved one's chance of survival. |



Figure 14-45 Hound and Hunter. Artist: Winslow Homer. 1892. American. (ID: 222)

| Tags | Indication of the tags | Relevance code |
|-------------------------|--|-----------------------|
| stag, deer, deer, | Reasoning from the horns (part) depicted in the image to the stag (whole) emerged in the water and not explicitly visible. | [Generic inference] |

14.2 Forward Inference: Reasoning from the Cause

Both backward inference and forward inference are causal reasoning. Forward inference is “looking ahead” or “forward chaining”, reasoning from the cause to the consequence/effect or from actor to what is acted upon. Looking forward is essentially making predictions. Just as any kind of prediction, it deals with an open reasoning space and the possibilities of a predicted event are many if not infinite. Thus, we can infer only with a low or medium level of certainty.

Inferring from earlier event and *Inferring from action/situation to reaction* are special cases of *Reasoning from the cause*.

14.2.1 Inferring from Earlier Event

Inferring from earlier event(s) to a later event or phenomenon. If the probability of the association of an early event A and a later event B is high, and if the actual occurrence of early event A is known, we can surmise that the later event B, the one of interest, did also occur.

| | |
|-------------------------------------|---|
| Topic | Expropriations of Jewish businesses |
| Inferring from earlier event | Segments discussing Jewish business owner who was imprisoned after the Anschluss. |
| Note | The segments imply the eventual expropriation of the business. |

| | |
|-------------------------------------|---|
| Topic | Stories of children hidden without their parents and of their rescuers |
| Inferring from earlier event | A survivor tells of his sister’s absence on the day of the roundup and explains that one sister had been delivering food to extended family members already in Malines. |
| Note | Not being at the roundup may lead to later hiding experience of his sister, however faintly. |

| | |
|-------------------------------------|---|
| Topic | Counterfeiting in Sachsenhausen [Oranienburg] |
| Inferring from earlier event | MS describes his school accounting classes. |
| Note | We can infer that early monetary talent led to later choice for counterfeiting. |

| | |
|-------------------------------------|---|
| Topic | Survivor's impact on their children and grandchildren |
| Inferring from earlier event | EV reflects on the important people in her life at the time of her testimony. She tells how her son became interested in her Holocaust experiences. |
| Note | From her son becoming "interested", we infer that he is influenced by the survivor's experience later on. |

14.2.2 Inferring from Action/Situation to Reaction

When a topic asks for reactions or feelings about an event rather than the event itself, this type of indirect evidence is useful.

| | |
|--|--|
| Topic | Survivors' attitudes toward Germans |
| Inferring from action to reaction | LS recalls German efforts to humiliate and harass Jews in the ghetto. |
| Note | From the description of German's efforts to humiliate Jews (action), we could infer the reaction or attitude of Jews toward Germans. |

| | |
|--|---|
| Topic | Survivor's impact on their children and grandchildren |
| Inferring from action to reaction | ES states the names of her children, their ages and talks about their families. ES tells of often speaking to her grandchildren about the Holocaust. She mentions the effects of the Holocaust on her postwar life. |
| Note | From "often speaking to her grandchildren about the Holocaust" (action), we infer certain reactions of her grandchildren and the psychological impact on them. |

14.3 Backward Inference: Reasoning from the Consequence

Backward inference is “tracing back” or “backward chaining”, reasoning from the consequence/effect to the cause or from what is acted upon to actor. It is also called *abduction*. Backward inference may have higher inferential strength than forward inference. As we are tracing backward from the effect or consequence to what has happened before, there is a closed or much restricted reasoning space and thus lower probability to go wrong.

The evidence itself does not mention a particular event (or phenomenon) directly, but the consequences caused by the event (or phenomenon) lay out substantial clues for us to trace back to the event (or phenomenon).

| | | |
|--|--------------|--|
| | Topic | Red Cross in the Holocaust |
| <i>Inferring from the consequence (1)</i> | | MG recalls that Red Cross representatives occasionally visited Plaszow. From time to time Red Cross visitors came to camp, the day before that they always got better food. |
| | Note | Reasoning from getting extra food (effect) to Red Cross' beneficial influence (cause) during the war, i.e., it was trying to bring some positive improvements on the camps. |
| <i>Inferring from the consequence (2)</i> | | ES recalls an inspection carried out by the Red Cross. She speaks about a woman named Eva who informed the Red Cross representatives about the camp. ES recalls Eva's subsequent execution by hanging the next day. <i>Audio detail:</i> “One day given decent bed clothes barracks cleaned up. Late Dec 44, Red Cross walked through, accompanied by Nazi guards. Woman named Eva yelled that ‘Gas chambers. Don't believe a word you hear.’ No questions asked. Germans said take Eva away ‘She is mad.’ hanged next day. Everything back to old mode after RC left.” |
| | Note | 1) Reasoning from Nazi changing sheets & pretentious efforts (effect) to Red Cross' beneficial influence (cause); 2) Reasoning from Red Cross' not questioning and ignorance to the fact that it is either not really concerned about the welfare of the prisoners or they were not strong enough to confront Nazi and had very limited positive impact. |

| | | |
|-------------------------------------|--------------|---|
| | Topic | Materials that support or rebuff the claim that Bulgaria saved its Jews from Nazism |
| Inferring from earlier event | | A survivor comments about the quality of life being better in Bulgaria. |
| | Note | It does not explicitly address the Bulgarian government's policy to its Jews, but better living quality in Bulgaria is definitely one important effect resulting from the leniency of the government. |

Inferring from later event and *Inferring from reaction to action/situation* are special cases of *Reasoning from the consequence*.

14.3.1 Inferring from Later Event

The event asked by a topic is missing from a survivor's narration but the survivor discusses some other events that happened following the particular event. Sometimes those later events can lead us to a conclusive argument about the earlier target event.

| | | |
|---------------------------------------|--------------|--|
| | Topic | Nazi theft and expropriation of family property and assets |
| Inferring from later event (1) | | Segments discussing forced labor of seized valuables (maybe just clothes or Jewish ritual objects) or that sorted during intake procedures at a camp. They describe the sorting labor or sorting process but do not specifically say that property/valuables were seized by Nazis. |
| | Note | From what happened later, sorting valuables, we infer what happened earlier, seizure of properties by Nazis. |
| Inferring from later event (2) | | Segments discussing seizure of property or restitution or compensation for theft of property, but do not specifically say that theft was by Nazis. |

| | | |
|-----------------------------------|--------------|---|
| | Topic | Hidden children and rescuers |
| Inferring from later event | | CR explains why he felt the need to attend a meeting for hidden children. He discusses his reluctance to speak of his Holocaust experience, though he often did so. |
| | Note | Attending meeting for hidden children after the War implies that CR was one of the hidden children during the Holocaust. |

14.3.2 Inferring from Reaction to Action/Situation

Reactions towards experiences and attempted experiences rather than those that actually occurred fall into this subcategory. The target event is not mentioned or may not have happened at all, but reaction, perception, feeling, attitude, or attempt is a good mirror to reflect what has been happening.

| | | |
|--|--------------|--|
| | Topic | Nazi theft and expropriation of family property and assets |
| Inferring from reaction to action | | Segments discuss Jewish efforts to hide property. |
| | Note | The fact that property needs to be hidden points to the fact that theft or confiscation is common. |

| | | |
|---|--------------|--|
| | Topic | Sexual experiences during the Holocaust |
| Inferring from reaction to situation | | Survivor discusses how the women feared being raped. |
| | Note | This indirectly indicates that rape/sexual molestation was common. |

| | | |
|---|--------------|--|
| | Topic | Nazi eugenics policy (Dr. Mengele's medical experiments) |
| Inferring from reaction to situation | | Segments talk about how, after liberation, medical treatment still induced fear of medical experiments. |
| | Note | Inferred from the effects of medical experiments during WW II on Holocaust survivors, fear of medical treatments after the war, we understand the cruelty and terror of the medical experiments and Nazi Eugenics Policy during the War. |

| | | |
|---|--------------|--|
| | Topic | Jewish-gentile relations in Poland |
| Inferring from reaction to situation | | A survivor notes that his parents talked of leaving Poland in the mid-1930s <i>Audio detail:</i> "family discussed leaving - heder teacher pled with dad to leave and father wanted to but mother didn't want to - they were in their 40s/50s. He didn't have enough money to start over somewhere else." |
| | Note | From planning to leave Poland, we could infer the Jewish-gentile relations in Poland were getting very tense and made Jews in Poland feel threatened enough to consider leaving their homes. |

14.4 Comparison-Based Reasoning

This category consists of two sub-categories: *Reasoning by analogy* and *Reasoning by contrast*.

14.4.1 Reasoning by Analogy

Important and sufficient similarities between A and B are observed and we believe that A and B are similar; given the truth that A possesses a key feature of x , we infer that B possesses the same key feature of x .

| | |
|-----------------------------|--|
| Question | Does quinine reduce leg cramps for young athletes? |
| Topic | Leg cramps |
| Reasoning by analogy | It should be noted that during the 2 weeks immediately following the treatment period, numbers of cramps were still low compared with the pretreatment period and no significant difference was seen in number of cramps between groups. This raises suspicion that the improvement in both groups was due to the self-limited nature of cramps and represented the regression-to-the-mean phenomenon rather than a true treatment effect of hydroquinine. |
| Note | After some time period, no difference is shown between treatment group and control (placebo) group. We know for sure that placebo does not treat and given the similar effect between the two, we infer that treatment does not treat either. |

14.4.2 Reasoning by Contrast

Important and sufficient differences are observed between A and B and we believe that A and B are different or opposite; given the truth that A possesses a key feature of y , we infer that B does not possess the same key feature of y .

| | |
|------------------------------|---|
| Topic | Bulgaria saved its Jews |
| Reasoning by contrast | <p>AF talks about friendship with surrounding non-Jews prewar. He indicates that they lived in harmony until the alliance with Germany.</p> <p>AF speaks about his friendship with a non-Jewish boy in Sofia before Bulgaria's entry into the war in 1941.</p> <p><i>Audio detail:</i> "Apt. house had lots non-Jews. No differences between us. Lived in very good harmony. Had Bulgarian friend LD. We played as children and when war started [we] discussed it. He pro-Germany and AF pro-Allies. They discussed it freely till the laws [came] and he started wearing uniform, Hitler Youth. This was 1940 or 41."</p> |
| Note | The situation described in the segment contrasts the fact that anti-Semitism was heated and Gentile and Jews were not mixed in most European countries. This contrast enables us to make conclusions that the government of Bulgaria was quite friendly to its Jews at the time and general populace in Bulgaria was not conducive to eliminationists' anti-Semitism. |

14.5 The Improved Topical Relevance Typology

The analysis of the three empirical datasets further enriched and refined the topical relevance typology. In the following, Table 14-1 to Table 14-4 presents the four facets of the improved typology respectively:

- **Functional Role / Function-Based Topical Relevance Relationships (Table 14-1):**
This facet is the focus of this study and most heavily analyzed in the coding process. Notes: (H) indicates that the category was suggested by analyzing the MALACH oral history dataset; (M) indicates that the category was suggested by analyzing the medical dataset; and (I) indicates that the category was suggested by analyzing the CLiMB image tags dataset.
 - Broadly speaking, Argumentation Role (Argument-Based) are also functional: This facet is not particularly analyzed for the datasets.
- **Mode of Reasoning / Reasoning-Based Topical Relevance Relationships (Table 14-2):** This facet is also important in the empirical analysis, which in turn polished the reasoning relationships.
- **Semantic Relationships / Semantic-Based Topical Relevance Relationships (Table 14-3):** It is directly taken from the study of Green & Bean (1995). Given the authors' in-depth discussion on the semantic-based relevance relationships, detailed analysis of this facet was not repeated in this study, but the paradigmatic relationships (such as, *whole/part*, *member/set*, *class/subclass*) were incorporated with function-based relevance categories and the presentation facet (in particular, *Elaboration*) in the analysis.

The function-based facet serves as the conceptual basis for a generic topic-oriented information architecture that can be used to structure topic spaces across

domain boundaries (see more discussion in Section 15.3). This shows a unique advantage of the function-based facet over the reasoning- and semantic-based relevance facets. All the three facets help to characterize and organize different types of topic information from meaningful perspectives. However, the reasoning-based facet only covers the reasoning-related information of a topic; it does not provide a framework as inclusive as the function-based facet does, because not all the topic information necessarily involves reasoning and the non-reasoning topic information has to be left out. The semantic-based facet is inclusive enough but it rests on a level so analytic and granular that it does not pull together a coherent and meaningful high-level framework for a topic. Among the three, only the function-based framework is both comprehensive and makes immediate sense on the high level.

The facet of presentation types are also presented at the end (Table 11-1).

Table 14-24 Functional Role / Function-Based Topical Relevance Relationships

| | |
|--|--|
| <p>▶Matching topic</p> <ul style="list-style-type: none"> . Manifestation (M) .. Symptom (M) . Image Content (I) .. Focal (I) .. Peripheral (I) . Image Theme (I) .. Title (I) <p>▶Evidence</p> <ul style="list-style-type: none"> . Direct vs. indirect evidence .. Direct evidence .. Circumstantial (indirect) evidence . Supportive vs. contradictory evidence .. Supportive evidence .. Contradictory evidence <p>▶Context relevance</p> <ul style="list-style-type: none"> . Scope, broader (H) .. Member::Set (H) (I) .. Subclass::Class (H) (I) .. Part: Whole (H) (I) ... Step::Process (H) (I) . Scope (M) .. Population (M) . Framework . Environmental setting .. Physical location ... Region / Country (H) (I) ... Type of location (M) . Social background .. Political (H) ... Policies and laws (H) .. Cultural (H) .. Religious (H) . Time and sequence .. Time / Period (I) .. Sequence .. Precedence ... Preceding event (historical) (H) ... Preceding experience (personal) (H) (M) Preceding status / stage (M) ... Preparation ... Patient history (M) .. Subsequence ... Subsequent event (historical) (H) ... Subsequent experience (personal) (H) (M) ... Subsequent status/stage (M) . Assumption / Expectation . Biographic information .. Creator / Artist (I) .. Sponsor (I) .. Nationality / Origin (I) .. Time / Period (I) | <p>▶Condition</p> <ul style="list-style-type: none"> . Condition (M) . Helping or hindering factor/condition .. Helping factor/condition ... Predisposing factor ... Boundary factor .. Hindering factor/condition ... Protective factor ... Constraint (M) . Unconditional . Exceptional condition <p>▶Cause / Effect</p> <ul style="list-style-type: none"> . Cause .. Etiology / Diagnosis (M) . Effect / Outcome .. Side effect (M) .. Reaction / Feeling (H) (I) . Explanation (causal) .. Rationale / Mechanism (M) .. Constructing causal model .. Explanatory relationships . Prediction .. Prognosis (M) ... Recovery (M) ... Complication (M) ... Recurrence (M) ... Mortality (M) <p>▶Comparison relevance</p> <ul style="list-style-type: none"> . By similarity vs. By difference .. Comparison by similarity ... Metaphor and analogy ... Classification .. Comparison by difference (Contrast) ... Contradictory contrast ... Juxtapositional contrast . By factor that is different .. Difference in external factor (H) ... Different time (H) ... Different place (H) Different country (H) ... Different type of situation (H) .. Difference in participant (H) ... Different actor (H) ... Different experiencer (H) ... Different population (group) (M) .. Difference in act or experience (H) ... Difference in act (H) Different act (H) Different attitude (H) Different purpose (H) Different method (H) Different medical intervention (M) ... Different degree of intensity (H) ... Difference in experience (H) ... Difference in etiology (M) |
|--|--|

Table 14-24 Functional Role / Function-Based Topical Relevance Relationships

| | |
|---|--|
| <ul style="list-style-type: none"> ▶<u>Evaluation</u> . Significance . Limitation (M) . Criterion / Standard (M) . Comparative evaluation (M) .. Medical trial (M) .. Prevalence study (M) ▶<u>Method / Solution</u> . Method or instrument .. Method / Approach ... Guideline (M) ... Research design (M) ... Medical treatment (M) ... Diagnostic method (M) Diagnostic indicator (M) .. Instrument ... Material / Medium (I) . Technique / Style .. Technique .. Style / Genre (I) ... Design / Composition (I) ... Detail (I) . Solution ▶<u>Purpose / Motivation</u> . Purpose .. Used for (M) .. Goal . Motivation | <p>Argumentation Role (Argument-based)</p> <ul style="list-style-type: none"> ▶Grounds (Evidence / Data) ▶Warrant (Justification) . Backing ▶Claim (Conclusion) . Rebuttal ▶Propositional relevance |
|---|--|

Table 14-25 Mode of Reasoning / Reasoning-Based Topical Relevance Relationships

| | |
|--|---|
| <ul style="list-style-type: none">▶Generic inference. Assignment into a class (H). Without explicitly making the connection (H). Inferring from part to whole (I) ▶Rule-based reasoning vs. Generalization. Rule-based reasoning (Deduction).. Types of reasons (rules)... Classificatory reasons... Anankastic reasons... Deontic reasons... Epistemic reasons.. Extrapolation or Interpolation... Extrapolation... Interpolation. Generalization (Induction).. Schema induction | <ul style="list-style-type: none">▶Causal-based reasoning. Forward inference (Deduction)= Inferring from the cause.. Inferring from earlier event (H).. Inferring from action/situation to reaction (H). Backward inference (Abduction)= Inferring from the consequence.. Inferring from later event (H).. Inferring from reaction to action/situation (H) ▶Comparison-based reasoning. Reasoning by analogy. Reasoning by contrast ▶Transitivity-based reasoning ▶Dilemma-based reasoning. Constructive dilemma . Destructive dilemma |
|--|---|

Table 14-26 Semantic Relationships / Semantic-Based Topical Relevance Relationships
From (Green & Bean, 1995)

| | |
|--|--|
| <p>► Paradigmatic relationships</p> <ul style="list-style-type: none"> . Class :: subclass (taxonomy) . Set :: member . Abstraction :: instance . Generalization :: specific . Whole :: part (partonomy) .. Process :: step . Object :: attribute .. Adjectival ... Characteristics Magnitude .. Adverbial ... Temporal conditions ... Manner <p>► Frame-based</p> <ul style="list-style-type: none"> . Generic frame elements .. Object: That toward which an action is directed .. Result: Consequence of action .. Purpose/goal: Desired result that prompts action .. Source: Point of origin ... Authority: Source of decision, power, etc. .. Recipient: Personality who acquires entity .. Experiencer: Personality who perceives physiological states, emotions, psychological states, etc. .. Standard ... Ideal: Paragon in a comparison ... Landmark: Point of reference, often spatial | <ul style="list-style-type: none"> . Complex frame structures .. Force ... Why/motivation: Psychological cause for action ... Precipitating conditions: Conditions occurring before action is performed ... Enabling conditions: Conditions permitting action to be performed ... Agent: Personality that performs action ... Instrument: Tool used by personality to perform action ... Need: Lack that requires action ... Impediment: Barrier to action .. Work = Force. Speed. Time ... Impediment: Barrier to action ... Force: Structure in which action is performed ... Temporal conditions: Time when action occurs ... Magnitude: Size, quantity of entity ... Need: Lack that requires action .. Perseverance ... Force: Structure in which action is performed ... Verdict/judgment: Decision of an evaluating body ... Impediment: Barrier to action .. Debt ... Debt: Amount owed ... Debtor: Personality that owes ... Payment: Amount paid to reduce debt .. Judgment ... Evidence: Support for a proposition ... Verdict/judgment: Decision of an evaluating body ... Balance/equilibrium Force: Structure in which action is performed Counterforce: Structure in which counterbalancing action is performed .. Metaphors: Structural equivalence across domains |
|--|--|

Table 11-1 Types of Presentation (Repeated from Chapter 11)

- **Reference**
- **Pointer**
- **Definition**
- **Restatement**
 - Paraphrase
 - Clarification
 - Translation
 - Representation
- **Summarization**
 - Abstraction
- **Elaboration**
 - Amplification
 - Extension
 - Specification or specialization
 - Example (Exemplification)
 - Illustration
 - Instance (Instantiation)
 - Elaboration through Class :: Subclass
 - Elaboration through Whole :: Part
 - Elaboration through Process :: Step
 - Elaboration through Object :: Attribute
 - Adjectival attribute
 - Frequency
 - Prevalence
 - Adverbial attribute
- **Interpretation**
 - Organization
 - Concretization
 - Humanization
 - Transformation
 - Model of cognitive process
 - Model of physical process
- **Emphasis / Drawing attention**

Part 4

Conclusions and Implications

Chapter 15. Conclusions and Implications

Chapter 15. Conclusions and Implications

This dissertation research completed a multidisciplinary inquiry into topicality, involving an in-depth examination of literatures and empirical data and an inductive development of a faceted typology (containing 227 fine-grained topical relevance relationships and 33 types of presentation relationship). This inquiry discerns a large variety of topical connections beyond topic matching, rendering a closer look into the structure of a topic and providing the conceptual basis for a cohesive topic-oriented information architecture that is meaningful across topics and domains. The findings from the analysis contribute to the foundation work of information organization, intellectual access / information retrieval, and knowledge discovery.

Topical relevance is the central concept of information seeking and information retrieval; yet our understanding and research of topical relevance is not matching up with its importance. As discussed in Chapter 2 (Literature review), much relevance research in information science studies user behavior and criteria applied by users in assessing relevance and usefulness, often focusing on non-topical criteria rather than analyzing the structure of topics and in what ways the relevant information relates to a topic. With very few exceptions, topical relevance is treated as a single relationship type, matching topic, without further discussion or analysis of this complex concept. A major goal of this research is to draw attention to this worrying gap and revive the discussion on the “topical layer” of the puzzle, especially under the current circumstance where information overload and content management have become such pressing issues.

The major outcome of this research, a typology of topical relevance relationships, is a work in progress and open to further developments (especially in specific domains).

15.0 Overview

A significant part of the inquiry is dedicated to an analytical review of relevance literature in a broad range of disciplines. *Relevance* lies at the heart of human cognition; in turn, *topical relevance* lies at the heart of relevance. The concept of relevance and topicality is so fundamental that it becomes an inevitable subject for discussion in any field that is concerned with human thinking, reasoning, and learning, even though these fields and literatures may not label it as such. For example, rhetoric labels the topical connection by “rhetorical functional role”; cognitive psychology calls it “cognitive mechanism”.

Relevance and topicality is a key notion shared and enriched by thinking and theories from many disciplines; to fully study and truly understand its nature, we cannot limit our scope to just one field, information science. The first group of fields and literatures selected for the analytical review has an emphasis on investigating human thinking, reasoning, communication, and learning in a *general context*: argumentation & logic, cognitive psychology & education (learning theory), communication (relevance theory), rhetoric (rhetorical structure theory), and information science. The second group focuses on thinking and reasoning in *specific subject domains*: legal reasoning, clinical medicine, and art history.

The literatures reviewed approach the intangible notion of topicality and relevance from many angles and contribute to elaborating its substance. The analysis focuses on what is *generically* true about the concept instead of going into details of domain-dependent specifics. The analytical literature review identified fine-grained topical relevance relationships and organized them into a typology of three facets plus an additional presentation facet, a *theory-grounded* typology of topical relevance relationships, as summarized and discussed in Chapter 11 and displayed in Appendix H, with definitions and annotations gleaned from various domains.

Among all literature reviewed, the major contributions to the structure and specific relationship types of the typology come from

- Mann & Thompson's (1988, 2006) Rhetorical Structure Theory (RST) (the 31 RST relationships become the "building blocks" to the function-based facet of the typology);
- Toulmin's argumentation theory (1958; 1984) (main source for the reasoning-based facet); and
- Green & Bean's (1995) semantic-based topical relevance relationship inventory.

Rather than incorporating these schemes and their relationships directly, the study selected and re-organized them into a systematic framework; in some cases the relationships are given more generic definitions. In particular, RST provides a rather comprehensive framework for investigating relational propositions based on *functional role*. It is an inclusive inventory of rhetorical relations that has a wide range of applications in text annotation and discourse analysis. During the review, it became clear that, from an information perspective, the inventory of RST relationships is a mixture containing relationships related to

- The substance of information, e.g., *Purpose, Evaluation, Means*;
- Forms of presentation, e.g., *Elaboration, Definition, Summarization, Reference*; and
- Emphasis on rhetorical use, as in *Concession* (Ex: *Tempting as it may be, we shouldn't embrace every popular issue that comes along.*) and *Antithesis* (which implies the substance-based relationship *Contrast*; what distinguishes *Antithesis* is its rhetorical use of *Contrast*)

Substance-related RST relationships deal with the essence of the given information or message, which is the focus of the present inquiry. **Presentation-related** RST relationships also differentiate types of relevant information on a topic, e.g., the relevant information can be a *definition* or a *summary*, but they account for the differences in presentation rather than in substance; they do not address the issue of in what way the given information relates to the topic, e.g., *definition* does not specify if it is matching topic, or delivers context, or provides comparisons. Presentation is a secondary aspect; relevance relationship types combine with forms of presentation. **Rhetorical-use-related** RST relationships account for differences in rhetorical devices used rather than in substance. These three types of RST relationships are orthogonal to each other. Recognizing these nuances may better structure the RST relationships and improve its applications in text analysis.

This is just one example of how the study brought in relationships from original inventories, sorted them out, and put them together under the current framework of topic-oriented information. Examining these schemes from multiple perspectives going beyond their original purpose led to new insights and frameworks that might not have been discovered otherwise. These insights inform the original theories and

inventories by suggesting more thought-out structures and opening new angles for applications.

The second part of the inquiry is devoted to the empirical analysis of three datasets showing topical relevance relationships, not only to investigate how the theory-grounded topical relevance relationships manifest themselves in various contexts but also to further enrich and polish the typology. Following the same rationale as the literature analysis (Phase 1), the analysis of relevance data in Phase 2 ensures that the scope of examination is comprehensive and the findings are inclusive and not limited to an individual domain. Three kinds of empirical relevance data were used to achieve considerable variations in “forms”, “domains”, and “contexts” (as illustrated in Table 3-2):

- **Holocaust oral history** topical relevance assessment data from the MALACH project (see Section 3.2.3.1)

Data analyzed: 41 topic notes provided by eight relevance assessors (graduate students from history and information science) on a total of 40 MALACH topics;

- **Clinical questions and answers**, collected from two online clinical QA resources (see Section 3.2.3.2)

Data analyzed: 26 clinical questions posed by practitioners and associated answers provided by expert physicians;

- **Art images and tags** (subject descriptors) assigned to the images, collected in the CLiMB project (see Section 3.2.3.3)

Data analyzed: 11 art images and associated 768 *unique* tags assigned by 13 indexers (art librarians and art historians).

The study used *qualitative content analysis* (see discussion in Section 3.2.2) and conducted qualitative coding based on the typology derived from Phase 1. The findings provide rich examples to illustrate the large variety of topical connections between a *topic* or *question* and an *information object* or between two information objects. Examples of an *information object* are: a Holocaust survivor testimony or a passage from it, an evidence-based clinical answer or a passage from it, a tag assigned to an art image. The analysis also highlights the domain effects on refining the typology. (See the discussion of coding examples in Chapter 12 to 14)

15.1 Improved Conceptual Understandings of Topical Relevance

The reviewed definitions of topical relevance across disciplines share a common anchor point, that is, the *cognitive effect* achieved on the receiver (a reader, hearer, information user, etc.). “An essential part of a relation definition is the section labeled *Effect*...an RST analysis always constitutes a plausible account of what the writer wanted to achieve with each part of the text.”(Mann & Thompson, 1988) RST definitions are effect-centered. Essentially, RST is a relationship framework for differentiating cognitive effects to be achieved, by specifying the functional role and highlighting the contribution of text parts. Although Maron and Hutchins (Information retrieval) take different approaches on defining “aboutness”, they both stress the inherent connection between aboutness and topical relevance and the cognitive effects on the receiver. As described by Maron (1977:40): “How you interpret and understand what you were reading relates to what you previously knew and how the document in question changed or strengthened your prior states of knowledge and belief.” In Wilson and Sperber’s definition of relevance (Communication): An input is relevant if it connects with the receiver’s background information to yield conclusions that matter to the receiver. The “cognitive effect” refers to a substantial change of the receiver’s knowledge state or view points after receiving a piece of relevant information, which can confirm, reinforce, revise, or disprove the receiver’s beliefs (See Patrick Wilson’s definition of “Evidential Relevance” in Chapter 6).

RST relationships and topical relevance relationships are conceptually the same but seen from different perspectives. They both aim at explicating “positive cognitive effects” (Wilson & Sperber, 2002) on the receiver (given she a reader, a searcher, a user, or else). By essence, both RST relationships and topical relevance relationships

are effect-centered. The difference between the two is that, the positive cognitive effect is *intended* by the writer in a RST relationship, whereas the effect is *established* or *achieved* on the receiver for a topical relevance relationship.

“Within-text” relationships (e.g., discourse relationships, rhetorical structures, and semantic relationships) can be applied as “within-search-result” relationships. In other words, the set of relationships used to organize inside a text or a discourse can easily be applied to organize search results. A coherent discourse is organized around a topic; different text parts play different roles and work together to improve the reader’s understanding of a topic. In information search, the process is quite similar: we also have a topic, and we gather and organize different pieces of relevant information to improve the user’s understanding on the topic. In terms of contributing to the receiver’s (a reader, a searcher, etc.) understanding of a topic, the functional roles played by different parts of text and those by different pieces of relevant information are much the same. Therefore, the relevance relationships can be used:

1. To explain why a given piece of information (in RST: the Satellite text span) helps the reader or hearer to understand a topic or a statement (in RST: the Nucleus text span) (this use is emphasized in rhetoric and communication);
2. To lead to a new piece of information (through search or navigation) that helps the reader to understand a topic or a statement (this use is emphasized in information studies).

Intention is another important and intriguing aspect of topical relevance. In communication and Rhetoric, the reviewed theories emphasize the perceiver drawing conclusions about the intention (or the intended purpose) of a piece of text, speech, or conversation. To a large extent, searching for relevance in the context of communication means searching for intentions. In conversations, the receiver

assembles and processes evidence to identify and infer about the other communicator's intentions; in text comprehension, the receiver reads for the author's intentions; in art history, the receiver seeks for the artist's intended meanings and purposes. The meaning or cognitive effect *intended* by the sender (author, creator, etc.) presents only one side of the coin. Taking a more constructive viewpoint, there are also meanings or purposes (re)constructed by the receiver rather than intended by the original sender, as emphasized by the Reader-Response Theory (a school of literary theory that focuses on the reader's experience of a literary work, in contrast to the focus on the author). The reader or receiver's perspective is not only existing but also valid. In information seeking, people often start with their own tasks and seek useful information to fit into their tasks. In this process, they judge the relevance of information to their own purpose more than to the intended purpose; they actively repurpose the information they found and reconstruct relevance. In image tagging, people often tags images not only by the intended meanings, but also by their own viewing reactions, interpretations, and purposes (this behavior rests on the third dimension of the image topic model proposed in Chapter 10). We need to take into account these different perspectives when considering topical relevance and topical relevance relationships.

15.2 The Topical Relevance Typology

The primary result of the inquiry is a theory-grounded and empirically-refined typology of topical relevance relationships that deal with the substance of information. The typology consists of three facets and total 227 fine-grained topical relevance relationships:

- functional role (function-based): 151 relevance relationship types

- mode of reasoning (reasoning-based): 30 relevance relationship types; and
- semantic relations (semantic-based, developed by Green & Bean (1995)): 56 relevance relationship types.

The secondary result is a scheme of 33 “presentation” types that can be combined with the topical relevance relationships.

The top-level topical relevance relationships characterized by the three facets are presented in the following table. (See the full typology in Table 14-1, Table 14-2, and Table 14-3 for each facet).

Table 15-27 Top-Level Structure of the Topical Relevance Typology

| Relevance facet | Definition | Top-level relationships characterized by the facet |
|---|---|--|
| Function-based | What functional role a piece of information plays in the overall structure of a topic. | <p>Matching topic: manifestation/symptom, image content, image theme;</p> <p>Context: scope, framework, environmental setting, social background, time and sequence, assumption/expectation, biographic information;</p> <p>Condition: helping factor/condition, hindering factor/condition, unconditional, exceptional condition;</p> <p>Cause and effect: cause, effect/outcome, explanation (causal), prediction;</p> <p>Comparison: by similarity, by difference (contrast), by factor that is different;</p> <p>Evaluation: significance, limitation, criterion/standard, comparative evaluation;</p> <p>Purpose/Motivation: purpose, motivation;</p> <p>Method/Solution: method, approach, instrument, technique, style, solution.</p> |
| Reasoning-based | How information contributes to users' reasoning about a topic. | <p>Generic reasoning;</p> <p>Reasoning by analogy;</p> <p>Reasoning by contrast;</p> <p>Rule-based reasoning (deduction);</p> <p>Generalization (induction);</p> <p>Causal-based reasoning: forward/backward inference</p> |
| Semantic-based (Green & Bean, 1995) | How information connects to a topic semantically. | <p>Class – Member;</p> <p>Whole – Part (partonomy): process – step, etc.;</p> <p>Object – Attribute: adjectival, adverbial;</p> <p>Class – Subclass (taxonomy).</p> |
| Secondary aspect | | |
| Presentation types | In what form or style information is presented; it can be combined with the topical relevance facets. | <p>Reference;</p> <p>Definition;</p> <p>Restatement: paraphrase, clarification, translation, representation;</p> <p>Summarization: abstraction</p> <p>Elaboration: amplification, extension, specialization/specification, object – attribute;</p> <p>Interpretation: organization, concretization, humanization, transformation;</p> <p>Emphasis / Drawing attention.</p> |

This dissertation focuses primarily on the function-based facet and secondarily on the reasoning-based facet.

- Functional role: the role a piece of information plays in the overall structure of a topic or an argument, by taking into account its relations with other parts of the given information passage or the argument. Adopting the rhetorical structure theory (Mann & Thompson, 1988) perspective, “for every part of a coherent text, there is some function for its presence, evident to readers”.
- Mode of reasoning (Evidentiary connection): logic- and inference-based relationships that link pieces of information and a topic; it can be seen as the inference chain between information and topic. This perspective is concerned with how pieces of information can be identified through an inference chain and how specifically they relate and contribute to a receiver’s reasoning about a topic.

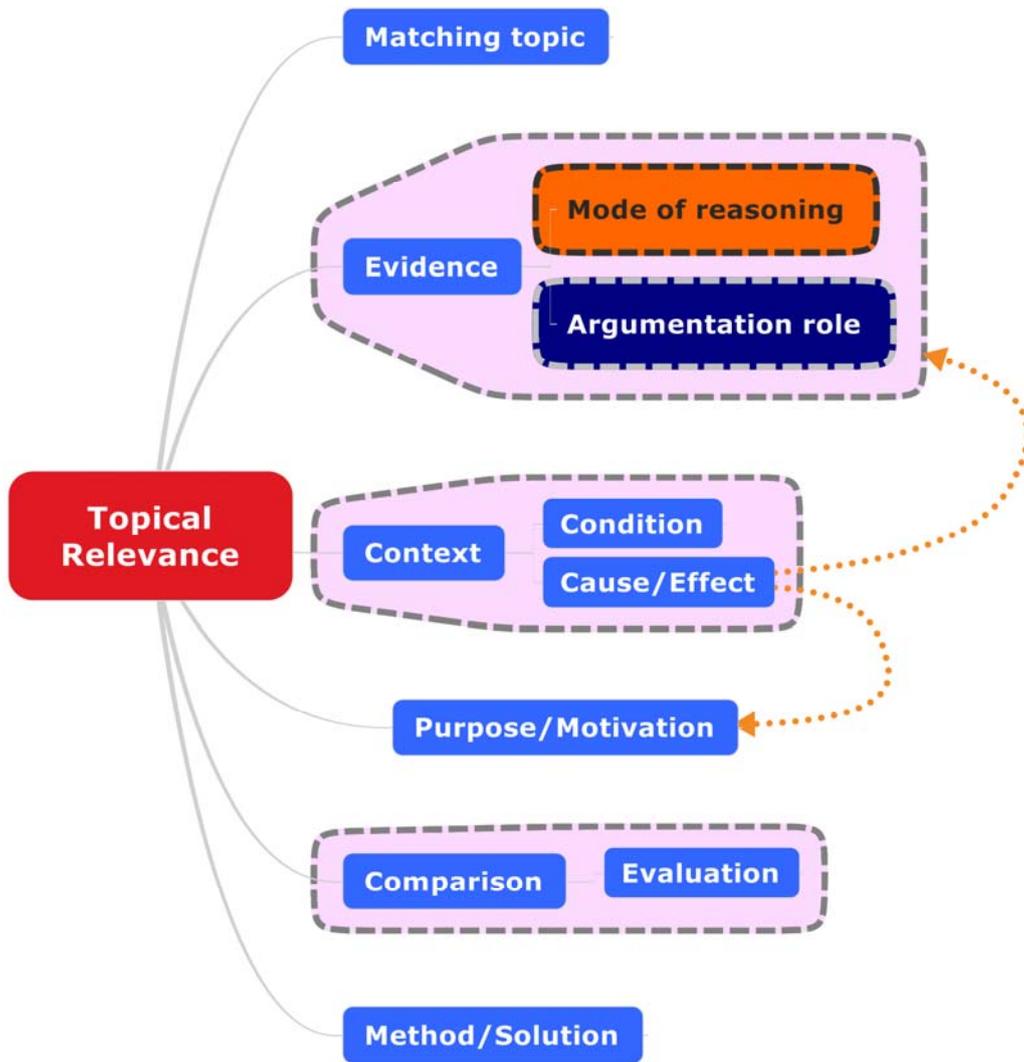


Figure 15-46 Function-Based Topical Relevance Categories and Their Inter-Relations

Figure 15-1 displays the main function-based relevance categories and their groupings based on the empirical analysis:

- [Condition], containing helping/hindering factors, is a “weaker” version of [Cause/Effect]; in many cases, [Cause/Effect] and [Condition] play the same functional role as [Context] and provide supplemental background information about a topic.
- [Evaluation] implies comparison to a standard or to an alternative, e.g., “Medical trial” is an evaluation between alternative treatments or between treatment and placebo (non-treatment); likewise, “Significance” is concluded on comparing the effect of current solution to alternative or certain standard or baseline which may not be explicitly stated. Therefore, [Evaluation] is closely linked to [Comparison].
- [Evidence] is tightly associated with Argumentation and Mode of reasoning (the second relevance facet of the typology): According to Toulmin’s augmentation theory (1958), both “evidence” and “justification” (reasoning rule) are the central elements of the core structure of making an argument. [Evidence] becomes an important connection point between the function-based and reasoning-based facets of the typology. In the empirical analyses, “Circumstantial evidence” (under the function-based facet) is simultaneously coded with the particular type of reasoning involved in the case.
- Strong connections are also observed between [Cause/Effect] and [Purpose/Motivation] and the Evidence/Argumentation/Reasoning group. Causal elements are inherent in [Purpose/Motivation]: “Motivation” provides the cause for a topic and “Purpose” or “Goal” presents the effect to achieve. [Cause/Effect] is embedded in “Causal-based reasoning”, as discussed in Section 11.2.

The inquiry did not study the semantic facet on its own, since Green & Bean (1995) have provided a thorough explication on this facet in their study. Some relations from the semantic facet, such as *class – member*, *class – subclass*, *whole – part* (including *process – step*), and *object – attribute* (including *adjectival* and *adverbial*), were combined with the function-based facet and the presentation facet to facilitate the empirical analysis (See examples in Table 11-2)

In addition to the three relevance facets, the study identified a separate facet of 33 *presentation types* (see Section 11.2; Table 11-1), which includes *Reference*, *Pointer*, *Definition*, *Elaboration*, *Restatement*, *Summarization*, and *Interpretation*. With this presentation facet, a distinction between “substance” and “presentation” is made. Although useful to classify different types of topical information, the forms of presentation are not associated with any type of topical relevance; neither do they suggest any substance-based relevance type. Therefore, it is separated from the other three topical relevance facets. The forms of presentation serve as a secondary aspect for coding and were examined only for the [Matching topic] relevance category in the data analysis.

15.3 Function-Based Relevance Relationships for a Generic Topic-Oriented Information Architecture

The *function-based* facet or a subset of the facet can serve as a basis for a generic *topic-oriented information architecture* that organizes and structures the topic space, filling a gap in knowledge organization and content management; see Figure 15-2.

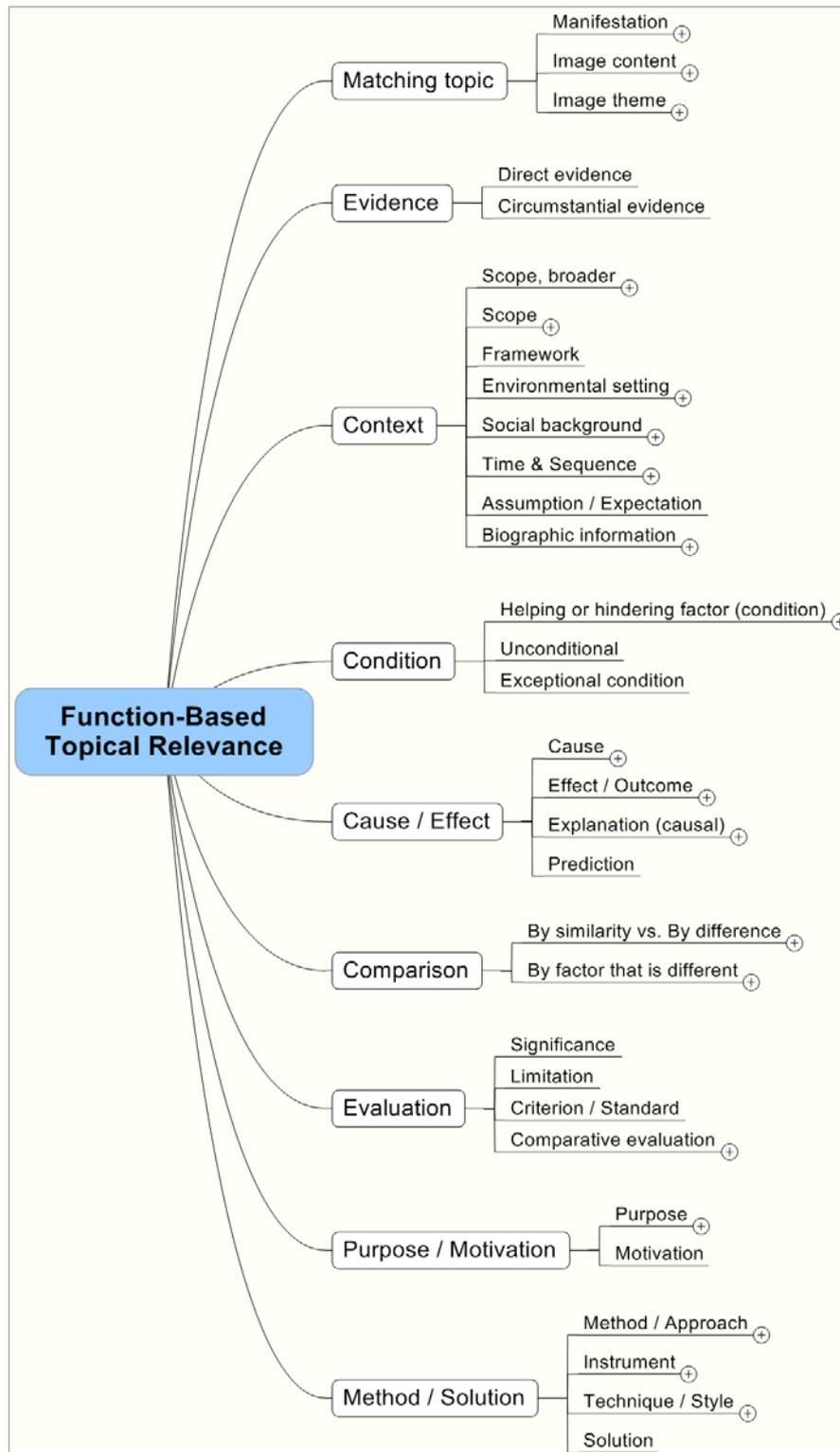


Figure 15-47 Function-Based Topic-Oriented Information Architecture

Based on the empirical analysis, the function-based topic-oriented information architecture has the followings features:

- The function-based topic framework provides the overall structure for organizing a topic. Particular domains and topics may use only some branches of the architecture and may instill domain-specific meanings to these branches, but the overall framework remains stable and meaningful across multiple domains analyzed (oral history, clinical medicine, and art images).
- The function-based topic-oriented information architecture can be easily customized to a subject domain through domain-specific definitions and extensions. For example, [Method / Solution] is used to characterize “Medical treatment” and “Diagnostic method” in clinical medicine, whereas in fine arts it is used for describing “Technique” and “Style / Genre”.
- The function-based topic-oriented information architecture is a *multi-level* topical structure, as demonstrated with the clinical examples and discussed in Section 12.2.1. To fully represent the complicated structure embedded in the very rich information on a topic (such as an evidence-based clinical answer), the function-based relationships and framework need to be applied on multiple levels (See Figure 12-12 in the following for an example). Note that in the example the topical relevance relationships are applied at each level and the presented information relates to the central topic only through “steps” of connection. For example, “A large random trial” does not directly connect to the central topic of “ADHD in children”: It is not the “Evaluation” of “ADHD in children”; instead, it is the “Evaluation” of “Stimulant medication therapy”, which in turn is the “Medical treatment” of “ADHD in children”.

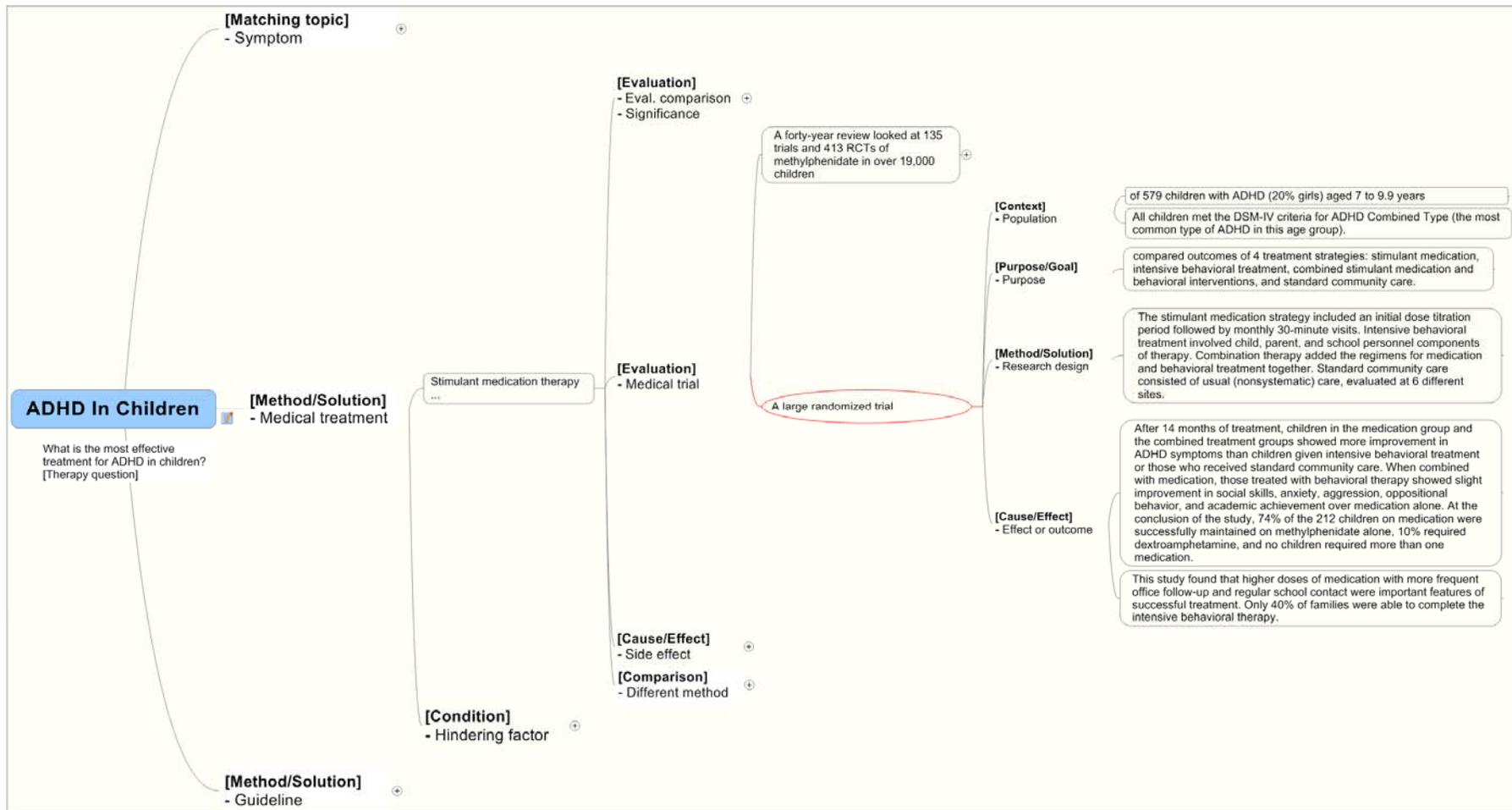


Figure 12-2 (repeated) Zooming In On One Branch of the ADHD Therapy Question: “A Large Randomized Trial”

15.3.1 Application: Content Management

The topic-oriented information architecture contributes to the important “topic layer” of content management models. More and more IT decision makers in government and in business recognize the value of “information structure” for effective content management and enterprise search, which becomes critical to improve operational efficiency and competitiveness of the organization. To meet this increasingly pressing need in enterprises, solutions have been suggested with faceted metadata profiles and faceted search output for content management and access (e.g., Autonomy, or MOSS search embedded in SharePoint). Currently, the facets available in such products rely largely on document attributes and “Dublin Core” type of metadata elements: document / content type (e.g., html file, spreadsheet, blog, memo, report, and announcement), creator / author, source (e.g., division, department), creation date, version / edition, and so on. In other words, the present faceted solutions focus on form attributes. The topic component or the topic layer that plays the most significant role in meaningfully organizing content is yet missing from the foreground. The topic-oriented information architecture presented here fills this gap and provides a generically meaningful framework for organizing content. It is an explicit relational framework parallel to the non-topical metadata framework, except that it directly addresses the content whereas the other manages the properties closely associated with the content.

15.3.2 Application: Topic Navigation

Structured with function-based topical relevance relationships, the topic-oriented information architecture can serve as a useful navigation tool for the user to explore a new topic space more efficiently and more systematically; it also allows the user to

easily pin down specific branches of information that are precisely tailored to his/her task. Under the current context of information overload, simply saying the information is relevant but not specifying how it is related to a topic gives limited assistance to the user. It would not help the user from getting overwhelmed or lost in the sea of relevant information. Topical relationships and topical structures built upon these relationships are essential for the user to quickly make sense of a topic space, particularly when the user is not familiar with the topic.

The function-based topical information framework serves the same purpose as the *Relation Browser* (Gary Marchionini) and the *Flamenco* search interface framework (Marti Hearst), both of which are topic navigation tools based on content-oriented category metadata. This inquiry approaches the same goal from a different perspective by proposing an *explicit relational structure* that is discipline- and dataset-independent. The intention is to leverage topic knowledge structure and thinking across domain boundaries.

Figure 12-15 shows an example of a topic space structured with the topic-oriented information architecture. It is the combined topic map for “ADHD in Children” that was introduced earlier in Section 12.2.2.6. Given the limited space, the topic map displays only the high-level structure not all the details (“+” indicates the branch can be further expanded).

In addition to structuring a single topic space, the topical relationships can also be used to link different topics and connect them into a knowledge network.

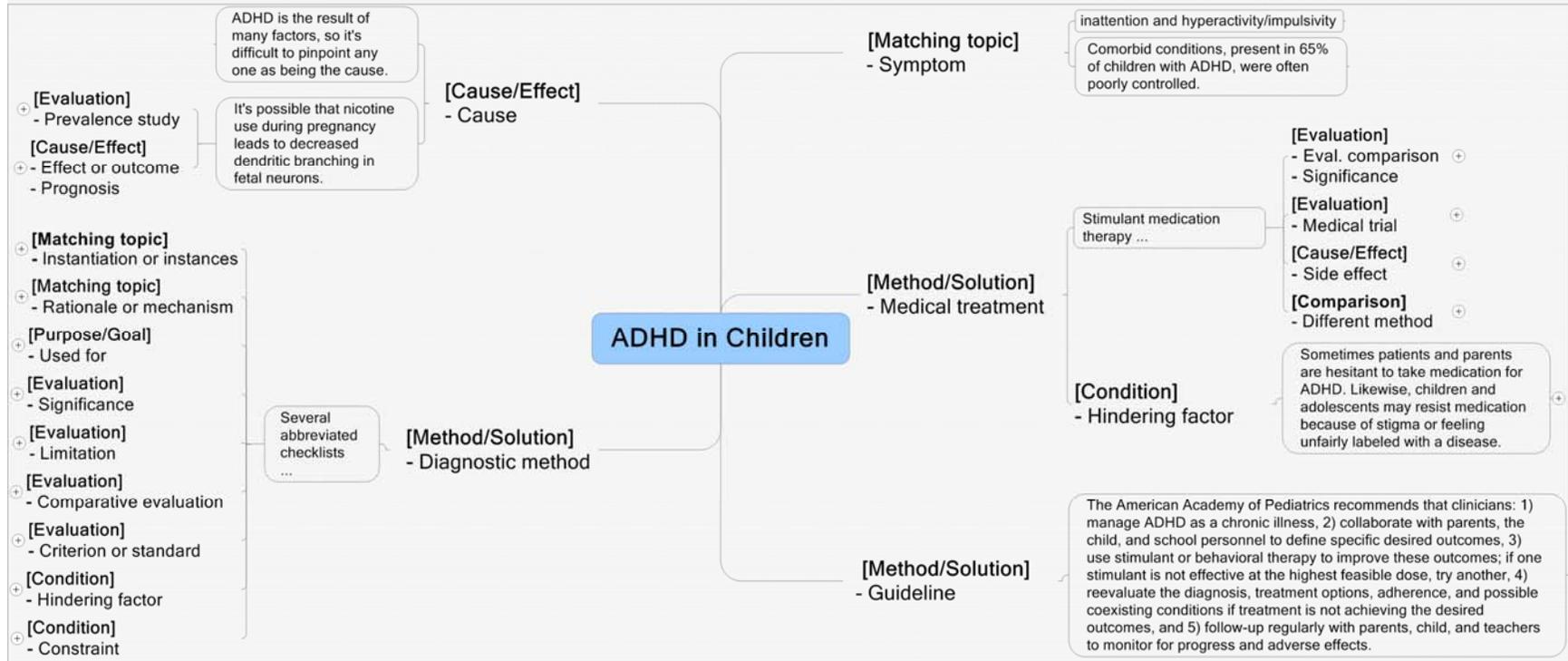


Figure 12-15 A Combined Topic Map of “ADHD In Children” From ADHD_Therapy, ADHD_Diagnosis, And ADHD_Etiology

15.3.3 Application: Organize Search Output

The topic-oriented information architecture can be used to organize the search results for a topic. For example, on the result interface, instead of having a long unordered list, we can have expandable categories indicating “Social background”, “Contrasting cases”, “Circumstantial evidence”, “Definitions”, “Cause / Effect”, etc. With this faceted output, the user can quickly get an overview of the topic s/he is researching. It also substantially cuts down on the time and energy to navigate to the specific aspects of interest, instead of digging through the hodgepodge of one million results. It provides similar functionality of “faceted filtering” describe in Padilla (2008) by allowing users to actively whittle down the information space.

Taking a clinical answer as an example, Figure 15-3 shows the original answer text in paragraph form and Figure 15-4 provides the equivalent presentation organized with the function-based structure. The organized output assists the reader to quickly digest the essence of the information and map out the relationships between different elements.

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Does a Short Symptom Checklist Accurately Diagnose ADHD?

http://www.jfponline.com/content/2004/05/jfp_0504_00412.asp

Evidence-Based Answer

Several abbreviated checklists perform well in distinguishing children with attention deficit/hyperactivity disorder (ADHD) from those without ADHD under ideal conditions and in research settings. While many guidelines and experts recommend using these checklists as an efficient method to collect data from multiple sources (strength of recommendation: B, based on extrapolation from cohort studies to define test characteristics and consensus opinion), experts point out the subjective nature of responses on behavior rating scales, and the limitations in using checklists as the sole source of information.

The Swanson, Nolan, and Pelham (SNAP) checklist from the Diagnostic and Statistical Manual of Mental Disorders, revised 3rd edition (DSM-III-R) has been shown to have a sensitivity and specificity in excess of 94% to distinguish hyperactive, inattentive, and impulsive children with ADHD from those without ADHD. This was based on criteria in the DSM-III-R. The DSM-IV SNAP checklist (available at www.adhd.net/snap-iv-form.pdf), based on the newer diagnostic criteria, has not been adequately evaluated. The ADHD Rating Scale-IV (in DuPaul et al, ADHD Rating Scale IV—Checklists, Norms, and Clinical Interpretations, available from Guilford Press) and the ADD-H Comprehensive Teacher/Parent Rating Scale (ACTeRS; available from MetriTech, Inc at www.metritech.com) are useful for their brevity, but they do not perform as well in differentiating children with ADHD from those without ADHD.

**Figure 15-48 The Original Answer Text to the Question:
Does a Short Symptom Checklist Accurately Diagnose ADHD?**

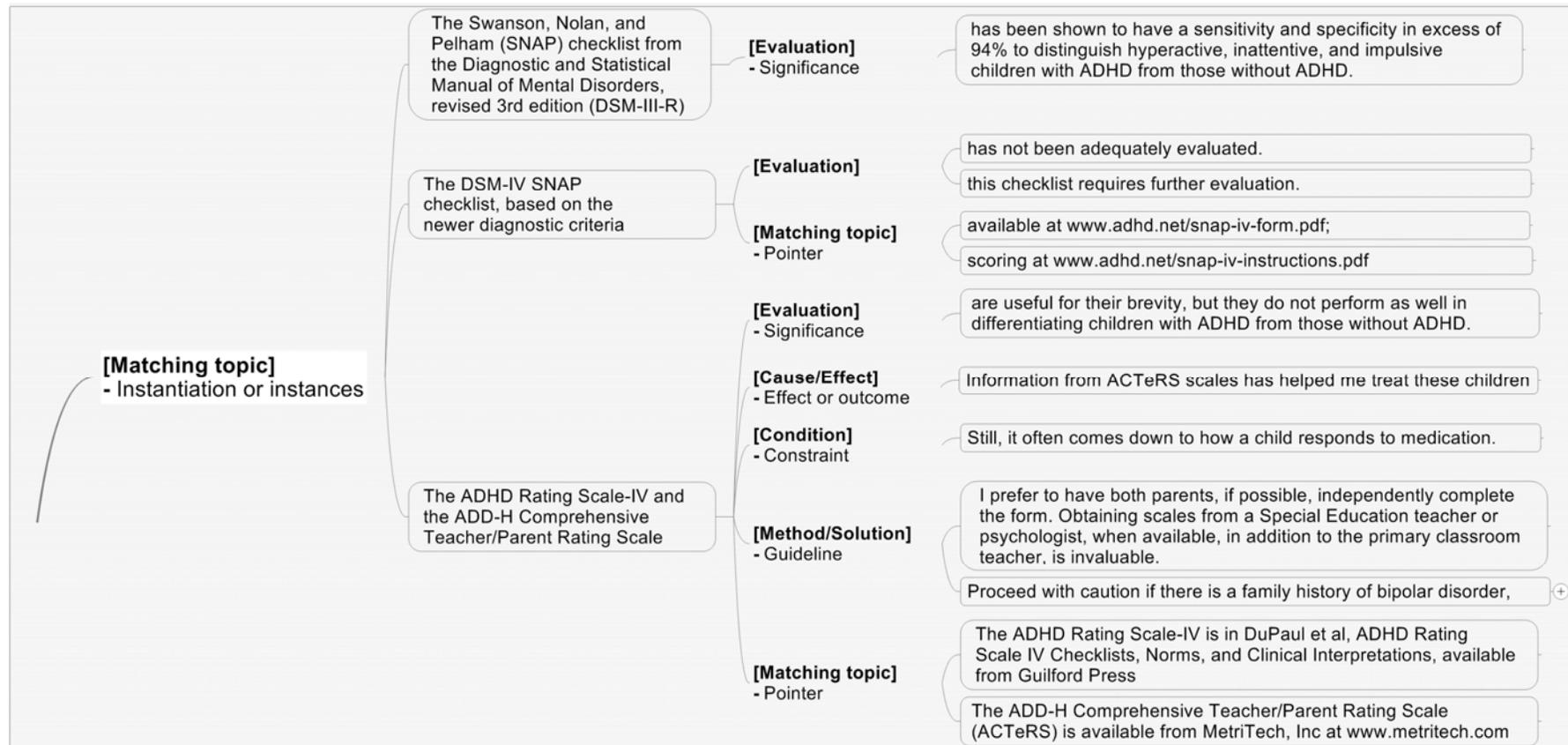


Figure 15-49 An Organized Answer to the Question: Does a Short Symptom Checklist Accurately Diagnose ADHD?

15.3.4 Application: Assist Structural Analysis

The typology can be used as a vehicle to investigate and understand the topical structure in specific subject domains. For example, it allows us to extract the high-level structural features of clinical questions and answers, in particular, to identify the common structural features of therapy questions, diagnosis questions, prognosis questions and etiology questions. This type of structural analyses supplies important implications to automatic clinical question answering and structural search of evidence-based medicine.

In addition to the applications of topic architecture discussed above, the developed typology has the following direct implications in knowledge organization and information retrieval:

- Improve indexing and tagging:
 - Empower relational subject indexing (Section 15.4.1);
 - Organize user tags and structure social tagging (Section 15.4.2);
- Extend information retrieval beyond topic matching (Section 15.5);
- Structure the user's thinking and argument-development process:
 - Assist users in structured thinking (Section 15.6.1);
 - Assist users in developing better arguments (Section 15.6.2).

Looking forward, many of these applications are potential research topics worth further exploring (See “Future Directions” in Section 15.7).

15.4 Implication: Improve Indexing and Tagging

15.4.1 Empower Relational Subject Indexing

In conventional indexing, we only indicate what topic terms are relevant and assign them to the information object without differentiating the topical connections held between the terms and the information object. With this fine-grained topical relevance typology, we can also specify in what specific ways the topic terms relate to the information object. Ultimately, it helps to fine-tune the correspondence between an information object and a user's request (topic), allowing users pin down the desired information much faster and easier.

The topical relevance relationships are structured by facet; the three facets complement each other to suit different needs. This allows more flexibility for the indexer to reveal topical connections from different perspectives and to better adjust to the target audience.

15.4.2 Organize User Tags and Structure Social Tagging

The typology can be used to organize user tags and structure social tagging. Web 2.0 provides an open and dynamic environment for social collaboration and sharing of information (knowledge) on a scale never imagined before. Among all, social tagging empowers and engages users to organize information through generating and sharing their own metadata. No longer passive receivers at the door, individual users can now come in and contribute. They actively index the Web, ranging from texts, blogs, websites, to music, photos, fine arts, and cultural artifacts.

There has been an increasing awareness of viewing information as institutional assets to create value by aggregating knowledge across departments and discovering hidden knowledge links in the vast amount of enterprise information. Under this

context, user tagging has also rapidly gained its popularity as an innovative solution to content management in government sectors and corporations, such as the fast-spreading *Fundelious* project at the IMF (International Monetary Fund).

As a tag is assigned to an information object, a relevance relationship to a particular topic (feature) is established, shared, and preserved for future recall. As tags accumulate every second, we can picture every tag weaving into this large invisible “web” of relevance relationships, rapidly grouping knowledge, meanings, ideas, and opinions for easy access. While the “social layer” of the Web has been heavily discussed among researchers, we need to focus attention to this “relevance layer” which engages users’ relevance judgments and cultivates a meaningful bottom-up information structure onto the Web.

Containing rich fine-grained topic relevance relationships, the derived typology equips users to make sense of the ever-growing “tag cloud”, to achieve a better understanding of the relationship propositions underlying the “relevance web”, and to better facilitate its development. In particular, we can directly apply the typology to arrange user tags into a more useful presentation, using the following Flickr Image (Figure 15-5) and associated tags as an example:



Figure 15-50 Flickr Image Example: Wasteland

Tags: stairs
 stadium
 bcplace
 distagon35
 railing
 empty
 alone
 vancouver
 day
 black and white (bw)
 film
 bathroomdarkroom
 rodinal
 ilford
 fp4
 contax
 rtsii
 stand
 development
 standdevelopment

Image Tags Organized With the Topic-Oriented Information Architecture

Matching topic

- . **Image theme: Title**
- . . . Wasteland
- . **Image content**
- . . *Reference*
- . . . stairs,
- . . . stadium,
- . . . railing,
- . . *Elaboration (Adj.)*
- . . . empty,
- . . . alone,

Context

- . **Environmental setting: Physical location**
- . . . bcplace,
- . . . vancouver,
- . **Time & sequence: Time / Period**
- . . . day,

Method / Solution

- . **Style / Genre**
- . . . blackandwhite (bw),
- . **Style / Genre: Design or composition**
- . . . standdevelopment
 {stand, development}
- . **Technique**
- . . . bathroomdarkroom,
- . **Instrument**
- . . . distagon35,
- . . . contax rtsii,
- . **Instrument: Material or medium**
- . . . film,
- . . . ilford fp4,
- . . . rodinal,

See more tag organization examples of art images in Section 12.3.

This *frame-based* tag organization could be guided by the system at the point of tagging. It could be also achieved automatically and/or through a collaborative effort by users other than the tagger, preferably through simple drag-and-drop manipulations available through the interface. We need to make the tag-organizing process as intuitive and painless as possible, so as to attract users to participate, contribute, collaborate, and move the tagging power onto a new level. This is an intriguing idea to be explored in the T3 project.

In addition to create structure for the tag clouds, the typology can improve the match between image tags and image queries as well. As demonstrated by the “jewelry” example in Section 12.3 (Figure 12-16), it is very important to allow both the user and the tagger to specify the terms in relation to the image content. In that particular case, allowing the tagger and the user to indicate jewelry depicted in the foreground (focal) or the background (peripheral) helps to avoid the mismatch between “focal querying” and “peripheral tagging”, and vice versa.

Taking the above image of “Wasteland” (Figure 15-5) as another example, “blackandwhite” is a tag assigned to it. The same tag, “blackandwhite”, is assigned to the following image of “Brothers” (Figure 15-6) as well. It becomes evident that this same tag means two different things when analyzed with the function-based topic information architecture:

- For *Wasteland* (Figure 15-5):
 - . [Method / Solution] – Style / Genre
 - . . . blackandwhite;

- For *Chess* (Figure 15-6):
 - . [Matching Topic] – Image content: Focal
 - . . Elaboration (Adj.)
 - . . . blackandwhite.



Figure 15-51 Flickr Image Example: Brothers
(Note: It is a color image.)

15.5 Implication: Extend IR Beyond Topic Matching

Topical relevance is at the heart of content-based IR systems and has the greatest impact on retrieval results. The fundamental notion underlying present IR design is “matching”, a very limited interpretation of topical relevance. As discussed in the literature review (Chapter 2), IR systems have evolved from naïve keyword matching to more advanced and sophisticated matching models, such as vector-based matching or probabilistic matching. However, the underlying assumption remains the same, that is, being topically relevant to a topic is *matching* the topic directly or algorithmically. This inquiry has challenged this assumption with convincing literature and empirical evidence. As demonstrated in the study, many other relationships contribute to topical relevance and should be incorporated in the design of retrieval algorithms.

It may be argued that matching-based IR systems have worked well; why do we bother to have other types of relevant information? This view is oversimplified and fails to take into account the large variety of information needs and user situations:

- In many situations, direct evidence [Matching topic] is simply not available. For instance, in court cases, direct witnesses are preferred but often not available. Much trial reasoning is based on indirect (circumstantial) evidence. In the history domain, when direct evidence on an event is missing, historians collect indirect, contextual, or comparative information to make hypotheses and establish arguments.

- For many tasks direct evidence [Matching topic] alone is not sufficient. The need for comparable cases in law is discussed above. For another example, in Evidence-based Medicine a direct quick diagnostic answer is not sufficient; what matters is how the physician gathers and uses evidence to arrive at the answer, how well s/he understands the background and problem of an individual patient, and how much s/he is aware of comparative treatments or tests. EBM (Evidence-Based Medicine) puts a focus on contextual and comparative evidence into clinical information seeking.

Matching-based IR design fails to effectively respond to non-matching types of information needs. However, in exploratory searches, users approach the central topic from various angles. For example, with the current IR systems, it is challenging for the user to search for contextual information pre-9/11 (e.g., cultural conflicts that contribute to the development of 9/11) or to explore comparative cases of 9/11 (e.g., comparable historical events to 9/11). Instead of simply submitting a query of “context pre-9/11” or “similar events to 9/11”, the user may need to use a particular event or person s/he knows to be relevant as a starting point. This makes it difficult for “exploratory” users who do not have much background on the subject. Even for users more knowledgeable, it still demands extra mental work to “reformulate” their non-matching requests before they can interact with the matching-based retrieval system.

Extending information retrieval beyond topic matching allows us to retrieve a fuller scale of relevant information and cover a broader range of user requests.

Systems capable of detecting information that is relevant in a non-matching way allow users to keep their focus and stay at the center of their task; yet support them in thinking about the topic more comprehensively.

We can incorporate new capabilities into IR systems and search engines by indicating topical relevance relationships in indexing (as discussed earlier in Section 15.3.4.1): The indexer not only identifies the topic to which a piece of information is related but also indicates in what way they are related. This may substantially improve the systems' response to different types of information needs. Indexing topical relationships to achieve the desired flexibility is just a starting point. A more general solution is to equip the system with reasoning power so that it can automatically detect what information in the collection is relevant directly, indirectly, in context, or by comparison. Such a facility, to the extent that it could be achieved, would work best with well-structured texts and is presumably more difficult (if at all possible) with texts that are poorly organized. The functionality of automatically detecting relevance types by search engines could be supported by an ontology that stores type-of-relevance relationships at the concept level. For a system that works along these lines, using the relevance types implied by the PICO (Problem, Intervention, Comparison, & Outcome) frame in Evidence-Based Medicine as precision device, see Niu & Hirst (2004) and Demner-Fushman & Lin (2005).

In the scenario of conventional information seeking in libraries, reference librarians, as informed of various types of topical relevance, can directly take on the

initiative to extend the scope of relevant information to stimulate their clients' thinking on a topic from novel perspectives and better assist their research. As a matter of fact, a reference librarian in a local physics lab has been adopting this approach to provide her clients with different types of relevant information on a topic. She has found this multi-faceted typology a useful framework tool to guide her search for clients at work. Her feedback not only provides interesting insight into the potential of the typology in extending reference librarians' frame of thinking, but also raises a practical question on how to more systematically train the librarians to effectively apply the typology to their reference search. Counting in all the 227 detailed relationships (many are very domain specific on the bottom levels), the full typology is indeed too fine-grained to be easily grasped and remembered. It is best to extract a subset, for example, by hierarchical level (the first and second levels of the functional facet contains 35 topical relevance relationships), or by the subject domain, for the information environment at hand.

The topical relevance typology provides an overall generic structure in sufficient detail for most purposes. As pointed above, not all applications require the entire scheme; each application could select a suitable subset. On the other hand, an application may require more fine-grained extensions, especially domain-specific extensions, which could be easily fit into the overall structure. In the design of IR systems and search engines, the topical relevance typology can be combined with non-topical approaches to relevance and other schemes or frameworks for retrieving

information and structuring search results. In sum, the typology is open and meant for flexible adaptations in specific contexts.

15.6 Structure the Thinking and Argument-Development Process

15.6.1 Assist Users in Structured Thinking

As shown in the interview study (Huang & Soergel, 2004), this typology has a positive impact on the user's thinking and learning process. It raises users' awareness to a broad range of relevant information in their research and helps them develop a fuller view of the topic. The top-level framework of the typology can be taught to students to improve their thinking skills. It helps to streamline users' overall thinking process and to trigger their internal organization of knowledge to achieve *true learning*.

By providing a multi-faceted view of the topic, the system connects discrete pieces of topic-oriented information. Connections previously buried are easier to surface and new knowledge links are more likely to get established. Especially in medical problem solving where structured knowledge plays a key role, the typology complements the existing medical schemes (e.g., PICO, "illness script") and provides extra assistance for physicians to manage the vast amount of diversified evidence, to maintain a structured view of the patient problem at hand, and ultimately to make well grounded decisions.

15.6.2 Assist Users in Developing Better Arguments

Various topical relevance relationships play different roles in reasoning, making a conclusive argument, deriving a rich understanding, or performing a task. *Direct* [Matching topic] and *Indirect* relevance [Circumstantial evidence] provide a relatively restrictive evidential space leading to a specific fact or conclusion, whereas *Context* relevance is much more open to different possibilities and does not necessarily lead to *one* answer or conclusion at all. For fact-establishing tasks (for example, in law), direct (seeing the suspect shoot at the victim) and indirect (seeing the suspect throwing a gun away) evidence may differ in inferential strength but both can serve as valid proof. On the other hand, comparative evidence [Comparison] cannot be used to establish a fact. However, when the judge comes to decide what laws and precedents apply to the case at hand, comparison becomes the essential reasoning tool. Only by looking at the similarities and discrepancies in various dimensions can the judge establish critical connections between cases and make appropriate decisions. Likewise, in the history domain, if the goal is to recover a historical event, direct, indirect, and sometimes context evidence is more useful; but if the goal is to generate interpretation, examining similar or contrasting historical events can provide much insight. Another example is case-based reasoning in weather forecast where one gathers and compares similar cases and uses *inductive* reasoning to predict future events. Comparative evidence is only a last resort for establishing facts but it is useful for deriving perspectives and inspiring informed hypotheses.

In the age of information explosion, users seek information precisely tailored to their tasks and want to quickly integrate the information they find into their own work task. From the perspective of task-based retrieval (Vakkari, 2003), the relevance types indicate ways in which a piece of information supports a task. In particular, the developed typology facilitates the following process:

- Identify the type of the task/question and the corresponding argument structure;
- Fit available pieces of information into the argument structure;
- Determine gaps in the information needed to complete the argument, and the roles these missing pieces play in the argument;
- Find pieces of information that are in the proper relationship to the question (type of relevance);
- Present the results organized by type of relevance or, even better, organized by the structure of the argument (possibly shown graphically).

Exploration of user tasks and understanding the full complexity of topical relevance are intimately linked. We need more effort to advance the understanding of both and ultimately to improve IR system performance by creatively incorporating an enriched concept of user tasks and of topical relevance.

15.7 Future Directions

For the purpose of developing a generic topical relevance typology and *topic-oriented information architecture* meaningful across domains, this work can be considered only the starting point rather than the destination. Given the amount of work, the multidisciplinary approach adopted in the present inquiry is applied only to what the author considers to be a “core set” of literatures and disciplines, leaving many contributory areas unexplored, especially the whole branch of science and engineering. A broader scope and more cross-field synthesis are needed to make the work more inclusive, convincing, and informative to reach a wider range of audience.

Another interesting area to explore is the possible impact of culture and language on the typology. Would the typology be different if constructed based on Chinese texts and the Chinese way of thinking? Would RST have been different if developed in China or India? Do value judgments contribute to the development of the typology? In a sense, examining the typology in different cultural contexts is similar to examining it in different disciplines or subject domains. Disciplines often develop and use their own set of terminologies and languages for communication and establish their particular ways of approaching and solving problems; therefore, to a large extent, each discipline constitutes a specific sub-culture of its own. For example, Physics and English literature apply different ways of thinking and languages to the extent that they could be considered as two different sub-cultures. As such, the research on different disciplines and the research on different cultures

can very well inform each other. In either case, it is the “thinking” more than the “language” that really makes the difference.

More systematic investigation on the user perspective is the logical next step. In-depth qualitative interviews were conducted on four MALACH relevance assessors in 2003 and the findings suggested positive impacts on the assessors’ thinking and searching on a topic (Huang & Soergel, 2004). It is important to understand how users perceive and interact with the relevance typology, especially how they apply the topical framework to structure information search for their own tasks. Interviews, focus-groups, and direct interaction with the topical framework on a search interface are planned in the user study. It is not only a necessary step to validate the typology, but also an opportunity to discover new angles for further refining the typology and to develop into its applications in the long run.

Appendix G lays out a detailed plan for the subsequent user study.

After years of relevance research, the notion of topicality remains the most fundamental black box in this field. To a large extent, this dissertation research aims to re-open the discussion of what is inside this black box. It serves as a starting point and calls for future research. In particular, the followings are directions for further pursue:

- A multimedia perspective of topicality, to model topicality for paintings, photos, music, and art objects, etc. This becomes particularly meaningful as multimedia play an increasingly significant role in information access;
- Use the typology / topical framework to structure social tagging and

collaborative indexing, to investigate how users assign terms or tags to an image from different angles and to observe how these different angles converge; etc.

(See discussion in Section 15.4.2)

- Relational topic modeling/indexing based on the identified typology of topical relevance relationships (See discussion in Section 15.4.1);
- Apply the topical framework to structure the human thinking and problem-solving process, e.g., to support clinical decision making and problem solving (See discussion in Section 15.6.1);
- Create topical maps from texts automatically; this would involve dividing the texts into meaningful segments and finding the topical relevance relationships held between these segments;
- Specifically, further pursue the line of analyzing topical structures of clinical answers with the typology, identify topic structural patterns for different clinical question types, and apply the findings to improve structural search of evidence-based medicine and automatic clinical question answering (See discussion in Section 15.3.4);
- Applications of improving retrieval algorithms to respond to under-served, non-matching type of user queries and to better support exploratory search (See discussion in Section 15.5).

The typology provides a conceptual basis for a generic *topic-oriented information architecture* that is domain- and dataset-independent; it assists users to navigate a (new) topic space more efficiently and more systematically. Detecting and discerning various topical relevance relationships enable the system to retrieve a fuller range of relevant information beyond *topic matching*. Further, by organizing search results into specific relevance categories (“Social context”, “Contradictory cases”, “Indirect evidence”, “Methods”, etc.) allows users to quickly pin down specific pieces of information that are precisely tailored to their need without being overwhelmed. Structured with fine-grained faceted topical relevance relationships, the typology can also be used to empower *relational* subject indexing, in particular, to organize the ever-growing “tag cloud” and structure social tagging on the Web. The top-level framework of the typology can be taught to students and benefit their learning. The multi-faceted view of a topic helps to streamline users’ overall thinking process and to trigger their internal organization of knowledge to achieve *true learning*.

This inquiry demonstrated that topical relevance with its close linkage to thinking and reasoning is central to many disciplines. The multidisciplinary approach allows synthesis and examination from new angles, leading to an integrated scheme of relevance relationships or a system of thinking that informs each individual discipline. The scheme resolving from the synthesis can be used to improve text and image understanding, knowledge organization and retrieval, reasoning, argumentation, and thinking in general, by people and machines.

Appendices

Appendix A: Previous Work

Appendix B: Examples of the Conceptual Analysis of the Relevance Literature

Appendix C: An Example of the MALACH Relevance Assessor's Topic Notes

Appendix D: Chapter 13 with More Coding Examples

Appendix E: Full Coding Maps of Clinical Answers

Appendix F: CLiMB Art Image Tags Analysis

Appendix G: User Study Design

Appendix H: Theory-Grounded Typology of Topical Relevance Relationships with

Definitions and Annotations

Appendix A: Previous Work

This dissertation incorporates my previous work reported in the following two publications:

1. Huang, X., & Soergel, D. (2004). *Relevance Judges' Understanding of Topical Relevance Types: An Explication of an Enriched Concept of Topical Relevance*. Paper presented at the Proceedings of 67th Annual Meeting of the American Society for Information Science and Technology (ASIS&T 2004), Providence, Rhode Island.
2. Huang, X., & Soergel, D. (2006). An Evidence Perspective on Topical Relevance Types & Its Implications for Task-Based Retrieval. *Information Research*, 12(1). Paper presented at Information Seeking in Context Conference (ISIC 2006), Sydney, Australia.

Based on coding and analyzing a set of MALACH relevance assessment data, I have some preliminary findings about topical relevance relationships, which is reported in Huang & Soergel (2006). In this dissertation, I intend to use and extend this dataset by revisiting/revising the coding already done and coding more cases. For more detail about the MALACH relevance assessment data, see Section 3.2.3.1 in Chapter 3 Methodology.

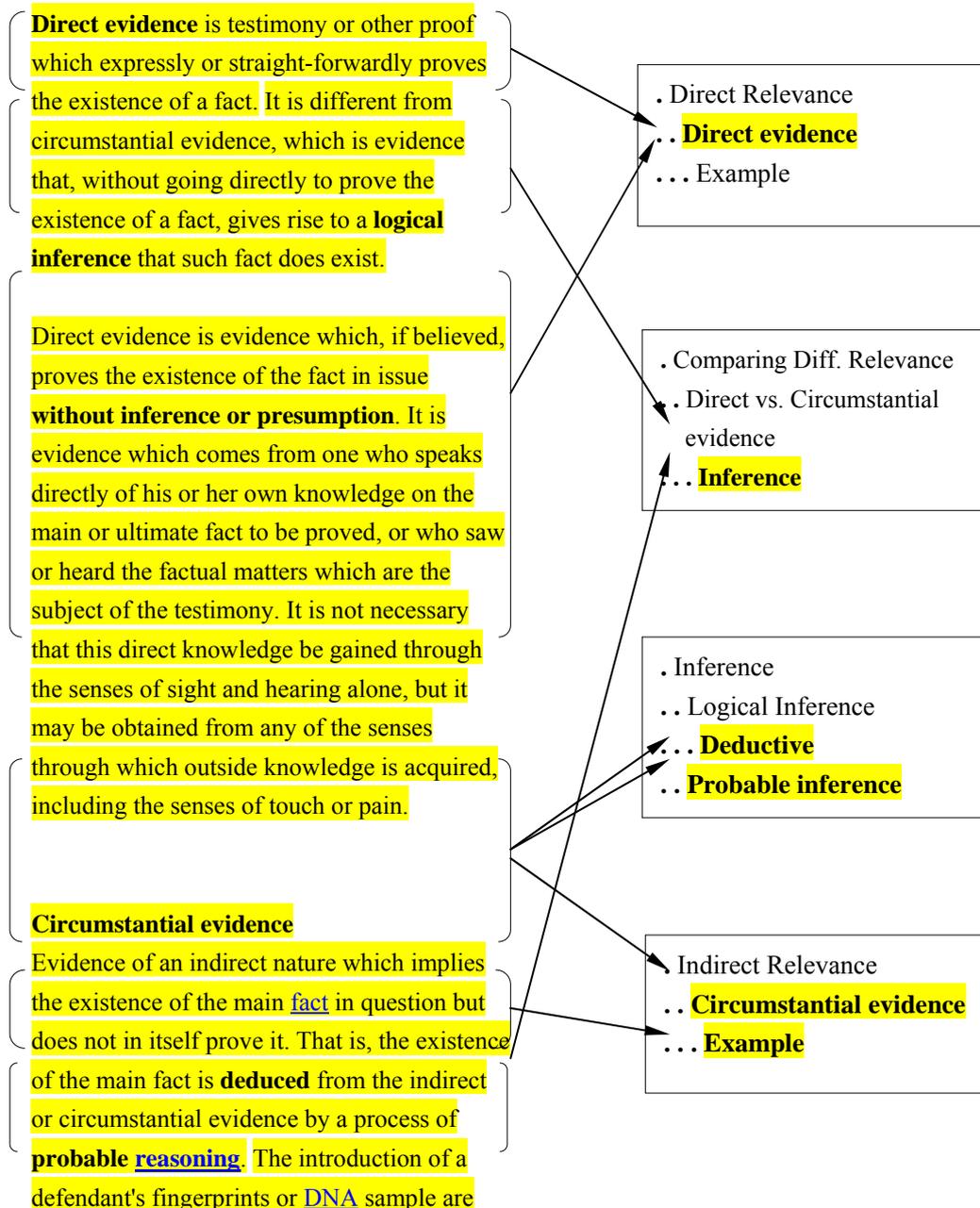
To understand how relevance assessors perceive different topical relevance relationships, I conducted seven interviews with the MALACH relevance assessors following a qualitative interview approach (Rubin & Rubin, 1995). Four interviews

were transcribed, analyzed, and reported in Huang & Soergel (2004). Three additional interviews were conducted in 2006, which will be transcribed and analyzed as part of this dissertation research. Findings derived from these interviews shed light on understanding the user's perspective on topical relevance relationships and will be incorporated as part of the User Study (see Section 3.3).

Appendix B: Examples of the Conceptual Analysis of the Relevance Literature

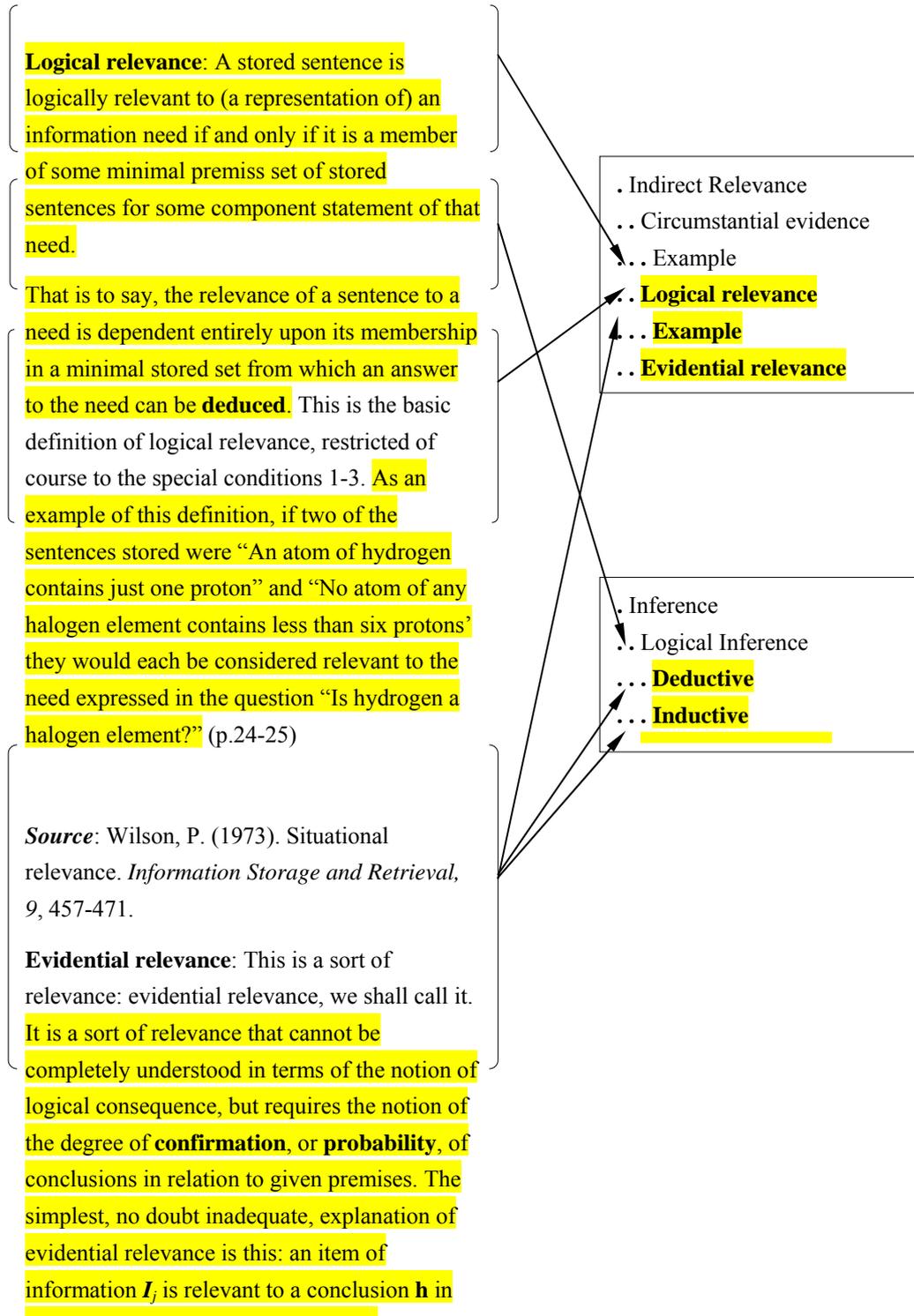
Example 1: Law of Evidence

Source: State v Famber, 358 Mo 288, 214 SW2d 40.



Example 2: Information Science

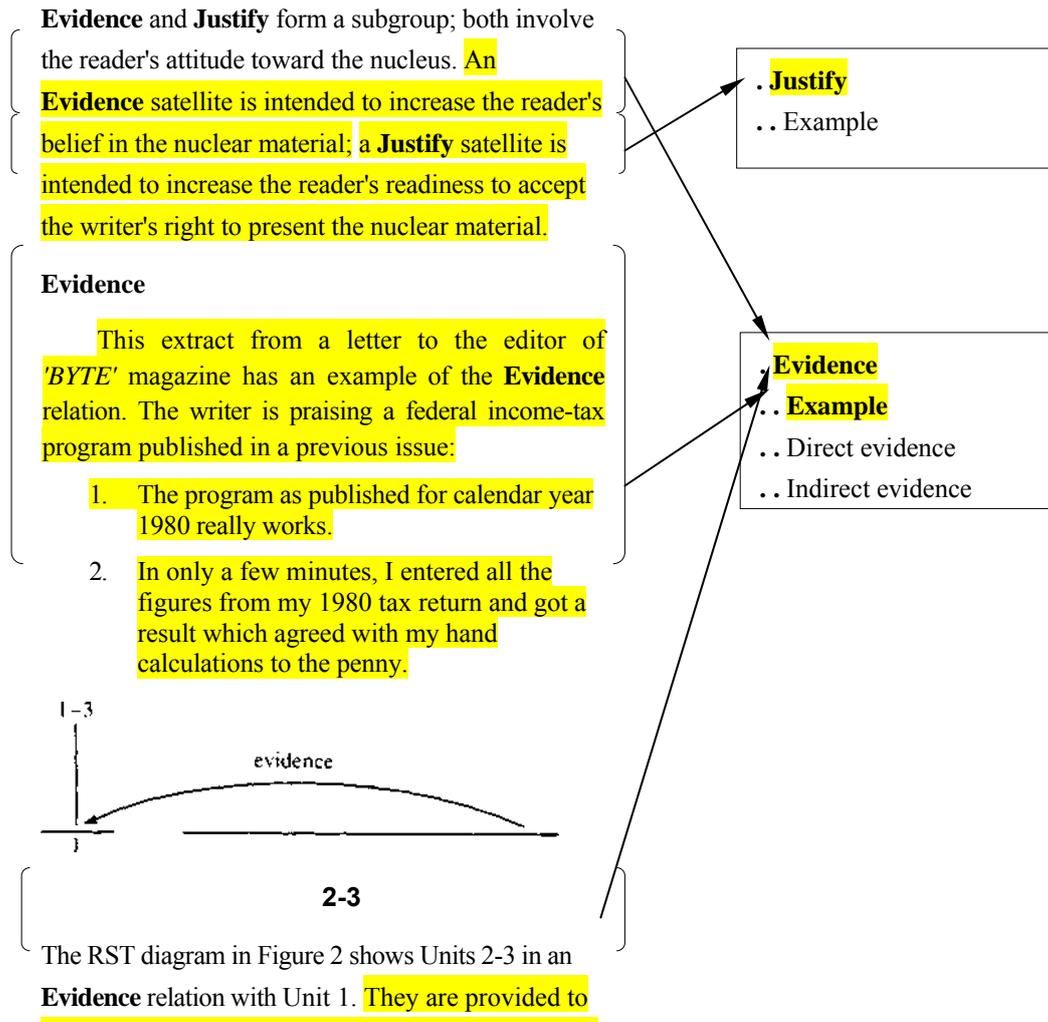
Source: Cooper, W. S. (1971). A Definition of Relevance for Information Retrieval. *Information Storage and Retrieval*, 7(1), 19-37.



Example 3: Communication & Rhetoric –Rhetorical Structure Theory

Source: Mann, W. C., & Thompson, S. A. (1988).

Rhetorical structure theory: Toward a functional theory of text organization. *Text*, 8(3), 243-281.



Comparison and Integration among the Three Examples

All the three examples of literature analysis focus on *evidence* as one type of topical relevance relationship. Different disciplines reveal different aspects of the issue:

- **Rhetorical structure theory:** defines evidence as relevant information that “increase the reader's belief in the nuclear material”, which is often an argument or conclusion (as shown in the example). The emphasis is placed on *increasing the receiver's belief* in an argument (conclusion). Therefore, evidence as a relevance relationship, regardless of its specific type, is always tied to some argument, e.g., a diagnostic hypothesis, a belief, a truth statement.
- **Law of evidence:** defines two types of evidence in the context of court cases—direct evidence and circumstantial evidence. To differentiate the two, *inference* is introduced, including both logical inference and probable inference. The major difference between direct evidence and circumstantial evidence, if any, is whether or not the evidence involves inferences. Rather, direct evidence and circumstantial evidence can be seen as two ends of a continuous inferential scale.
- **Information science:** Cooper's and Wilson's work directly relate logic and inference to the conceptualization of topical relevance. Taken together, they further specify two major types of evidence that involves inference: Cooper's logical relevance follows deductive logic and is based on logical consequence, which is inferring backward. Wilson's evidential relevance follows inductive logic and probable reasoning, which is inferring forward and involves

uncertainty.

Taking the three perspectives together, an enriched understanding of evidence as one type of topical relevance relationship is developed. The integrated notion of evidence as relevance derived from the three examples can be represented as follows:

- . . Evidence as relevance relationship
 - . . . By degree of inference:
 - Direct Evidence
 - Indirect/Circumstantial Evidence
 - By type of inference:
 - Logical inference
 - Deductive/Backward inference (e.g. logical relevance)
 - Inductive/Forward inference (e.g., evidential relevance)
 - Probable inference (e.g., evidential relevance)

These examples help to illustrate the process of literature analysis in Section 3.1.

The reading of rhetorical structure theory brings in the viewpoint of convincing a *reader*—a somewhat different angle from the common sense *user* who actively seeks relevant information for her tasks. Therefore, I need to consider broadening the scope and definition of “user” as discussed early on in Chapter 1 to include this notion.

Appendix C: An Example of the MALACH Relevance

Assessor's Topic Notes

Assessor name

XXXX

TopicID **3005**

Title Death Marches

Description Experiences on the death marches conducted by the SS to evacuate the concentration camps as allied armies approached.

Narrative Of interest are descriptions of the preparation for the marches by the camp administration and by the inmates, conditions during the march, shooting of people who stayed behind, assistance from people living at the route of the march, escape or hiding from the march.

Interpretation and general comments of the topic

This is an extremely broad topic, as a considerable number of Holocaust survivors were forced to embark on westward moving death marches in the face of the Soviet invasion in the East. Simply using "death marches" or "forced marches" as a search term produces well over 2,000 results.

The topic is specific however, in that it is seeking information on marches that took place during the winter and spring of 1945 as a consequence of allied advances. Most of the marches described by survivors were from Auschwitz-Birkenau, as the SS evacuated the camp as the Red Army approached, and led the survivors through

Czechoslovakia and into concentration camps in central Germany, such as Belsen and Buchenwald.

Placing 1945 in the search parameters reduces the results to over 300. Placing 1944 in the search also limits the results to 150, all of which are within the 300 found in the previous search.

Highly Ranked (3,4): 161

Overall Scale/Examples

0. Not relevant
1. Minimally Relevant (8103)
2. Marginally Relevant (213414)
3. Highly Relevant (119608)
4. Optimally Relevant (114796)

4: 114496: DGB describes her physical condition at the beginning of her death march from Birkenau. She talks about marching for several days and explains that the prisoners had no food during this time. She recalls boarding a freight train. She remembers that by this time she was suffering from dysentery.

3: 119608: MH discusses his death march from Plattling, Germany, in 1945. He mentions the shooting of prisoners who were unable to continue. MH reflects on the medical treatment in the concentration camps. He tells of being harbored at a farm near Traunstein. MH recalls being told by one of the SS guards that the war was coming to a close.

2: 213414: LF mentions her liberation in January 1945. She briefly recalls that a Soviet soldier tried to rape her. LF talks about her liberation by the Soviet army during a death march in January 1945. She briefly speaks about returning to her hometown, where she was reunited with her brother Miklos in early 1945.

1: 8103: AR speaks of being forced to donate blood at the Auschwitz concentration camp. AR talks about the Sonderkommando uprising. AR remembers watching Soviet planes photograph the camp.

Direct Scale/Examples

Any specific description of an experience during a death march, providing detailed description of the experience and events that took place during the march are ranked 4 or 3. 2 refers to a segment which notes a death march, but does not go into much detail. 1 is only minimally relevant, and provides little information at all. 0 is not relevant at all.

- 0. Not relevant
- 1. Minimally Relevant (8103)
- 2. Marginally Relevant (120284)
- 3. Highly Relevant (21933)
- 4. Optimally Relevant (144056)

4: 144056: FK relates that she was taken from Auschwitz on a death march. She describes the conditions on the march. FK remembers prisoners being shot along the way.

3: 21933: PP reflects on the reason that he decided to try to escape from the death march. He describes his escape from the group. He explains how he was betrayed by a local farmer. He talks about the punishment that he received from the SS guards.

2: 120284: MZ recalls his final contact with his father and brother. He describes a forced march from Birkenau to the main camp at Auschwitz. He remembers his fear while walking next to an armed SS guard.

1: 8103: AR speaks of being forced to donate blood at the Auschwitz concentration camp. AR talks about the Sonderkommando uprising. AR remembers watching Soviet planes photograph the camp.

Indirect Scale/Examples

Any segments providing strong circumstantial evidence for death marches (the health consequences of victims arriving in camps in western and central Germany) are ranked 3-4. 2-1 will be given to segments which only provide vague allusions to circumstantial evidence concerning the death marches.

0. Not relevant
1. Minimally Relevant
2. Marginally Relevant (67540)
3. Highly Relevant (21897)
4. Optimally Relevant (21950)

4: 21950: PP remembers the effects of being treated as a human being from a local farmer during a stop along the death march. He comments on the bombardments of

approaching Soviet troops. PP gives the reason he decided to make a second escape attempt.

3: 21897: PP recalls the mayhem that ensued at Blechhammer concentration camp when the prison population was informed that they would have to participate in a death march. PP discusses the environmental conditions on the day that this death march began, and describes the ways in which the prisoners tried to prepare themselves for the march.

2: 67540: SL speaks of the final days of his forced march. He tells of arriving in Annaburg after several days without food. He recalls the arrival of Soviet liberating forces. He talks about the departure of the SS guards. He notes how many died during the forced march.

Context Scale/Examples

Any segments providing evidence concerning the circumstances of the war which helped provoke the death marches. The SS implemented the marches in the wake of the advancing Red Army. Thus, any segments concerning this issue will be ranked 3-4. 2-1 will be given to segments of marginal or minimal relevance.

0. Not relevant
1. Minimally Relevant
2. Marginally Relevant (136655)
3. Highly Relevant (68690)
4. Optimally Relevant

3: 68690: JR talks about the approach of Soviet forces and the panic this caused among camp personnel. He recalls setting out on a forced march in winter. JR describes the deaths and shootings that occurred during the march. He speaks of older Wehrmacht soldiers who guarded the prisoners. JR remembers his attempted escape from the march with some fellow prisoners. He states that all of them were shot and explains how he survived the bullet that struck him.

2: 136655: JR talks about the approach of Soviet forces and the panic this caused among camp personnel. He recalls setting out on a forced march in winter. JR describes the deaths and shootings that occurred during the march. He speaks of older Wehrmacht soldiers who guarded the prisoners. JR remembers his attempted escape from the march with some fellow prisoners. He states that all of them were shot and explains how he survived the bullet that struck him.

Comparison Scale/Examples

The distinctiveness of the death marches makes it difficult to consider any events that can be considered a point of comparison. However, since the topic specifies SS marches, marches instituted by Hungarians and Rumanians, for example, will be considered comparative segments. Segments focusing on the experience of Jews being transported by train in the wake of the Red Army's advance would also be considered of comparative relevance. Also comparative will be segments about SS lead forced marches between ghettos and camps before 1944, since these were initiated for reasons other than attempting to flee the approaching allied armies.

0. Not relevant
1. Minimally Relevant (125901)
2. Marginally Relevant (116612)
3. Highly Relevant (67118)
4. Optimally Relevant (116644)

4: 116644: CD explains why she was hit by a guard during a forced march from Budapest. She remembers her forced labor digging trenches for the military. CD recalls her mother was killed by a Hungarian gendarme during the march.

3: 67118: SL notes that soon after the Germans declared war, they began to bomb Grojec. He mentions 12 leaders of the Jewish community who were shot. He discusses his and his father's arrest. SL talks about being taken to Biala via forced

march. He mentions the shooting and hanging of 8 men who tried to escape the march.

2: 116612: CD remembers being deported from Budapest on a forced march. She describes her forced labor carrying corpses and piling them up. CD explains how she obtained food and water by bribing farmers. She recalls her confrontation with a Hungarian guard. She mentions an altercation she had with her mother over sharing food with other prisoners during the march.

1: 125901: BS tells of being marched from the protected house to a brick factory with her family members. She remembers the execution of Jewish men into the Danube river and recalls her reaction. She names two friends who were in the brick factory as well. BS describes the conditions in the factory.

Pointer Scale/Examples

Segments providing possible pointers to evidence or segments on the death marches will be granted a rank based on the detail and quality of the evidence.

0. Not relevant
1. Minimally Relevant
2. Marginally Relevant (81437)
3. Highly Relevant
4. Optimally Relevant

2: 81347: ES speaks of leaving a forced march and returning to Auschwitz. She recalls the fires that were set in the camp, presumably by the Germans. She recalls her physical condition. She talks about the reaction of camp personnel to oncoming

Allied troops. ES recounts the temporary liberation of Auschwitz by Soviet armed forces. She reports the return of the camp personnel and a subsequent forced march. ES remembers fighting between the Germans and Soviets.

Difficult Examples

Search (please keep in mind that the system keeps the search history)

ALL death marches AND "1945" produces 312 results

ALL death marches AND "1944" produces 150 results (all of which have been judged)

ALL "death marches" AND "1945" produces 72 results (all of which have been judged)

ALL "death marches" AND "1944" produces 36 results (all of which have been judged)

ALL forced marches AND "1945" produces 304 results (all of which have been judged)

ALL forced marches AND "1944" produces 304 results (all of which have been judged)

ALL "aid during forced marches" produces 10 results (all of which have been judged)

ALL "betrayals during forced marches" produces 1 result (which has been judged)

ALL "killings during forced marches" produces 27 results (all of which have been judged)

ALL "guards: forced marches" produces 18 results (all of which have been judged)

ALL "mass executions during forced marches" produces 2 results which have been judged

Thesaurus problems

Data errors

Comments and Suggestions for the system

Other comments

Appendix D: Chapter 13 with More Coding Examples

Empirical Data Analyses (2): Type-Centric Manifestations: Function-Based

Chapters 13 and 14 pull together coding examples from the three datasets and organize them by relevance type. It helps to develop a fuller view of the topical relevance relationships across domains.

As shown in earlier discussion, the first two facets of the relevance typology, *Functional role* and *Mode of Reasoning*, are the focus of the empirical analysis. This Chapter also focuses on these two facets and organizes the coding examples by the top-level relevance categories under each facet, specifically,

Chapter 13 Functional role / Function-based topical relevance relationships

13.10 Matching topic (direct relevance)

13.11 Evidence

13.12 Context

13.13 Condition

13.14 Cause / Effect

13.15 Comparison

13.16 Evaluation

13.17 Method / Solution

13.18 Purpose / Goal

Chapter 14 Mode of reasoning / Reasoning-based topical relevance relationships

14.1 Generic inference

- 14.2 Causal-based reasoning: Forward inference
- 14.3 Causal-based reasoning: Backward inference
- 14.4 Comparison-based reasoning
 - 14.4.1 Reasoning by analogy
 - 14.4.2 Reasoning by contrast

Notes: *Rule-based reasoning*, *Generalization*, *Transitivity-based reasoning* and *Dilemma-based reasoning* are not sufficiently represented in the selected datasets of this study.

Examples repeated from Chapter 13 are indicated with *

13.1 [Matching Topic (Direct Relevance)]

Exactly and explicitly on topic; it is the most straightforward and intuitive relevance relationship type, with minimal, if any, inferential reasoning involved.

Good direct evidence has a wealth of specific details about a topic and has the most significant impact on overall topical relevance.

[Matching topic] is the most recognized and emphasized topical relevance type in both research and practice. It has become the central meaning of topical relevance and is even mistaken as the only meaning of topical relevance. This misperception restricts the attention to a very narrow focus of topical relevance. The major goal of this inquiry is to broaden our vision to the often ignored non-matching topical relevance types.

Depending on the particular domain and the specific dataset being discussed, [Matching topic] can be defined differently. In other words, the definition of [Matching topic] is “contextualized”, which also applies to non-matching topical relevance types. Based on the current analysis, [Matching topic] has the following interpretations:

- **MALACH oral history**: mostly Holocaust survivors’ experiences that directly match the user topic, for example,

| | |
|-----------------------|---|
| Topic | Strengthening Faith by Holocaust Experience |
| Matching topic | A survivor talks about how an elderly Salonikan Jew helped strengthen their religious faith during their incarceration; “we called him grandfather. He always said to us ‘you must say Kaddish every night.’ I was forced to dispose of corpses in the camp at the time. One day I came back from work and said to him ‘Are you crazy?’ He said: ‘No, something good will happen one day after this. We have to pay a very dear price but we're gonna have our own state of Israel.’ And it happened. I survived with my faith and went to Israel.” |

- **Clinical questions & answers:** given the topic of the questions is disease- or symptom-centered (see discussion in Section 12.2.2), topic-matching information, by definition, refers to symptom descriptions and disease manifestations, for example,

| | |
|-----------------------|--|
| Question | What are the indications for evaluating a patient with cough for pertussis? |
| Topic | Pertussis |
| Matching topic | Cough longer than 2 weeks, inspiratory whoop, posttussive vomiting, coughing paroxysms, and absence of fever are commonly associated with pertussis... |

- **CLiMB image tagging:** refers to Image content (both focal and peripheral) and Image theme, see discussion in Section 12.2.3, for example,



Figure 12-17 The Martyrdom of Saint Bartholomew.
Artist: Jusepe de Ribera. 1634. Spanish. (ID: 207)

***Matching topic**

- **Image theme**
 - martyrdom {martyr},
 - mystical experience {mystical},
 - biblical,
 - religious,
- **Image content: Focal**
 - *Reference*
 - nude body,
 - old man {man, old},
 - Saint Bartholomew {St. Bartholomew, saint, saints},
 - executioner {executioners},
 - knife,
 - *Elaboration (Adj.)*
 - Bearded {beard, bearded man},
 - physical anguish {anguish},
 - luminous {light},
 - profound emotion {emotional},
 - *Elaboration (Adv.)*
 - expressive hands,
 - gestures,
 - confronts,
 - flayed alive {flayed, flaying},
 - torture,
- **Image content: Peripheral**
 - *Elaboration (Adv.)*
 - lurking,

The topic-matching examples gathered from the analyses are organized and discussed by *Presentation types* (see Chapter 11; Table 11-1) in the following.

In the analyses, the forms of presentation are analyzed primarily for the [Matching topic] relevance category for two reasons:

1. [Matching topic] is the utmost important topical relevance relationship that worth more attention and more in-depth analysis;
2. [Matching topic] has many pieces of information that can be better organized by using the presentation facet for further subdivisions.

However, it is important to note that in principle the presentation types can be applied to every relevance category in the typology, for example, *Definition* as a presentation type can deliver information that is matching topic, it can also be presenting context, or comparison, etc.

13.1.1 Reference

For the MALACH data, as opposed to Elaboration, the presentation form of Reference provides information that briefly mentions the topic without giving further detail. See the two MALACH examples with comments embedded in the following.

For the image data, *Reference* is straightforward and heavily used for tagging, by directly pointing out what is depicted in the image without much elaboration. *Reference* accounts for a large number of tags for “Image Content”, both focal and peripheral, as shown in the earlier example (see Figure 12-16). The presentation type

of *Reference* accounts for many (if not most) image tags collected for the study; it is very important for both describing and searching images.

Reference

| | |
|------------------|--|
| *Topic | Eichmann witnesses |
| Reference | Testimony of survivor who mentions briefly that she came into contact with Eichmann, but no specific description of the encounter. |
| Note | The segment refers to the encounter with Eichmann, but it provides minimal information on topic. |

| | |
|------------------|---|
| *Topic | Jewish children in schools |
| Reference | HF speaks of the schools which he attended. He recalls that anti-Semitism was present in the schools. |
| Note | Survivor HF touches on the topic of anti-Semitism in school; it is referring or mentioning without much detail. |



Figure 12-16 A Young Woman and Her Little Boy.
Artist: Agnolo Bronzino. 1540. Florentine. (ID: 204)

***Matching topic**

- **Image content: Focal**
 - Reference
 - Boy,
 - Child {children},
 - Mother and child,
 - Woman {women},
- **Image content: Peripheral**
 - Reference
 - Costume,
 - Head coverings,
 - Gloves,
 - Textiles,
 - Jacquard,
 - Jewelry,

13.1.2 Pointer

Pointer by itself gives minimal (if any) information directly on the topic but it points you to a publication, a person, a website, a place, etc. that may host a wealth of relevant information. Pointer is not the relevant information, but the source of relevant information.

| | |
|----------------|---|
| Topic | Children's art in Terezin |
| Pointer | EW tells of a book entitled "Terezin", which she found during one of her visits to Prague. She recalls reconnecting with Helga due to that book. EW mentions the documentary film entitled "The Terezin Diary," which was based on Helga's diary. |
| Note | Two pointers: a book entitled "Terezin" and a documentary film entitled "The Terezin Diary". |

| | |
|----------------|--|
| *Topic | Wallenberg rescues Jews |
| Pointer | Dr. Cha worked with Wallenberg closely in Hungary. |
| Note | Dr. Cha is a pointer person worth researching on. |

| | |
|----------------|--|
| *Topic | Nazi Eugenics Policy (Dr. Mengele's medical experiments) |
| Pointer | EK talks about her desire to found a museum dedicated to preserving the experiences of the Mengele's twins and mentions the organization of C.A.N.D.L.E.S. |
| Note | Pointer as an organization. C.A.N.D.L.E.S. (Children of Auschwitz Nazi Deadly Lab Experiments) is an organization dedicated to the experiences of victims of cruel human medical experiments in Auschwitz. |

| | |
|------------------|--|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Pointer | Useful information for physicians and parents regarding medication use and behavioral therapy are described in the American Academy of Pediatrics ADHD Toolkit available at www.nichq.org/resources/toolkit |
| Note | A pointer to a treatment method of ADHD; it is a pointer of [Method/Solution] rather than [Matching topic]. |

| | |
|-----------------|--|
| Question | What is the prognosis for acute low back pain? |
| Topic | Low back pain |
| Pointer | The Agency for Healthcare Research and Quality (www.ahrpr.gov) section on health outcomes [of low back pain] (see http://www.ahrpr.gov/research/jan99/ra6.htm) |
| Note | A pointer to the prognosis of low back pain; it is a pointer of [Cause/Effect] – Prognosis rather than [Matching topic]. |

13.1.3 Definition

Definition is a highly formalized type of presentation which restricts its application to a formal context. Oral history is not formal; it is rare for a Holocaust survivor to provide some kind of formal definition in his reflection of life stories. Image tags, mostly 1~3 words in length, are too brief to define anything. On the contrary, in the highly specialized medical domain, definitions are very commonly used for defining a disease (condition), a medication, or other technical terms.

| | |
|-------------------|--|
| Question | Does quinine reduce leg cramps for young athletes? |
| Topic | Leg cramps |
| Definition | Leg cramps (heat cramps) in athletes are defined as painful involuntary muscle contractions, usually in the large muscle groups of the legs, which occur during or in the hours following exercise. |
| Note | Defining a disease (condition): Leg cramps |

| | |
|-------------------|--|
| *Question | What are the indications for evaluating a patient with cough for pertussis? |
| Topic | Pertussis |
| Definition | The Centers for Disease Control and Prevention and the World Health Organization describe the clinical case definition for pertussis as a cough illness lasting at least 2 weeks with at least 1 of the following: paroxysms of coughing, inspiratory whoop, or posttussive vomiting, without other apparent cause. |
| Note | Defining a disease (condition): Pertussis |

The following two examples are definitions of relevance categories other than [Matching topic]. They demonstrate that the presentation facet can be applied to other relevance types as well.

| | |
|-------------------|---|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in Children |
| Definition | Atomoxetine , a specific norepinephrine reuptake inhibitor, is an FDA-approved alternative to stimulants for ADHD treatment in children and adolescents. |
| Note | Defining a medication for ADHD. It is a definition of [Method/Solution], instead of [Matching topic]. |

| | |
|-------------------|---|
| *Question | Does a Short Symptom Checklist Accurately Diagnose ADHD? |
| Topic | ADHD in Children |
| Definition | The effect size is the difference in mean scores between 2 populations divided by an estimate of the individual standard deviation. |
| Note | Defining a technical term involved in the rationale/mechanism of ADHD diagnostic checklists. It is a definition of [Cause/Effect] – Rationale/Mechanism, instead of [Matching topic]. |

13.1.4 Summarization & Abstraction

Summarization captures the essence of the data by leaving out second-level details, whereas *Elaboration* supplements second-level details (as discussed next). *Abstraction* goes one step further than *Summarization* by even eliminating the material footprints from the data; it is often alleviated to a more abstract level (as shown in the image tagging examples). In many cases, there is only a thin line between *Summarization* and *Abstraction*. A major distinction between the two is, from *Summarization* we can still recover the original data to some extent, whereas from *Abstraction* we can hardly recover anything for concrete links to the data. This distinction is illustrated by the following image tagging example (Figure 13-1):



Figure 13-52 Still Life with Fruit and Carafe.
Artist: Pensionante del Saraceni. 1610/1620. Roman. (ID: 228)

***Matching topic**

- **Image content: Focal**
 - *Reference*
 - apples,
 - pear,
 - watermelon {melons},
 - wine, ...
 - *Summarization*
 - fruit,
 - foodstuffs,
 - *Abstraction*
 - still life,

The followings are examples for *Summarization*:

| | |
|----------------------|---|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in Children |
| Summarization | In numerous systematic reviews, RCTs, and meta-analyses, 70% of children responded to stimulant medications with short-term improvements in ADHD symptoms (inattention and hyperactivity/impulsivity) and academic achievement. |
| Note | An example of <i>Summarization</i> . |

| | |
|----------------------|---|
| Question | Does quinine reduce leg cramps for young athletes? |
| Topic | Leg cramps |
| Summarization | Several trials involving the general adult population exist. A meta-analysis of 4 published and 3 unpublished reports of randomized, double-blind controlled crossover trials (n=409) showed that adult patients had significantly fewer nocturnal cramps when taking quinine compared with placebo. The absolute reduction in number of leg cramps was 3.6 (95% confidence interval [CI], 2.15~5.05) over a 4-week period, and the relative risk reduction was 0.21 (95% CI, 0.12~0.30). |
| Note | A case of <i>Summarization</i> . |

| | |
|----------------------|--|
| *Topic | Death marches |
| Summarization | Most of the marches described by survivors were from Aushwitz-Birkenau, as the SS evacuated the camp as the Red Army approached, and led the survivors through Czechoslovakia and into concentration camps in central Germany, such as Belsen and Buchenwald |
| Note | This topic note summarizes individual descriptions on marches that took place during 1945 as a consequence of allied advances. |



Figure 13-53 The City from Greenwich Village. Artist: John Sloan. 1922. American. (ID: 226)

Matching topic

- **Image content: Focal**
 - *Reference*
 - city lighting {electrical lighting, lights}
 - skyline,
 - reflections,
 - commercial buildings,
 - office buildings,
 - highrises,
 - Woolworth Building,
 - water tower,
 - elevated train tracks, ...
 - *Elaboration (Adj.)*
 - shimmering,
 - darkness,
 - humid,
 - foggy, ...
 - *Summarization*
 - night scenes,

The followings are examples for *Abstraction*:

| | |
|--------------------|--|
| *Question | Do TCAs or SSRIs have any effect on decreasing tinnitus, and if so, in what dosage? |
| Topic | Tinnitus |
| Abstraction | Therapy usually involves a multidisciplinary approach. It should include the effect of tinnitus on the patient, the investigation and treatment of any identifiable pathology, and, if the tinnitus is found to be idiopathic, to reassure the patient of its benign nature. |
| Note | The first sentence gives a high-level abstract statement; the following paragraph (in light grey) provides detail for the statement. |

| | |
|--------------------|---|
| Question | Does quinine reduce leg cramps for young athletes? |
| Topic | Leg cramps |
| Abstraction | Use of quinine for common cramps in non-athletes has been controversial. In 1994 the Food and Drug Administration (FDA) issued a statement banning over-the-counter sale of quinine for nocturnal leg cramps, citing lack of adequate data to establish efficacy and concern for potential toxicity. Between 1969 and 1990 the FDA received 26 adverse reaction reports in which quinine was concluded to be the causative agent. The 3 studies discussed above consistently mention only tinnitus as likely related to quinine use. However, the descriptions and inference testing of side effects were inadequate in each study. |
| Note | The first sentence gives a high-level abstract statement; the following paragraph (in light grey) provides detail for the statement. |

| | |
|--------------------|---|
| *Topic | People making hard decisions during the Holocaust |
| Abstraction | SR reflects on the difficult choices people in the ghetto were forced to make in order to survive. |
| Note | A case of <i>Abstraction</i> , by abstracting the individual dilemmas to “difficult choices”. It states the point without specifying what the difficult choices were. |



Figure 12-18 Red Rose Cantata. Artist: Alba Thomas. 1973. American. (ID: 224)

Matching topic

- **Image theme**
 - *Reference*
 - musical composition {composition},
 - cantata,
 - visual cantata, ...
 - Abstraction
 - Nature,
 - childhood memories {childhood impressions},
- **Image content**
 - *Reference*
 - Red,
 - White,
 - Spots,
 - Dots,
 - Lines, ...
 - Abstraction
 - Petals,
 - *Elaboration (Adj.)*
 - Red punctuated by white intervals {intervals},
 - Vertical splashes of red {vertical splashes, vertical, splashes},

13.1.5 Elaboration

Elaboration elaborates:

- by giving specific examples or instances,
- by discussing in depth as well as in breadth, and
- by providing second-level details.

In the following, the Elaboration coding examples are discussed in these three groups accordingly. These three groups have different emphases but they are not exclusive. In fact, in the analyzed data, it is often the case that we have instances describing a topic in depth or in breadth. In the coding, the same information can have multiple *elaboration* codes assigned to it. The coding examples here are used to illustrate their different emphases and should not to be taken exclusively.

| | |
|--------------------|---|
| *Topic | Wallenberg rescues Jews |
| Elaboration | Found out about a house of Mr. Weiss who had relations with the Swiss embassy, he let people in who had connection with a Zionist organization, ...People from the Zionist organization needed young people who spoke several languages, selected in a group of 12, organized by Wallenberg of Sweden Swiss ambassador, Lutz, of Switzerland, organized ghetto in nice part of Budapest, an international Cartier, checking in people with a Schutzpass, passports issued by Sweden, the Vatican, and Spain, thousands of people were coming through. |
| Note | This segment directly matches the topic by elaborating the method of Wallenberg's rescue plan. It describes Wallenberg's rescue in general rather than restricting to one individual's experience (<i>instance</i>). |

•

13.1.5.1 Elaboration: Instance (Instantiation)

Although differentiated in the theoretical literature analysis, the presentation types of *Example/Exemplification*, *Instance/Instantiation*, and *Illustration* are found to be considerably overlapping with one another in the empirical analyses and therefore grouped together in this discussion.

The level of detail makes a difference. A good *Elaboration* with rich detail and uncovering deeper issues makes it *Amplification*, as discussed in the following section.

| | |
|---------------------|---|
| *Topic | Wallenberg rescues Jews |
| Instance (1) | Copy of the Schutzpass which belonged to MS's mother and contained the signature of Raoul Wallenberg. |
| Note | This segment directly matches the topic as an instance of being rescued. |
| Instance (2) | AB recalls hiding in Budapest in 1943. AB recalls being taken to a Swedish protected house in 1944 by Raoul Wallenberg. |
| Note | This segment directly matches the topic as an instance of being rescued. |

| | |
|-----------------|---|
| Topic | Children removed from their parents |
| Instance | ES discusses how her siblings were smuggled to Hungary a Hungarian woman, by Mrs. Tafon, who legally adopted them. She reports the last time she saw her sister Judith. ES recalls what she knows of Judith's fate. <i>Audio detail:</i> "Dad decided very dangerous to be together, found hiding places for all. Mrs. Tafon for lot of \$\$ smuggled siblings one by one to Hungary. Kurti, Naomi, Marta first to go. Mom had family in Szarvar and Budapest adopted brother and sister, then Judith went as Mrs. Tafon's child. Judith had blond hair blue eyes. Dad and mom took to train, waved to Mr. Tafon and looked at us. Last time seen, two brothers anesthetized put on train woke up in foreign country different language." |
| Note | Focuses on the actual experience of the children who were removed from their parents, whereas context relevance focuses more on the causes and consequences. |

13.1.5.2 Elaboration: Amplification & Extension

In terms of elaboration, *Amplification* tends to move into a greater “depth” whereas *Extension* tends to move into a broader “scope”. *Amplification* provides lots of detail, lays out the deeper thinking, and gives perspectives. *Extension* covers non-typical cases and thus broadens the perspective and enriches the understanding of a topic; it is used for information that deviates from the typical or the majority that is still directly on topic but not exactly in the thick of what is typically considered “direct”, in this sense, the scope of *Matching topic* is "extended". *Extension* provides unique information on a topic and has a more important value.

| | |
|----------------------|--|
| *Topic | Wallenberg rescues Jews |
| Amplification | WB states he delivered official and forged protection papers in Budapest for Raoul Wallenberg in 1944. <i>Audio detail:</i> “He had joined the Underground and aided the refugees in getting to Romania and out of Eastern Europe to Palestine. ... Raul Wallenberg came to Budapest. The operation became strong when Wallenberg arrived. WB was able to copy Wallenberg’s official papers for those who could not obtain real ones. Wallenberg set up the Swedish protective houses. Wallenberg used him and others to make and deliver the papers. They tried to get the Polish refugees out first because they could not speak Hungarian and were noticed.” |
| Note | An example of <i>Amplification</i> . This segment provides rich insider detail about the method and the strategy of Wallenberg’ rescue activities. |

| | |
|------------------|---|
| *Topic | Wallenberg rescues Jews |
| Extension | WB continues to discuss his involvement with Raoul Wallenberg in Budapest. He tells of making and delivering false protection papers. <i>Audio detail:</i> “No official list of people who were marked for help by Wallenberg. Many did not know that their papers were forged. A list would have identified people to the Germans and they would have been killed...no records, no proof. He helped in the printing and the delivery of the papers. He knew Hungarian. Had gentile papers with him if he was stopped. Knew the Budapest sewer system and could enter building through the sewers. Had specific assignments without knowing too much...just in case he was captured and tortured he could not divulge too much information. Always scared but it did not stop him from functioning. It was his choice to be involved with those activities.” |
| Note | An example of <i>Extension</i> . In addition to further reveal the process of Wallenberg’s rescuing activities, this segment presents a unique perspective as a rescuer: the challenges and dangers faced, the motivation behind, and the decision made, which makes it special compared to other Wallenberg’s rescue segments. |

Let us look at the other topic for *Amplification* and *Extension* examples:

| | |
|--------------------------|---|
| Topic | Children removed from their parents |
| Amplification (1) | HT talks about living with a foster family in Sweden beginning in 1939. She notes feeling abandoned while living apart from her biological family. <i>Audio detail:</i> “The people were kind to me. They took me in because it was their religious belief. There had been an advertisement in newspaper for Swedish families to take in Jewish children and all you needed to do was request sex and age of child...they were in their 50s. They had 3 grown daughters and they loved their children and the children had same beliefs. They had their own room and nice things. And I felt right away that I was an outsider. This was not people who wanted a child to love. What they gave me was the necessities roof over head, food, clothing. I didn't have love or closeness and I missed that because I had that with sister and mother and father and grandparents and here I felt abandoned. I don't know why but felt like my parents just got rid of me. From May until August when I started school, it was just doing nothing around house in summer. I spent time outside in big yard of house didn't have friends then until school. They were very religious Baptists who didn't believe in any entertainment. No dancing, no movies. They went to church. It was right next door and I had to go...there was praying and singing. My Swedish wasn't that good so I didn't understand too much. It was not what I was used to.” |
| Note | An example of <i>Amplification</i> . The segment describes the fate of survivor who as a child was adopted and raised in another family. Right on topic with lots of detail. It delivers a vivid picture of the adopted child’s life in a strange family with psychological details and her feelings as an outsider. It also sheds light on the motivation and procedure of children adoption during the Holocaust. |

| | |
|--------------------------|--|
| Topic | Children removed from their parents |
| Amplification (2) | <p>SW outlines the life of Sacha Feller, an orphan abused by a Volksdeutscher. She reveals that the child had been used as a footstool and discusses the disability which resulted from this mistreatment. SW tells of caring for Sacha after the war and notes that Sacha was eventually adopted by her music teacher.</p> <p><i>Audio detail:</i> “Zocha filer, came from Katowice. Was 4 years old when parents sent to death camps. Was folksdeutscher who separated children from parents. Small children taken away. Zocha fila was one of the children. She was taken to his house. She was not allowed to stand or walk. Only to crawl. He used her back as a footrest. Kicked her if she moved. Always kicked her. Was always hungry. Treated like a dog or worse. After war polish neighbors went to police. Arrested him and she came to quarantine house. One leg shorter. Had kicked her in hip and dislocated. Had best doctors. Could do nothing then, maybe now, not in Poland 1946. Could not walk well. Short leg. Remembered her name. Wanted to be hugged and kissed. Wanted affection, love. Missed her mother [who] kissed her always. Had damage in her hip. Very talented in music. Later got her a special boot. Much better. Bought her the shoes. For Vera also from her salary. Zocha went to teacher, music teacher adopted her. Yanka was teacher. Zocha was in school for music. Sent her to special school. Looked after her very well. Did not take money for teaching music. Every day taught music for nothing. Yanka never married.”</p> |
| Note | Another example of <i>Amplification</i> . Testimony describes the fate of survivor who as a young child was forcefully separated from parents and brutally mistreated. Right on topic with lots of detail. |

| | |
|------------------|--|
| Topic | Children removed from their parents |
| Extension | <p>FM details her family's escape from the Brens concentration camp and subsequent flight to Nice. She recalls that she and her brother were placed in the care of an American woman in Villefranche-sur-Mer. FM briefly speaks of her life while in the care of this woman.</p> <p><i>Audio detail:</i> “Went to see mother's cousin. One of her patients was Mrs. Moore, American, cousin told them to place children with her. Went to see Mrs. Moore. Parents went to Grenoble joined underground. Most of the time were in Marseilles, lived normal life in villa, living like multi-millionaire children, went to school, went on trips to Monte Carlo, went there saw a show at casino, was nice living.”</p> |
| Note | An example of <i>Extension</i> . Testimony of survivor who as a child was removed from parents for reasons other than being orphaned or being adopted or raised with foster parents. It gives quite an untypical case. |

13.1.5.3 Elaboration: Adjectival Attribute & Adverbial Attribute

The given information elaborates the topic through providing second-level details, both adjectival and adverbial, which is best illustrated with the image tagging examples (see discussion and examples in Section 12.2.3 and Appendix F). One image tagging example is extracted in the following Figure12-17.

In the medical domain, “Manifestations/Symptoms”, “Prevalence” can be seen as adjectival attributes or qualifications of the disease (condition).

In addition to elaborate an “object” (topic) with adjectival or adverbial “attributes” (information), there are other means to elaborate, such as specifying a “class” (topic) with “subclasses”(information), or specifying a “set” (topic) with “set members” (information), or specifying “whole” (topic) with “parts” (information), or specifying a “process” (topic) with “steps” (information).



Figure 12-17 The Martyrdom of Saint Bartholomew.
Artist: Jusepe de Ribera. 1634. Spanish. (ID: 207)

***Matching topic**

- **Image content: Focal**
 - *Reference*
 - nude body,
 - old man {man, old},
 - Saint Bartholomew {St. Bartholomew, saint, saints},
 - executioner {executioners},
 - knife,
 - *Elaboration (Adj.)*
 - Bearded {beard, bearded man},
 - physical anguish {anguish},
 - profound emotion {emotional},
 - luminous {light},
- *Elaboration (Adv.)*
 - expressive hands,
 - gestures,
 - confronts,
 - flayed alive {flayed, flaying},
 - torture,
- **Image content: Peripheral**
 - *Elaboration (Adv.)*
 - Lurking,

| | |
|---------------------------|--|
| *Question | What are the indications for evaluating a patient with cough for pertussis? |
| Topic | Pertussis |
| Symptom | Cough longer than 2 weeks, inspiratory whoop, posttussive vomiting, |
| Elaboration (Adj.) | coughing paroxysms, and absence of fever are commonly associated with pertussis... |
| Prevalence | Ten prevalence studies of adolescents and adults seeking medical attention |
| Elaboration (Adj.) | for a prolonged cough (defined variously as >1~4 weeks) found acute pertussis in 12% to 32%. |

13.2 [Evidence] – Circumstantial (Indirect) Evidence

Making inference about a topic is the central feature of indirect relevance. Indirect evidence, or inferential or circumstantial evidence, is implicit information on a topic. While direct evidence *is* the answer, indirect evidence can be used to *infer* the answer; it is one or more inferential steps away from the answer. After “joining the dots” it contributes as much to understanding a topic as direct evidence. Indirect or circumstantial evidence is often used in court to establish facts. Both direct and indirect evidence are valid for establishing a fact but they may differ in the level of certainty: the inferential relationship between A and B may be subject to uncertainty, that is, given A we can infer that B with a given probability, also known as inferential strength (Kadane & Schum, 1996). To be recognized and further used to draw a conclusion, the inferential strength of indirect evidence needs to be sufficiently high.

Indirect relevance plays an important role in gleaning relevant information from the Holocaust survivor interviews. Survivors usually go into great detail of their personal experience and feelings, without clearly describing or even explicitly mentioning the events or phenomena asked by a topic (request). Direct discussion is rare for many topics, especially for those looking for information on particular phenomena rather than specific events. In these cases, indirect evidence, which is relatively more available, is usually very helpful for leading us to conclusive points.

Reasoning or inference is at the center of establishing “Circumstantial (indirect) evidence”; there is no way to separate the two. Therefore, in the coding, circumstantial evidence is always coded with the specific reference(s) involved in the case. It is true to claim that, specific modes of reasoning involved *define* specific types of circumstantial

evidence. The coding examples of “Circumstantial (indirect) evidence” will be discussed under the *Reasoning* facet of the typology (Chapter 14).

13.3 [Context]

Contextual information helps us to better understand or describe a central event by seeing the general picture where the central event fits in. It can be the setting or environment, the factors or effects, something allowing or hindering an event, something happening behind the scene, etc. To conclude, context evidence is information not specifically *on* a topic, but *surrounding* the topic. Contextual evidence is something we use to backup an argument but not to base an argument on.

There are two major sense of “surrounding” a topic: by scope and by time/sequence.

- [Dimension 1] Context **by scope**: Doing research on a specific event is similar to using a camera to take pictures. If we focus only on the event, we collect directly or indirectly relevant information that is right on target. By adjusting the lens, we start to see the background and gain a broader view on the target event. In this sense, context evidence is something happening in the background that enriches our understanding of what is going on in the foreground. It sets up a big picture on both physical and social dimensions. Specifically, “Context by scope” includes the following sub-categories:

- Context as scope
- Context as framework
- Context as environmental setting
 - Physical location
- Context as social background
 - Political
 - Cultural

- Religious
- These sub-categories are further broken down as adapted to the specific empirical data. They are explicated with coding examples in the following.
- [Dimension 2] ***Context by time and sequence***: This is the temporal dimension. It is concerned with the things that happened close to the target event in time; it is also concerned with giving an overall *sequence* within which the central event (topic) takes place. While the first dimension describes the background *at* the time, this dimension describes something that happened immediately *before* or *after* a target event. The preceding and following events link the isolated descriptions of events together to provide a more continuous view over the events' development. Unlike forward- and backward-inference evidence, their relations to a target event are certain and explicitly stated. Specifically, "Context by time and sequence" includes the following sub-categories:
 - Context as time/period
 - Context as sequence
 - Context as precedence
 - Preceding event (historical)
 - Preceding experience (personal)
 - Preceding status/stage
 - Preparation
 - Context as subsequence
 - Subsequent event (historical)

- Subsequent experience (personal)
 - Subsequent status/stage
- Just as Dimension 1, these sub-categories are further specified in the data analyses, as shown in the examples.

13.3.1 Context by Scope

Context by scope provides broader information on a topic. Another way to think about broader-scope contextual information is that it is essentially the opposite of Elaboration or Specification: Whereas Elaboration specifies a “class”(topic) with “subclasses”(information), or specifies a “set”(topic) with “set members”(information), or specifies “whole” (topic) with “parts” (information), or specifies a “process” (topic) with “steps” (information), the Broader scope is reversed, it provides the “subclass” (topic) with broader “class” information, provides the “set member” (topic) with broader “set” information, provides the “part” (topic) with “whole” information, and provides the “step” with more holistic “process” information.

In fact, Context as environmental setting can be seen as a case of “part–whole”, with the topic or central event being the “part” and the “whole” being the environmental information surrounding it. Likewise, Context as social background can be seen as a case of “part–whole” as well (as illustrated by example below) or as “member–set” or as “subclass–class” depending on the context. Here is an example.

| | |
|-------------------|--|
| *Topic | Jewish children in schools |
| Population | <i>Audio detail:</i> “Once Olympics were over, anti-Semitism really blossomed. In 1938, in November, I got up in the morning took the metro. One man was reading the newspapers and ranting about what they are doing to Jews, burning synagogues, deporting Jews. Got off the trolley and saw burning synagogues, etc. Well-dressed people cheering, not just thugs. Shops destroyed and I’m walking to the school and no class.” |
| Note | The segment discusses anti-Semitism not particularly in schools but in general during the time period. It provides broader social political context. It is also a part–whole relationship, with “anti-Semitism” as the whole and “anti-Semitism in school” as the part. |

The specific context relevance types by scope, *Context as scope*, *Context as framework*, *Context as environmental setting*, and *Context as social background* are discussed respectively in the rest of this section.

13.3.1.1 Context as Scope

One specific type of Scope is Population. In the analyses, Scope: Population is widely used in various medical contexts, just to name a few,

- Indication of the population scope of the prevalence of a disease:

| | |
|-------------------|---|
| Question | What are the indications for evaluating a patient with cough for pertussis? |
| Topic | Pertussis |
| Population | Pertussis is an important cause of cough in all age groups. |

- Indication of the population scope of certain prognoses:

| | |
|-------------------|--|
| *Question | What are the indications for evaluating a patient with cough for pertussis? |
| Topic | Pertussis |
| Population | Infants aged <6 months with pertussis are at particular risk for atypical presentations and serious complications. |

- Indication of the population scope of medical trials and research design:

| | |
|------------------------|--|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Population (1) | A forty-year review looked at 135 trials and 413 RCTs of methylphenidate in over 19,000 children with an average age of 8.8 years (range, 8.3-9.4 years) for an average duration of 6 weeks (range, 3.3-8.0 weeks). |
| *Population (2) | A large randomized trial of 579 children with ADHD (20% girls) aged 7 to 9.9 years compared outcomes of 4 treatment strategies: stimulant medication, intensive behavioral treatment, combined stimulant medication and behavioral interventions, and standard community care. |

- Indication of the applied or restricted population scope of specific medications:

***Question** Does quinine reduce leg cramps for young athletes?

Topic Leg cramps

Population (1) Quinine is better established as an effective treatment for nocturnal leg cramps in the general adult population.

***Population (2)** Of note, quinine is a category X drug and should not be used during pregnancy.

-

13.3.1.2 Context as Framework

Context as framework in the typology can also be seen as a case of “part–whole”, which sets up a systematic framework (whole) within which a topic (part) functions. No specific manifestations are identified for Framework in the current analysis.

13.3.1.3 Context as Environmental Setting

Descriptions of the physical setting and environmental factors, such as the general camp life, living conditions, and medical conditions for the MALACH topic. It also includes things happening in parallel to the target event in the same environment, such as the type of labor performed by the survivor in the camp (MALACH); with this information, the reader is able to establish a fuller picture of what the environment was like for hosting the target event.

MALACH examples:

| | |
|-----------------------------------|---|
| *Topic | Children's art in Terezin |
| *Environmental setting (1) | EW describes in detail the hygienic and sanitary conditions in the camp of Terezin and how conditions were better for children. <i>Audio detail:</i> "...How they washed their underwear, they do not remember. How they washed something, because they remember that the big laundry once in a month or so. They would be called that they could give it to some big laundry and they would bring it back clean." |
| *Environmental setting (2) | They [authorities in the camp] allowed the children to play, sing and draw. So EW was preoccupied most of the day, they were not allowed to work, they were all age 11-12-13 years old. By age 13 they [authorities] put them to work. But also not 8 or 9 hours, only half a day work and most of the children worked in the gardens of Terezin. |
| Note | Although not immediately related to artistic performance (see the matching-topic amplification in Section 13.1.5 <i>Elaboration</i>), information about specific living conditions (hygiene, etc.) and daily activities (play, labor, etc.) in children's house in Terezin provides relevant context. |

| | |
|------------------------------|--|
| Topic | Religious observances in the ghettos and in DP camps |
| Environmental setting | <p>JT talks about the ghettoization of the Jews of Warsaw. He notes the decreasing provisions and speaks of seeing children die.</p> <p><i>Audio detail:</i> “In 1940 the Germans issued order for Jews in Warsaw to move into a small slum area in Warsaw which they called a ghetto. We were ordered to leave everything. ...At beginning we received rations from the Germans. Small piece of bread, soup. As time passed they cut out almost everything, food, gas, electricity, medications. The ghetto was encircled with a 10 ft high brick wall. That wall was circled with armed German and Ukrainian guards with machine guns. Those found out trying to escape were gunned down immediately. People died from hunger and starvation. There were scenes where children roamed streets of ghetto throughout night crying from hunger. In morning they were silent. They were dead.”</p> |
| Note | Although not immediately related to religious observances in ghettos, information about the physical environment and living conditions in the ghetto sets up the background for us to better understand ghetto life and difficulties in maintaining community and society in ghettos. |

Examples collected from clinical questions and answers:

| | |
|--|---|
| *Question | What is the differential diagnosis of chronic diarrhea in immunocompetent patients? |
| Topic | Chronic diarrhea |
| Physical location: Country | A case series study from India evaluated 47 children over 6 months of age who had diarrhea for more than 15 days and were unresponsive to medications (mostly antibiotics) or relapsing after treatment. |
| Physical location: Type of location | Five case series of chronic diarrhea patients were identified. The largest adult study evaluated 193 patients referred to a tertiary-care center for diarrhea. |

CLiMB image tagging examples:



Figure 12-19 The Death of the Earl of Chatham.

Artist: John Singleton Copley. 1779. American. (ID: 219)

| *Tags | Indication of the tags | Relevance code |
|--|--|--|
| English, London, House of Lords, London House of Lords, | To describe the place where the historical scene depicted in the artwork happened (The tags are not directly from the image content but provide context for what is depicted in the image) | [Context] Environmental setting: Physical location |



Figure 12-21 The City from Greenwich Village. Artist: John Sloan. 1922. American. (ID: 226)

| Tags | Indication of the tags | Relevance code |
|-----------------------------|---|--|
| New York, New York City, | To indicate the location where the cityscape is physically situated; the tags pertain a “whole – part” relationship to the image: New York City (whole) vs. Image content (part); the tags provide a broader scope. | [Context] Environmental setting: Physical location |
| Winter evening, | To describe the seasonal context in which the depicted cityscape is situated; it is part of the environmental setting. | [Context] Environmental setting |

13.3.1.4 Context as Social Background

This subtype of context relevance addresses more intangible elements of social, political, and cultural aspects at the time when the target event happened. Most historical events did not happen in a vacuum; instead, they are better described as the highlights of some ongoing trend at the time. We better understand a historical event or phenomenon if we look at it in its broader social context.

MALACH examples:

| | |
|--|--|
| Topic | Expropriations of Jewish businesses |
| Policies and laws; Helping factor/condition | Nov 38 occupied by Hungarians the whole world changed. Anti-Jewish laws instituted certain professions taken away; monopolies had been given to Jews before but in 38 taken away. AP recalls that Jews were not allowed to own businesses and had to perform manual labor. |
| Note | It is not a direct discussion of seizure of particular Jewish businesses, but excluding Jews from certain professions and from owning their own businesses by law sets up the justifications for the appropriation that conducted widely later on by both Nazi and gentiles. The passage is double-coded both as <i>Helping factor/condition</i> under [Condition] and as <i>Policies and laws</i> under [Context]. |

| | |
|---|---|
| Topic | Stories of Varian Fry and the Emergency Rescue Committee who saved thousands in Marseille |
| Social background: Political; Hindering factor/condition | A survivor details the political situation in France in 1940-1941 regarding refugees and explains the changes in emigration regulations that made fleeing France difficult. |
| Note | The passage is double-coded both as <i>Hindering factor/condition</i> under [Condition] and as <i>Policies and laws</i> under [Context]. |

| | |
|------------------------------|--|
| Topic | Nazi Theft in Eastern Europe |
| Social background | The role of the Swiss and other neutral countries in accepting the stolen property. |
| Policies and laws (1) | Nuremberg laws or other restrictive policies |
| Policies and laws (2) | Restitution policies |
| Note | The segments fit the topic of Nazi theft into a broader social and political picture at the time. These policies also contribute to a fuller view surrounding the topic. |

| | |
|---|--|
| *Topic | Jewish-gentile relations in Poland |
| Social background: Political (1) | He discusses the rise of anti-Semitism in Poland after the death of Jozef Pilsudski. |
| Social background: Political (2) | He tells that all the government offices in Nowogrodek were staffed by non-Jewish Poles. |
| Policies and laws | MG discusses the separation of Jews and gentiles in Miechów. He recalls that Jews were not allowed to attend public high schools. |
| Social background: Religious | <i>Audio detail:</i> “Catholic teaching was permeated in the teaching everyday – no matter what the class, Catholic was ingrained in the education. Some kid would call me a ‘Christ killer’ – the Jews were blamed for killing the big guy – not a good thing for the Jews. I was 6/7 years old at the time, didn’t understand what a Christ killer was.” |
| Note | Social, political, and religious aspects come together to shed light on the Jewish –gentile relations in Poland. |

“Social background” also occurs in the clinical questions and answers:

| | |
|--------------------------|---|
| Question | What protective effects do vitamins E, C, and beta carotene have on the cardiovascular system? |
| Topic | Cardiovascular health |
| Social background | There has been a lot of press about the effects of antioxidant therapy such as vitamin C, E and beta carotene. |
| Note | Mass communication and media influence on promoting (or exaggerating) the effects of vitamins E, C, and beta carotene. It does not directly relate to the medication effects but supplements a broader social context surrounding the medication being discussed. |

| | |
|--------------------------|---|
| *Question | Does quinine reduce leg cramps for young athletes? |
| Topic | Leg cramps |
| Policies and laws | In 1994 the Food and Drug Administration (FDA) issued a statement banning over-the-counter sale of quinine for nocturnal leg cramps, citing lack of adequate data to establish efficacy and concern for potential toxicity. |
| Note | Related FDA policy of quinine for treating leg cramps. It is not directly describing the effect of quinine but it is closely related and important enough to inform readers of interest. |

Image taggers also assigned tags to indicate the social background associated with the image content, as shown in the following:



Figure 12-16 A Young Woman and Her Little Boy.
Artist: Agnolo Bronzino. 1540. Florentine. (ID: 204)

| *Tags | Indication of the tags | Relevance code |
|--------------------------|---|--------------------------------|
| Medici court, Medici, | The opulence and impressive display of the portrait and the prestige of the sitters indicate that they must have been highly connected to <i>Medici circles</i> . [The Médici family was a powerful and influential Florentine family from the 15th to 18th century. The family had amongst its members, the likes of three popes - Leo X , Clement VII , and Leo XI , numerous rulers of Florence .] The tags provide social background related to the depicted sitters and hint on their prestige, coldness, and vulnerability. | [Context] Social background |



Figure 12-19 The Death of the Earl of Chatham.
Artist: John Singleton Copley. 1779. American. (ID: 219)

| Tags | Indication of the tags | Relevance code |
|---|---|--|
| War of Independence, American War of Independence, Aristocracy, Colonialism, | On 7 April 1778, William Pitt, the 1st Earl of Chatham, rose to speak in London's House of Lords. In the midst of a debate about the colonial revolutionaries, Pitt suffered a stroke and died one month later. His death removed one of Britain's leading political moderates during the critical years of the American War of Independence. | [Context] Social background: Political |

13.3.2 Context by Time and Sequence

The second major dimension of [Context] is by *Time/Sequence*. It includes the indication of time/period for a central topic, the sequence of events, as well as the preceding and subsequent topic-related information.

13.3.2.1 Context as Time/Period

| | |
|--------------------|--|
| *Topic | Death marches |
| Time/Period | LF talks about her liberation by the Soviet army during a death march in January 1945. |

| | |
|--------------------|--|
| *Question | Urology after a renal biopsy. His creatinine has been stable for years, although slightly elevated at 1.37, and his blood pressure and proteinuria are normal while he takes his enalapril. What is his prognosis? |
| Topic | Urology |
| Time/Period | When IgA Urology was initially described in the 1970s it was thought to be a benign condition of recurrent hematuria typically accompanying upper respiratory infections. |
| Note | Gives the time/period for a misperception of the disease. |



Figure 12-19 The Death of the Earl of Chatham.
Artist: John Singleton Copley. 1779. American. (ID: 219)

| *Tags | Indication of the tags | Relevance code |
|---|---|---|
| 7th April 1778, 7 April 1778, C18th, 18th English, | The tags specify the date of the historical scene depicted in the image: On 7 April 1778, of William Pitt, the 1st Earl of Chatham, suffered a stroke in the midst of a debate about the colonial revolutionaries in London's House of Lords. | [Context] By time and sequence: Time/Period |

13.3.2.2 Context as Sequence

Context as sequence is also a case of “part – whole” relationship often along the temporal dimension. It provides a whole sequence of events (or statuses) of which the target event (or status) is part.

In the following example, the provided information gives the full sequence of how a specific disease progresses over time.

| | |
|------------------|---|
| *Question | Does acyclovir help herpes simplex virus cold sores if treatment is delayed? |
| Topic | Herpes simplex virus (HSV) cold sores |
| Sequence | Recurrent lesions progress quickly through several stages (prodrome, erythema, papule, vesicle, ulcer, crust, residual swelling, healed). |

13.3.2.3 Context as Precedence

This category is dedicated to the preceding events that happen immediately before the target event, i.e., the topical information preceding the topic in time. It includes the following sub-categories:

- Preceding event (historical)
- Preceding experience (personal)
- Preceding status/stage
- Preparation
- Patient history

Let us look at some coding examples:

| | |
|--------------------|--|
| *Topic | Nazi medical experiments |
| Preparation | The prisoner selections conducted by Dr. Mengele in concentration camps that are related to medical experiments. |
| Note | Dr. Mengele showed special interest on experimenting on twins, pregnant women, disabled, etc. These selection procedures provide a prelude to the notorious human experiments. |

| | |
|-----------------------------|---|
| *Topic | Liberation experience |
| Preceding experience | BS details how he hid as Auschwitz was being evacuated by the Germans. |
| Preceding event | SK recalls that the German SS guards in the camp fled as the British armed forces approached. She states that the camp was briefly under the control of Hungarian officials. SK remembers many women prisoners, including herself, who jumped over a fence to get some food and were shot at by the Hungarian officials. SK describes being liberated by the British and Canadian armed forces. |
| Note | The information helps me better understand what happened right before the Allied Army liberated the camps, such as German SS guards evacuated the camps and fled before the allied forces approached. |

| | |
|-----------------------------|---|
| Topic | The Jews of Shanghai |
| Preceding experience | Stories about transportation to Shanghai, directly to China or indirectly via other countries, such as Japan. Also includes those refugees who went to Kobe and were stranded in Japan without visas. |
| Note | Jews' refugee life in Shanghai is the center of interest, but how the Jews got there in the first place may also be of interest to the user. |

| | |
|------------------------|---|
| Topic | Sonderkommando Uprising [Sonderkommando units blowing up of Crematorium III in Birkenau on October 7, 1944] |
| Preparation (1) | OL explains that she joined a French resistance group in Birkenau. She details how explosives were smuggled from Russian partisans outside the camp to French resistance fighters in the camp. OL states that the explosives were smuggled in preparation for the Sonderkommando Uprising. <i>Audio detail:</i> OL said die for something. She joined the French resistance, couldn't do much because always guarded by Germans. Russian partisans in mts. Germans had farm out of camp cultivated by prison. Partisans put explosives in field for prisoners to hide on them. Germans checked them sometimes. That prisoner sent to do barracks repair, brought explosives to person nearer to sonderkommando, [who] gassed prisoners and disposed of remains, 3 months, then killed. Resistance wanted to get rid of crematorium and gas [chambers]. Underground said they would provide the explosives if they would blow them up. |
| Preparation (2) | AH details how she and her sister smuggled gunpowder into Birkenau from the Union munitions factory in which they worked. <i>Audio detail:</i> "I was curious. We weren't allowed to leave seat. Bathroom with permission only. I used to go round factory noted what went on, pretended I was doing something. Took the two boxes to sister and she put a little bit of gunpowder wrapped up in rag with string and put garbage on top. Walked to her door and back to mine. Put it under table inside the cuff of my dress. From there I went to the washroom and shared it with another girl, Alla. On the way from the factory it was about 3km to Birkenau where we lived. We used to carry it on our bodies. From time to time there were searches. When we heard there was one, we used to unwrap the gun powder, throw it on the ground and mix it with our feet so it was indistinguishable form the dirt. If no search, we took it into Birkenau. I gave it to my sister and she gave it either to [...] Or to someone else, I don't know who. From Rosa Robota [?] It went to a special hiding place. Rosa Robota had contact with men from crematorium. They had privileges to come into the women's camp and they used to come and pick it up and bring it to the crematorium." |
| Note | Lots of detail not directly on the topic of the uprising but the preparation (smuggling explosives) associated with the target event. |

| | |
|------------------------|---|
| Topic | Sobibor death camp |
| Preceding event | RB notes that his father was conscripted to work and tells of going in lieu of his father to Sobibor. He discusses the German soldiers' execution of Polish-Jewish prisoners. He talks about being forced to load the frozen corpses in a graveyard. <i>Audio detail:</i> "Sobibor, it was before they constructed the concentration camp, it was not the concentration camp, it was a crematorium, Sobibor,--because, when they released Polish prisoners, there were a lot of Polish Jewish prisoners, which at that time, their homes belonged to the Russian side already. So they brought them by train to Sobibor, which was on the border already. The same was our city, on the border, 5 or 7 km apart. Then they told them 'everybody go out of the cars and go home!' On top of the car, they were standing with machineguns and they machine gunned everyone. I witnessed this. I was sent to pick up the corpses. There were a few survivors from there. So I did what he saw others do. I picked up a few corpses and put them on slates and went back home ... they were heavy, frozen stiff..." |
| Preparation | SK discusses later working on the construction of the Sobibor camp. He remembers being told by his foreman about the purpose of gas chambers. |
| Note | The topic is interested in testimonies provided by survivors from the Sobibor death camp. The mass killing at Sobibor, albeit before it was converted to a fully functional camp, and the work in constructing gas chambers for the death camp shed light on the mass execution happened later on in the camp. |

Clinical examples:

| | |
|-------------------------------|--|
| *Question | What are the indications for evaluating a patient with cough for pertussis? |
| Topic | Pertussis |
| Preceding status/stage | A case series of 9 infants aged <7 weeks requiring admission to an intensive care unit for pertussis found that 8 had been sick for less than 4 days at the time of admission. All 9 presented with poor feeding and cough, and 5 had experienced apnea. |
| Note | Preceding patient status |

| | |
|-------------------------------|---|
| Question | Does quinine reduce leg cramps for young athletes? |
| Topic | pertussis |
| Preceding status/stage | Efficacy of quinine in young athletes has not been well studied. A case series reported on 2 athletes: 1 college basketball player and 1 professional football player. The basketball player experienced heat cramps during games that were resistant to hydration and dietary treatment. A regimen of 60 mg oral quinine sulfate taken 1 hour before game time and again at halftime eliminated cramps during the first game and the subsequent 15 games. The football player's heat cramps were only partially improved with oral electrolyte repletion and oral hydration. However, he suffered no further cramps after initiating a regimen of 120 mg oral quinine sulfate before games and 60 mg oral quinine during games for an undisclosed period of time. Both players had normal blood chemistries before starting quinine. No side effects were mentioned. |
| Note | The passages describe the patient status right before taking the medication and give the reader more information to understand the effect of the target treatment. |

13.3.2.4 Context as Subsequence

Context as subsequence provides follow-up information. In the following MALACH examples, the segments give an idea of what was going on in survivors' lives following the time the target event or phenomenon took place. To correspond to its counterpart, *Context as precedence*, the category consists of the following sub-categories:

- Subsequent event (historical)
- Subsequent experience (personal)
- Subsequent status/stage

| | |
|-----------------------------------|--|
| Topic | Liberation experience |
| Subsequent experience (1) | EH discusses her liberation by American soldiers in Rome in 1944. She tells of her family's plans to immigrate to the United States. She speaks of American immigration policies during this time and briefly recounts the role of American journalist Ruth Gruber in securing passage from Italy for Jewish refugees. |
| Subsequent experience (2) | JG notes he was liberated with his parents by Soviet armed forces in spring 1944. He recalls that he and his parents returned to their home in Brest. He states he and his parents reestablished contact with his brothers. |
| *Subsequent experience (3) | HB remembers returning to Warsaw to search for family members after liberation. HB notes she went to a Warsaw organization which registered Jewish survivors. She mentions leaving the city to find work. |
| Note | From these passages, we get to know how the survivors' rolled out their life right after the liberation, e.g., family reunion, migration to a new country, finding jobs, , registered as survivors, etc. |

| | |
|----------------------------------|---|
| Topic | The Jews of Shanghai |
| Subsequent experience (1) | FC talks about the certificate issued by the Hebrew Immigrant Aid Society (HIAS) in Shanghai, China, to the HIAS in San Francisco, California, also states her family stated to leave on the General Gordon on May 4, 1949—2 days before communists took over Shanghai. |
| Subsequent experience (2) | FB tells of leaving Shanghai after the war. She speaks of migrating to Palestine. She describes her apartment in Palestine. |
| Note | The information helps us understand what happened to the Jews in Shanghai after the war and what their plans were like. |

| | |
|-------------------------------------|---|
| <i>Topic</i> | Wallenberg rescues Jews |
| <i>Subsequent experience</i> | AB remembers being liberated in January 1945 while living in a protected house in Budapest. She recalls her interaction with Soviet troops. AB mentions searching for Raoul Wallenberg. |
| <i>Note</i> | Experience afterwards. It also broadens the perspective of what happened to the protected house and to Raoul Wallenberg afterwards. |

13.3.3 Context as Other Supplemental Information

In addition to the two major context relevance types, *Context by scope* and *Context by time/sequence*, there are other contextual information supplementing topic-related background, such as,

- *Assumption/expectation*: the shared believes, both spoken and unspoken, behind the decision-making process.
- *Biographic information*: it is especially important to tagging art images; it provides information not directly related to the image topic but associated with the image creation and distribution, such as its *creator/artist*, *sponsor*, *nationality/origin*, and *time/period*. Although often having nothing directly to do with the image topic, biographic information may provide background for us to better understand an image in its historical context. Also note that *nationality/origin* and *time/period* are different from *Context by scope/ Environmental setting/ Physical location* and *Context by time and sequence/ Time or period*, which are topic-related location and time. The *nationality/origin* and *time/period* discussed here are part of biographic information and not related to the topic per se. See more discussion on this distinction in Section 12.2.3.

| | |
|-------------------------------|--|
| *Topic | Experience of Jewish People in Nazi Hospitals |
| Assumption/Expectation | NM remembers his physical condition in Gross Rosen and talks about his stay in the camp's hospital. He explains why he decided to leave the hospital and tells the fate of those who remained. NM relates general impressions camp inmates had of hospitals, the widespread belief that those who went to a camp hospital did not survive, or were immediately selected for the gas chamber. |
| Note | NM decided to escape from the camp hospital which is related to a shared belief among the camp inmates that Nazi hospitals were not to cure but to torture and kill. |

| | |
|-------------------------------|---|
| Topic | Survivors' Post-war Adaptation |
| Assumption/Expectation | Everyone was looking for a place to go; #1 place was America #2 was Canada, then Australia, then Palestine; the younger people were motivated to go to Palestine. |
| Note | Shared preferences of immigration plans among the survivors which played a big role in their post-war lives. |

| | |
|-------------------------------|--|
| *Topic | Wallenberg rescues Jews |
| Biographic information | Wallenberg and his associates rescued Jews in Budapest, Hungary. Officially, Raoul Wallenberg died in a Soviet prison camp in 1947, but there are questions and some believe that he lived much longer or was killed even earlier. |
| Note | It is not directly related to Wallenberg's rescuing Jews, but it provides biographic information about the rescuer. |

As evident in the CLiMB data analysis, biographic information is important for tagging art images to indicate details associated with the creation of the art work. As shown in the following example, various types of biographic information, such as information about the artist, the sponsor, the time period, and the place associated with the creation of the art work.



Figure 13-54 Enthroned Madonna and Child. Artist: Byzantine. 13th Century. Byzantine. (ID: 203)

| *Tags | Indication of the tags | Relevance code |
|---|-----------------------------------|---|
| Greek | Nationality of the artist | [Context] Biographic information: Creator/Artist |
| Western patron | For whom was the art work created | [Context] Biographic information: Sponsor |
| Italy | Where was the art work created | [Context] Biographic information: Nationality/Origin |
| c13th, thirteenth century, late medieval, | When was the art work created | [Context] Biographic information: Time/Period |

13.4 [Condition]

[Condition] lays out influential factors behind an event or phenomenon, both helping and hindering, that are not sufficient to cause the event to happen or not to happen, but are important enough to affect the development of the event. To a large extent, [Condition] is a weaker version of [Cause/Effect] (discussed next).

[Condition] and [Cause/Effect] can be seen as another dimension of [Context], which suggests another way of “surrounding” the target event through causal relations. If the second dimension of [Context] is by time sequence, this dimension is by causal sequence. It situates our understanding of a target event into a causal network which helps illuminate relationships among events. Depending on the domain, for disciplines such as medicine, science, and engineering, [Condition] and [Cause/Effect] are important and rich enough to become a topic relevance category of their own, rather than being subsumed under [Context].

The detailed scheme of [Condition] is:

- . **Condition** (M⁸)
 - . **Helping or hindering factor/condition**
 - . . Helping factor/condition
 - . . . Predisposing factor
 - . . . Boundary factor
 - . . Hindering factor/condition
 - . . . Protective factor
 - . . . Constraint (M)
 - . **Unconditional**
 - . **Exceptional condition**

⁸ M: Indication of new relevance categories introduced through analyzing *medical* dataset; H: Indication of new relevance categories introduced through analyzing oral *history* dataset; I: Indication of new relevance categories introduced through analyzing *image* tags.

13.4.1 Condition

Indications of “dependencies”.

| | |
|---------------------------------|---|
| *Question | What’s the prognosis for a Stevens-Johnson syndrome conjunctival bullous eruption? |
| Topic | Acute low back pain |
| Helping factor/condition | The prognosis for Stevens-Johnson conjunctival bullous eruptions depends on a number of factors. These include whether or not the inciting factor is removed, whether or not secondary infection occurs, and the extent of the inflammation and scarring that result. |
| Note | Condition of making prognosis about a disease. |

| | |
|----------------------|---|
| Question | What is the prognosis for acute low back pain? |
| Topic | Acute low back pain |
| Condition (1) | The proportion of patients who are pain free or completely recovered after an acute episode of low back pain within 2 weeks to 6 months ranges from 21% to 90%, depending on the population studied and the method of measuring outcomes. |
| Condition (1) | The reported recurrence rates are also variable, from a low of 35% to a high of 75%, again depending on the length of follow-up and the study design. |
| Note | Condition of interpreting the results of prognosis studies of the disease. |

13.4.2 Helping Factor/Condition

Factors or conditions that increase the likelihood of the happening of the central topic or target event.

MALACH example(s):

| | |
|--|--|
| *Topic | Expropriations of Jewish businesses |
| Helping factor/condition; <i>Policies and laws</i> | Nov 38 occupied by Hungarians the whole world changed. Anti-Jewish laws instituted certain professions taken away; monopolies had been given to Jews before but in 38 taken away. AP recalls that Jews were not allowed to own businesses and had to perform manual labor. |
| Note | It is not a direct discussion of seizure of particular Jewish businesses, but excluding Jews from certain professions and from owning their own businesses by law sets up the justifications for the appropriation that conducted widely later on by both Nazi and gentiles. The passage is double-coded both as <i>Helping factor/condition</i> under [Condition] and as <i>Policies and laws</i> under [Context]. |

| | |
|---------------------------------|---|
| Topic | Jewish-gentile relations in Poland |
| Helping factor/condition | RZ recalls the increase in anti-Semitism during the holidays of Christmas, Easter and Passover. |
| Note | Holidays did not cause anti-Semitism but they became the trigger of anti-Semitism events |

Clinical example(s):

| | |
|---------------------------------|--|
| Question | What's the current success rate of electroconvulsive therapy (ECT)? |
| Topic | Depression |
| Helping factor/condition | ...Unfortunately, dramatic and out-dated depictions of ECT as in the movie, One Flew Over the Cuckoo's Nest, have left many patients reluctant to undergo this treatment. In the U.S., some states even outlaw this procedure despite the American Psychiatric Association's endorsement of this safe and effective procedure. |
| Note | APA's endorsement helps to promote the acceptance and usage of the ECT therapy for treating depressions. |

| | |
|---------------------------------|---|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Helping factor/condition | In my experience, when patients, parents, and teachers are well-educated about ADHD and use behavioral therapy along with medication, we achieve better outcomes. |
| Note | Better educated patients, parents, and teachers as well as combining behavioral therapy with medication help the treatment of ADHD in children. |

Image tagging example:



Figure 12-17 The Martyrdom of Saint Bartholomew.
Artist: Jusepe de Ribera. 1634. Spanish. (ID: 207)

| *Tags | Indication of the tags | Relevance code |
|--|---|---|
| influence of caravaggio's dramatic lighting, influence of caravaggio, influence, caravaggio, caravaggesque, | The artist's exposure to Caravaggio's Chiaroscuro and Tenebrism is an influencing factor to the style of this painting. | [Condition] Helping factor/condition |

Within the relevance category of *Helping factor/condition*, the medical data suggested two medicine-specific sub-categories: *Predisposing or risk factor* and *Boundary factor*, as illustrated in the following examples:

| | |
|---|---|
| Question | I have a 40-year-old male patient with a 19% spontaneous pneumothorax of his right upper lobe without oxygen desaturation, hemoptysis, or effusion. His only symptom is pleuritic chest pain." He would like to know: "Is it safe to follow him conservatively? What is the chance of a recurrence? Is pleurodesis likely in the future?" |
| Topic | Pneumothorax |
| *Predisposing or risk factor (1) | the risk increases in those who continue to smoke or patients with underlying lung disease. |
| Predisposing or risk factor (2) | if the patient has an occupation or hobby that puts him or her at higher risk, such as flying airplanes or deep sea diving. |
| Note | Smoking and extreme occupations/hobbies are risk factors of severe pneumothorax that would require thoracoscopy or open thoracotomy. |

| | |
|------------------------|---|
| *Question | What are the indications for evaluating a patient with cough for pertussis? |
| Topic | Pertussis |
| Boundary factor | Pertussis should be considered early in the evaluation of young infants with cough. In a case-control study comparing 15 fatal cases of pertussis with 32 who survived (infants aged <6 months), the mean number of days from symptom onset to hospital admission were 5.3 (fatal) and 8.6 (survivors). |
| Note | Young infants, aged < 6 months, is a boundary factor for fatal pertussis. |

13.4.3 Hindering Factor/Condition

Factors or conditions that reduce the likelihood of or prevent the happening of the central topic or target event. Some hindering factors or conditions manifest as *Constraint*.

| | |
|---|---|
| *Topic | Stories of Varian Fry and the Emergency Rescue Committee who saved thousands in Marseille |
| Hindering factor/condition; <i>Social background: Political</i> | A survivor details the political situation in France in 1940-1941 regarding refugees and explains the changes in emigration regulations that made fleeing France difficult. |
| Note | The passage is double-coded both as <i>Hindering factor/condition</i> under [Condition] and as <i>Policies and laws</i> under [Context]. |

| | |
|-----------------------------------|---|
| Topic | Muselman (Muselmanner) in concentration camps |
| Hindering factor/condition | Other prisoners' attitudes towards Muselmanner, or the factors that underlie the exclusion of Muselman from the social environment of the camp, for instance, having lost all their family members, having no one to protect them, etc. LC suggests that one had to have a friend or relative to give purpose of life in camp; if not - no reason for survival. |

| | |
|-----------------------------------|---|
| *Topic | Stories of children hidden without their parents and of their rescuers |
| Hindering factor/condition | Mentions of factors hindering hiding, such as “the authorities often raided the convent”; some children were hidden in convents during the war. |

| | |
|-----------------------------------|---|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Hindering factor/condition | Sometimes patients and parents are hesitant to take medication for ADHD. Likewise, children and adolescents may resist medication because of stigma or feeling unfairly labeled with a disease. |
| Note | Negative response of patients and parents can be a significant hindering factor for ADHD treatment to achieve desired outcomes. |

| | |
|--|--|
| Question | What's the current success rate of electroconvulsive therapy (ECT)? |
| Topic | Depression |
| Helping factor/condition; Social background | ...Unfortunately, dramatic and out-dated depictions of ECT as in the movie, One Flew Over the Cuckoo's Nest, have left many patients reluctant to undergo this treatment. In the U.S., some states even outlaw this procedure despite the American Psychiatric Association's endorsement of this safe and effective procedure. |
| Note | The negative and outdated depictions of ECT therapy in mass media became a significant hindering factor to popularize the effective medication. |

| | |
|-------------------|--|
| Question | Does a Short Symptom Checklist Accurately Diagnose ADHD? |
| Topic | ADHD in children |
| Constraint | The Institute for Clinical Systems Improvement recommends use of at least 1 ADHD-specific rating scale to be administered to parents and teachers. This information should be used as part of the overall historical database for the child and should not be used as the sole criteria for diagnosis of ADHD. |
| Note | The validity of ADHD rating scale is constrained on not being used in isolation. |

13.4.4 Exceptional Condition

| | |
|------------------------------|---|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Exceptional condition | Combination drug therapies offer no significant advantage to stimulants alone unless a comorbid condition is present. |

| | |
|------------------------------|--|
| Question | Does a polyp in the gallbladder pose any risk of becoming malignant? |
| Topic | Polyp in the gallbladder |
| Exceptional condition | Most gallbladder polyps don't have any malignant potential, usually turning out to be adenomatous hyperplasia or cholesterol polyps. Pure adenomas do apparently occur in the gallbladder, but I gather that no clear progression from adenoma to carcinoma has been demonstrated. I'd certainly be a bit concerned, however, if I saw a large polyp, say, greater than 1 cm in size. In my years of practice, though, I haven't come across such a situation yet. |
| Note | Gallbladder polyps are not malignant. They become concerning only if the size is too big (>1cm). |

13.5 [Cause / Effect]

Whereas [Condition] only tells us what affects or what is affected in a broad way and thus does not necessarily lead to *one* answer or any conclusive argument at all, causal relationships provide a restrictive evidential space that leads to a specific answer (or fact).

Causal relationships are also closely tied to *Causal-based reasoning* on the second facet.

- . **Cause**
- . . Etiology / Diagnosis (M)
- . **Effect / Outcome**
- . . Side effect (M)
- . . Reaction / Feeling (H⁹) (I)
- . **Explanation (causal)**
- . . Rationale / Mechanism (M)
- . . Constructing causal model
- . . Explanatory relationships
- . **Prediction**
- . . Prognosis (M)
- . . . Recovery (M)
- . . . Complication (M)
- . . . Recurrence (M)
- . . . Mortality (M)

⁹ M: Indication of new relevance categories introduced through analyzing *medical* dataset; H: Indication of new relevance categories introduced through analyzing oral *history* dataset; I: Indication of new relevance categories introduced through analyzing *image* tags.

13.5.1 Cause

Typically, the most commonly mentioned “cause” in the clinical question answering data is the etiology or diagnosis of a condition.

| | |
|----------------------------------|---|
| *Question | What is the differential diagnosis of chronic diarrhea in immunocompetent patients? |
| Topic | Chronic diarrhea |
| Cause: Etiology/Diagnosis | Case series from tertiary-care centers report toddler’s diarrhea, cow’s milk sensitivity enteropathy, infection, celiac disease, and idiopathic chronic diarrhea as the most common etiologies in the pediatric population. |
| Note | The common causes/etiologies for chronic diarrhea. |

| | |
|----------------------------------|---|
| Question | What are the causes of hypomagnesemia? |
| Topic | Hypomagnesemia |
| Cause: Etiology/Diagnosis | The causes of magnesium depletion and hypomagnesemia are decreased gastrointestinal (GI) absorption and increased renal loss. Decreased GI absorption is frequently due to diarrhea, malabsorption, and inadequate dietary intake. Common causes of excessive urinary loss are diuresis due to alcohol, glycosuria, and loop diuretics. |
| Note | The common causes/etiologies for hypomagnesemia. |

| | |
|----------------------------------|--|
| Question | I have a 40-year-old male patient with a 19% spontaneous pneumothorax of his right upper lobe without oxygen desaturation, hemoptysis, or effusion. His only symptom is pleuritic chest pain." He would like to know: "Is it safe to follow him conservatively? What is the chance of a recurrence? Is pleurodesis likely in the future?" |
| Topic | Pneumothorax |
| Cause: Etiology/Diagnosis | There is usually some underlying condition responsible for most cases of spontaneous pneumothorax. Many, however, are the result of apical subpleural emphysema often related to smoking. The most common causes for secondary spontaneous pneumothorax are chronic obstructive pulmonary disease, cystic fibrosis or some other underlying lung diseases like eosinophilic granuloma. |
| Note | The common causes/etiologies for pneumothorax. |

MALACH example:

***Topic** People making hard decisions during the Holocaust

Cause *Audio detail:* “MV explains why many Jews did not escape from the ghetto and explains that young people often decided not to escape because they did not want to leave their older family members behind. Sometimes if one goes away from the family will suffer for it, maybe killed. Some younger people left, not many. After massacre of 2,500 I realized that we will be shot sooner or later and I looked for way out. One day I gave someone 5 rubles of gold for a paper that you fill in the name, had a stamp on it, like a false passport. Some Jews were working in the print shop selling it. To write a name would be easier but I didn't know where to go, felt safer in the ghetto. When I speak Polish or Russian they can tell by my R that I'm Jewish. I didn't pursue it.”

Note People desired to maintain status quo because making a decision for change would be too difficult. The reasons underlying the decision to stay within the ghetto and what made these decisions difficult.

13.5.2 Effect / Outcome

Effect or outcome indicates the logical *consequence* of the topic.

| | |
|-----------------------|---|
| *Topic | Descriptions of Nazi medical experiments |
| Effect/Outcome | A survivor describes his long-term conditions related to the medical experiments in which he was forced to participate. |
| Note | Long-term effects on the survivor resulted from the cruel medical experiments. |

| | |
|-----------------------|---|
| *Question | What's the prognosis of and treatment for human papillomavirus of the throat? |
| Topic | Human papillomavirus (HPV) of the throat |
| Effect/Outcome | Human papillomavirus (HPV) can cause lesions in the oral cavity that take the form of either verruca vulgaris (common warts) or condyloma accuminata (genital warts). |
| Note | The physiological consequence of Human papillomavirus (HPV). |



Figure 12-17 The Martyrdom of Saint Bartholomew.
Artist: Jusepe de Ribera. 1634. Spanish. (ID: 207)

| *Tags | Indication of the tags | Relevance code |
|----------------------------------|---|----------------------------------|
| Pulls the viewer into the scene, | Indicate the effect of the dramatic composition on the viewer | [Cause/Effect] Effect/Outcome |

In the clinical context, Effect/Outcome can be used to refer to the effect of specific medication or the outcome or result of medical studies.

Assertion of the effect of specific medication:

| | |
|----------------------------|--|
| Question | Does a short symptom checklist accurately diagnose ADHD? |
| Topic | ADHD in children |
| *Effect/Outcome (1) | The Swanson, Nolan, and Pelham (SNAP) checklist from the Diagnostic and Statistical Manual of Mental Disorders, revised 3rd edition (DSM-III-R) has been shown to have a sensitivity and specificity in excess of 94% to distinguish hyperactive, inattentive, and impulsive children with ADHD from those without ADHD. |
| Effect/Outcome (2) | Many sources agree that ADHD-specific rating scales allow a rapid and consistent collection of information from multiple sources. |
| Note | The first example indicates the effect of the SNAP checklist for diagnosing ADHD. The second example is a statement approving the effect of ADHD-specific rating scales in general. |

The outcome or result of medical studies:

| | |
|-----------------------|--|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Effect/Outcome | The effect size from stimulant medication in these studies averaged 0.8 for symptom relief and between 0.4 and 0.5 for academic achievement. |

| | |
|-----------------------|---|
| Question | Does quinine reduce leg cramps for young athletes? |
| Topic | Leg cramps |
| Effect/Outcome | A meta-analysis of 4 published and 3 unpublished reports of randomized, double-blind controlled crossover trials (n=409) showed that adult patients had significantly fewer nocturnal cramps when taking quinine compared with placebo. |

| | |
|-----------------------|--|
| Question | What are the causes of hypomagnesemia? |
| Topic | Hypomagnesemia |
| Effect/Outcome | ...but magnesium replacement therapy has not been shown to improve outcomes in 2 large randomized trials, the Fourth International Study of Infarct Survival (ISIS 4) ¹⁵ and Magnesium in Coronaries (MAGIC). |
| Note | The <i>insignificant</i> outcome of magnesium replacement therapy in two large randomized trials. |

13.5.2.1 Side Effect

Undesirable side effect of specific medications:

| | |
|------------------------|--|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Side effect (1) | Side effects of atomoxetine are similar to stimulants and include mild but significant increases in blood pressure and pulse. |
| Side effect (2) | Several short-term reviews and meta-analyses show that side effects from stimulant medications are mild and have short duration. |

13.5.2.1 Reaction / Feeling

Another form of “effect” is the reaction or feeling caused. Compared to other effects described above, this category focuses on psychological and emotional effects rather than physical consequences:

| | |
|-------------------------|--|
| *Topic | Sonderkommando Uprising |
| Reaction/Feeling | MV outlines the plan for the Sonderkommando Uprising in Birkenau. He compares the reactions of the Greek and Polish prisoners to the plan. He recalls the signal that was to start the uprising. |

| | |
|-------------------------|--|
| *Topic | Cultural programs in ghettos and camps |
| Reaction/Feeling | Accounts of the authorities' reactions to such programs. |



Figure 12-18 Red Rose Cantata. Artist: Alba Thomas. 1973. American. (ID: 224)

| | Indication of the tags | Relevance code |
|---|---|--|
| harmony, tension, musical, rhythmic, | Verbalized reactions/feelings of the viewer towards the art image. Note the completely opposite reactions from viewing the image: “harmony” vs. “tension”; both are valid reactions since different viewers have different perspectives. | [Cause/Effect] Effect/Outcome: Reaction/Feeling |



Figure 12-20 Still Life with Fruit and Carafe.
Artist: Pensionante del Saraceni. 1610/1620. Roman. (ID: 228)

| Tags | Indication of the tags | Relevance code |
|---------------------------|---|--|
| Abundance, Melancholy, | Verbalized reactions/feelings of the viewer towards the art image | [Cause/Effect] Effect/Outcome: Reaction/Feeling |



Figure 12-21 The City from Greenwich Village. Artist: John Sloan. 1922. American. (ID: 226)

| Tags | Indication of the tags | Relevance code |
|-------------|---|--|
| Dreary, | Verbalized reaction/feeling of the viewer towards the art image | [Cause/Effect] Effect/Outcome: Reaction/Feeling |

13.5.3 Explanation (Causal)

Whereas the relevance categories, *Cause* and *Effect/Outcome*, have an explicit emphasis either on the cause or on the effect, *Explanation (causal)* focuses on the full causal chain that is constructed by both cause node(s) and effect node(s). It encompasses two sub-categories:

- *Rationale/Mechanism*: Explain the rationale or mechanism behind certain methods; explain “how it works”
- *Constructing causal model*: Propose a causal theory or hypothesis to extricate a phenomenon or effect
- *Explanatory relationships*: Other explanatory relationships involved

| | |
|-----------------------------|---|
| Question | Does a short symptom checklist accurately diagnose ADHD? |
| Topic | ADHD in children |
| Rationale /Mechanism | The test characteristics of a particular scale depend on the cut points for a positive or negative test. The usefulness of psychological tests in discriminating normal from abnormal behavior is often reported as “effect size.” The effect size is the difference in mean scores between 2 populations divided by an estimate of the individual standard deviation. An effect size of 4.0 means that abnormal subjects and normal controls are separated 4 standard deviations and thus almost completely separated. An effect size of 1.0 shows significant overlap between the 2 populations. An effect size of 4.0 is roughly equivalent to a sensitivity and specificity of 97%. An effect size of 1.0 is roughly equal to a sensitivity and specificity of 71%. |
| Note | The passage describes the rationale and mechanism underlying psychological test scales. |

| | |
|----------------------------|---|
| *Question | What protective effects do vitamins E, C, and beta carotene have on the cardiovascular system? |
| Topic | Cardiovascular system health |
| Rationale/Mechanism | The theory behind antioxidant therapy is that LDL cholesterol must be clinically transformed or oxidized to cause atherosclerosis, so that vitamins may be able to prevent this step. |
| Note | Give an explanation of how vitamins as antioxidant therapy help to protect cardiovascular system. |

| | |
|----------------------------------|--|
| *Question | What are the causes of hypomagnesemia? |
| Topic | Hypomagnesemia |
| Constructing causal model | Some authors have proposed a higher range for normal serum magnesium, asserting that dietary magnesium deficiency is endemic in developed countries where acid rain reduces the magnesium content of crops and food processing causes further large reductions in the magnesium content of the diet. |
| Note | Propose a theory (hypothesis) of hypomagnesemia due to dietary magnesium deficiency in developed countries. |

13.5.4 Prediction

All the examples of *Prediction* collected from the empirical analyses are *Prognosis* from the clinical dataset. Medical prognosis delivers predictions on patient outcomes; it involves both causal reasoning, making predictions based on the patient's current conditions, and rule-based reasoning, making deductions based on the disease's progression. *Prognosis* can be further specified by:

- Prognosis: Recovery
- Prognosis: Complication
- Prognosis: Recurrence
- Prognosis: Mortality

| | |
|---------------------------------|--|
| *Question | What is the prognosis for acute low back pain? |
| Topic | Acute low back pain |
| *Prognosis, general | The Agency for Healthcare Research and Quality (www.ahrq.gov) section on health outcomes (see http://www.ahrq.gov/research/jan99/ra6.htm) states, "recent studies suggest that once experienced, low back pain becomes a part of life for almost half of those affected, and for many, it is intermittently disabling. Repeated visits and procedures do not appear to improve patients' long-term well-being, but they clearly account for substantial health care costs. Finally, back pain prognosis does not differ based on the type of provider initially seen or the level of practitioner confidence." |
| Prognosis: Recovery (1) | The proportion of patients who are pain free or completely recovered after an acute episode of low back pain within 2 weeks to 6 months ranges from 21% to 90%, ... |
| *Prognosis: Recovery (2) | It has been widely stated that 80% to 90% of attacks of acute low back pain resolve within approximately 6 weeks, ... |

| | |
|---------------------------|--|
| Question | What's the prognosis for a Stevens-Johnson syndrome conjunctival bullous eruption? |
| Topic | Stevens-Johnson syndrome conjunctival bullous eruption |
| Prognosis, general | Generally, the prognosis is good. But in severe cases, which are rare, it can lead to severe corneal scarring and blindness, although there are reports of successful ocular surface reconstruction. |

| | |
|------------------------------|---|
| Question | I have a 40-year-old male patient with a 19% spontaneous pneumothorax of his right upper lobe without oxygen desaturation, hemoptysis, or effusion. His only symptom is pleuritic chest pain." He would like to know: "Is it safe to follow him conservatively? What is the chance of a recurrence? Is pleurodesis likely in the future?" |
| Topic | Pneumothorax |
| Prognosis: Recurrence | Patients with a spontaneous pneumothorax have a 30-50% chance of a recurrence; |

| | |
|--------------------------------|--|
| *Question | What's the prognosis of and treatment for human papillomavirus of the throat? |
| Topic | Human papillomavirus (HPV) of the throat |
| Prognosis: Recurrence | Like warts and HPV lesions elsewhere in the body, relapse or recurrence is common. |
| Prognosis: Complication | These growths sometimes undergo malignant transformation, particularly in patients who've had radiation therapy. |

| | |
|--------------------------------|--|
| Question | A patient of mine was diagnosed with IgA Urology after a renal biopsy. His creatinine has been stable for years, although slightly elevated at 1.37, and his blood pressure and proteinuria are normal while he takes his enalapril. What is his prognosis? |
| Topic | IgA Urology |
| Prognosis: Complication | Now it is well established that IgA Urology may present in many different ways and is not necessarily benign. It is estimated that 20 to 30% of patients may develop chronic renal failure. Some of the important poor prognostic manifestations include glomerular proteinuria (1.2 g/24 hours/1.73 m ²), abnormal renal function at diagnosis, hypertension and periglomerular sclerosis on kidney biopsy. If your patient had glomerular-range proteinuria and hypertension before starting converting enzyme therapy, he would be in the poorer prognostic category. |

13.6 [Comparison]

Comparison relevance is driven by perceived similarity, identifying both analogous and contrasting persons, places, events, phenomena, interventions, causes, etiologies, etc. that can help in understanding the central topic; it is related to analogical reasoning. It is not *on inferring* nor *surrounding* the target event or phenomenon; it *is* another event or phenomenon. That is why we do not use comparative evidence as valid proof in court cases. Its evidential value in terms of establishing a fact is even fainter than contextual evidence, which is at least remotely related to the *exact* event. But when it comes to justify a judicial decision, comparison relevance becomes useful in identifying comparable precedents.

To recognize similarity among seemingly discrete facts is at the heart of human thinking and reasoning; it establishes connections, inspires thinking, generates perspectives, and improves distinction among similar facts. On the one hand, by looking at similar cases (Code: *By similarity*), we obtain supplemental details, develop a comprehensive view on the same sort of events, and know better of something *unique* about the target event; on the other hand, by looking at contrasting cases (Code: *By difference*), we see the other side of the coin and gain alternative perspectives about the target event. Moreover, in cases where little material on the *exact* topic (event) is available, comparable cases can also *induce* some arguments but just not as strong and conclusive.

[Comparison] can be defined as information about a topic that shares characteristics of the topic but differs from the topic by one or more factors. A topic is usually characterized by many factors. A typical MALACH topic can be described by three

major factors: external factors (time and place); participants; and the act/experience.

Varying values of one or two of these factor, we obtain similar or contrasting cases.

Varying all three at once leaves no similarity or basis for comparison. Varying values of the first two topical facets, we often get the same or comparable

event/experience/phenomenon happening in a different place, at a different time, in a different situation, or with a different person; varying values of the last factor, we get an opposite event/experience/phenomenon happening in the same time-space or involving the same participant(s).

The coding in this study differentiates whether the comparative information emphasizes the *similarities* (such as analogy or metaphor) or the *differences*. At the mean while, the coding also indicates by which factor that is different in the comparison.

Therefore, the two facets of *By similarity vs. By difference* and *By factor that is different* are always coded simultaneously.

- . **By similarity vs. By difference**
- . . Comparison by similarity
- . . . Metaphor and analogy
- . . . Classification
- . . Comparison by difference (Contrast)
- . . . Contradictory contrast
- . . . Juxtapositional contrast
- . **By factor that is different**
- . . Difference in external factor (H¹⁰)
- . . . Different time (H)
- . . . Different place (H)
- Different country (H)
- . . . Different type of situation (H)
- . . Difference in participant (H)
- . . . Different actor (H)
- . . . Different experiencer (H)
- . . . Different population (group) (M)
- . . Difference in act or experience (H)
- . . . Difference in act (H)
- Different act (H)
- Different attitude (H)
- Different purpose (H)
- Different method (H)
- Different medical intervention (M)
- Diff degree of intensity (H)
- . . . Difference in experience (H)
- . . . Difference in etiology (M)

¹⁰ M: Indication of new relevance categories introduced through analyzing *medical* dataset; H: Indication of new relevance categories introduced through analyzing oral *history* dataset; I: Indication of new relevance categories introduced through analyzing *image* tags.

13.6.1 Comparison by Similarity

| | |
|---|--|
| *Topic | Nazi Theft in Eastern Europe |
| Comparison by similarity; By factor that is different: Different type of situation | <p>ZE recalls that at the beginning of the war, the Germans expropriated a famous Lublin Hasidic university and states that they destroyed all of the books and Torahs housed there.</p> <p><i>Audio detail:</i> “There was a lot of anti-Semitism. ... Nice Jewish population in Lublin. We had a famous Hasidic University there. The Germans used it as a hospital for other Germans. It was a modern building. All books and torahs were burned. This was in the beginning.</p> |
| Note | As specified by the topic, Nazi theft considers seizure of family properties and assets. The segment touches on seizure of non-family property. Not directly on topic, but similar. |
| Comparison by similarity; By factor that is different: Different actor | <p>SW reveals that her family was betrayed by the gentile girl who had been her best friend and discusses her feelings about this betrayal. She recalls how her family prepared to leave for the ghetto and describes the night Germans forced them out of their home.</p> <p><i>Audio detail:</i> “In their area, mostly poles. Heard Germans were coming to take them to ghetto. Came in the night. A day before, came Helena with a German officer to their apartment told officer that all the furniture, silver, cupboards, bedding, everything was hers. Not to touch. They were frightened, did not say a word... So horrible, was the shouting. Into big trucks, took them to ghetto. Could not believe her friend would do that to her. They were best friends. Was so down about it. Unbelievable. Came to her apartment at such a critical time, everything was hers. No shame, no morality. Could not till today could she betray her. Gave up so much for her friend, everything with her, was like a sister. So betrayed her.”</p> |
| Note | This is not directly Nazi theft; instead, it is theft by private citizens. However, in this instance, the Germans explicitly condoned the theft by the local Poles so the Germans role as an accomplice in the private citizens’ theft makes this segment relevant. It also provides context for showing the level of respect Nazi Germans had for Jewish property – certainly gives perspective on how little value they placed on Jewish ownership of property. |

| | |
|--|---|
| <p>*Topic</p> <p>*Comparison by similarity; By factor that is different: Different time (1)</p> <p>Comparison by similarity; By factor that is different: Different time (2)</p> <p>Note</p> | <p>Jewish-gentile relations in Poland during the war</p> <p>MG talks about the postwar killing of Jews by Poles. <i>Audio detail:</i> “went back to Poland to look for family. Came to Miechow and found a cousin had been in camp with MG. he told MG they couldn't go out in the evenings because might be killed by Poles. Mg had thought that after what the Poles had seen they might now feel differently about Jews but no; heard about a man who was hidden in Miechow, Aron Berger, had hid the whole war in Miechow and then after wars end was killed by Poles; along with cousin and few others MG crossed borders back to Germany...”</p> <p>RK recalls her family lived briefly in an abandoned house in Drohiczyn. She explains that they were forced to leave because the Poles began attacking the Jews who returned and several were killed. RK states her family moved to Siemiatycze where they encountered the same problems. She describes the violence they faced. <i>Audio detail:</i> “a very prevalent Jewish family in Drohi had perished, they had a lovely house, their belongings had been taken but the house left unoccupied,... and somehow RK's family got a bed and a table and they and other survivors moved in; stayed there few weeks and the Poles started up said they were going to finish the job the Germans hadn't and two survivors were killed within a week. Mother and Sol decided to go to Siemiatycze. The Russians just kind of looked the other way; they knew the Poles were killing the Jews. They moved to Siemiatycze but started getting attacked every single night. They had guns and ammo in the house and DNR being trained to load the magazines but knew how. One night they made it up a half flight and then a bunch of people were killed so they decided to leave. One time the shooting was so bad; remembers hid under bed with another girl; a bullet hit the other girl and she was killed.”</p> <p>An informative comparison that provides a richer perspective. It reveals something deep: the hatred towards Jews did not stop with the war.</p> |
|--|---|

13.6.1.1 Metaphor and analogy



Figure 12-17 The Martyrdom of Saint Bartholomew.
Artist: Jusepe de Ribera. 1634. Spanish. (ID: 207)

| *Tags | Indication of the tags | Relevance code |
|---|---|---|
| Christ's sacrifice and crucifixion, Christ metaphor, | Comparing the martyrdom of Saint Bartholomew to Christ's sacrifice and crucifixion. | [Comparison] By similarity: Metaphor/Analogy |

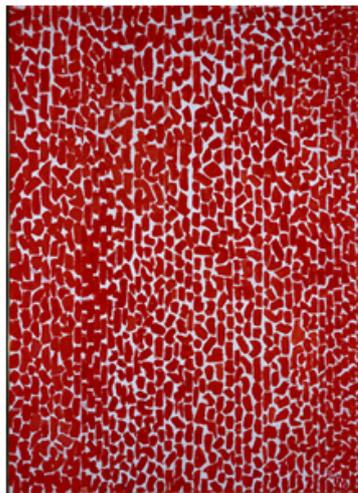


Figure 12-18 Red Rose Cantata. Artist: Alba Thomas. 1973. American. (ID: 224)

| *Tags | Indication of the tags | Relevance code |
|----------------|--|---|
| Leopard print, | Comparing the pattern of <i>Red Rose Cantata</i> to leopard print. | [Comparison] By similarity: Metaphor/Analogy |

13.6.2 .2 Classification

Classification is a special type of *Comparison by similarity*. It is based more on the inherent similarities, such as similar rationale or similar cause (etiology). Both the topic and the given comparative case belong to the same broader class.

| | |
|-----------------------|---|
| *Topic | Muselman in concentration camps |
| Classification | Segments describing prisoners in poor physical condition or those that were avoided by their fellow inmates. EK describes people in the infirmary at Auschwitz as "living dead". <i>Audio detail:</i> "Barrack filled with those so weak that could do nothing but scream. Trucks would come take them away twice a week and the screams were horrifying..." |
| Note | All segments describing an individual that fits the characteristics of a Muselman, though not specifically branded as such, are classified into the category of "Muselman." |

| | |
|-----------------------|---|
| *Question | What's the prognosis of and treatment for human papillomavirus of the throat? |
| Topic | Human papillomavirus (HPV) of the throat |
| Classification | Recurrent respiratory papillomatosis involves the larynx and is most common in young children (with a median age of three years), but it's occasionally seen in adults as well. It's caused by the same types of HPV that cause anogenital warts, which are probably transmitted at the time of delivery through an infected birth canal. |
| Note | Based on the same cause (etiology), Recurrent respiratory papillomatosis and anogenital warts are classified together. |

13.6.2 Comparison by Difference (Contrast)

| | |
|-----------------|--|
| *Topic | Survivors' impact on their children and grandchildren |
| Contrast | SR recounts the wartime experience of his wife and mother-in-law. He discusses the effort he and his wife make to avoid dwelling on their experiences. He names his children and grandchildren. |
| Note | Segments in which survivors make a point of not discussing their holocaust experiences; they note that they have kept it from their children and grandchildren. These segments indicate interviewee's intentions of trying not to impact their children and grandchildren, thus providing important comparative relevance. |

13.6.2.1 Juxtapositional Contrast

| | |
|---------------------------------|--|
| Question | Does quinine reduce leg cramps for young athletes? |
| Topic | Leg cramps |
| Juxtapositional contrast | One double-blind, randomized, controlled parallel group trial of 98 adult patients with a mean age of 50 years demonstrated that a regimen of daily quinine sulfate therapy of 200 mg with the evening meal and 200 mg at bedtime significantly reduced the number of nocturnal muscle cramps compared with placebo. Over a 2-week treatment period the quinine group experienced a median of 8 fewer cramps (95% CI, 7~10), while the placebo group experienced a median of 6 fewer cramps (95% CI, 3~7). However, patient evaluation of global efficacy of treatment was not statistically significant between the quinine and placebo groups. |
| Note | Juxtapositional contrast of the experiment results between treatment group and control group. |

| | |
|---------------------------------|---|
| *Question | What are the causes of hypomagnesemia? |
| Topic | Hypomagnesemia |
| Juxtapositional contrast | A study of 11,000 white urban Americans aged 45 to 64 years (probability sampling) found 2.5% with magnesium <0.7 mmol/L and 5% with magnesium <0.75 mmol/L; rates for 4000 African Americans were twice as high. |
| Note | Juxtapositional contrast of the disease prevalence rates between the white and black ethnic groups. |

13.6.2.2 Contradictory Contrast

| | |
|-------------------------------|---|
| Question | What are the causes of hypomagnesemia? |
| Topic | Hypomagnesemia |
| Contradictory contrast | Thus, a study of 16,000 German subjects (including blood donors, outpatients, and children) found a 15.5% prevalence of hypomagnesemia using a lower limit of 0.76 mmol/L1; however, applying the more commonly cited lower limit of 0.70 mmol/L (1.7 mg/dL) to the same data yielded a prevalence of 2%. |
| Note | Applying different criteria for evaluating hypomagnesemia to the same data yielded contradictory results. |

| | |
|-------------------------------|---|
| Topic | Muselman in concentration camps |
| Contradictory contrast | GM was left for dead after contracting typhus but woke up in the snow, and ran back to look for his shoes; his mind was fixated on items for survival (shoes and bowl). |
| Note | The segment describes someone who exhibited a very strong will to survive, which is in a great contrast to Muselman who had lost all their faith and given up the will of survival. |

| | |
|------------------------------------|--|
| Topic | Abusive female personnel |
| *Contradictory contrast (1) | TF talks about the tattoo she received in Auschwitz II-Birkenau. She shows her tattoo. She focuses on the woman who gave her the tattoo and instructed her on how to prevent swelling. <i>Audio detail:</i> “remembers when tattooed her, young woman hands shaking, looked at TF AND told her she'd give her a small number so it wouldn't be noticeable after war, took time to talk to her, told her to memorize it, would be called by number and not name, told her how to take care of tattoo.” |
| Contradictory contrast (2) | Food items as birthday gifts from a female guard <i>Audio detail:</i> “We had to pick potatoes from ground and load them onto trains. If you didn't work fast enough, the Guards had dogs that would bite you. That was one day when I was there. I turned 19 here in October. I told the girls and when the SS woman saw the commotion, she called me to her and gave me two lumps of sugar. I told my children this story. I was relieved I wasn't punished. I saw those who the dogs bit.” |
| Note | These segments provide contrasting examples in contradictory to the topic of “Abusive female personnel”. |

13.7 [Evaluation]

The empirical data analyses of the clinical dataset introduced sub-categories of *Limitation*, *Criterion/Standard* used as baseline for evaluation, and *Comparative evaluation* studies in clinical medicine.

[Evaluation] is based on comparison either to a standard or to an alternative, e.g., *Medical trial*, a type of *Comparative evaluation*, is an evaluation between optional treatments or between treatment and placebo/no-treatment; likewise, *Significance* or *Limitation* is concluded on comparing the effect of current solution to alternative or certain standard or baseline which may not be explicitly stated.

- . **Significance**
- . **Limitation** (M¹¹)
- . **Criterion/Standard** (M)
- . **Comparative evaluation** (M)
 - . . Medical trial (M)
 - . . Prevalence study (M)

¹¹ M: Indication of new relevance categories introduced through analyzing *medical* dataset; H: Indication of new relevance categories introduced through analyzing oral *history* dataset; I: Indication of new relevance categories introduced through analyzing *image* tags.

13.7.1 Significance

| | |
|---|---|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Significance | Stimulant medication therapy (Table) is the most effective treatment for attention deficit/hyperactivity disorder (ADHD) in children, producing significant improvements in symptoms and modest improvements in academic achievement. |
| Significance; Comparative evaluation | Nonpharmacologic therapies, such as behavior therapy, school-based interventions, and family therapy, are not as effective as stimulants but may add modest benefit to the effects of medication. |

| | |
|-------------------------------------|---|
| Question | Is the ThinPrep better than conventional Pap smear at detecting cervical cancer? |
| Topic | Cervical cancer |
| Evaluation; Significance | The ThinPrep is a cost-effective screening tool if used at 3-year intervals. |

| | |
|---------------------|---|
| Question | What are the indications for evaluating a patient with cough for pertussis? |
| Topic | Pertussis |
| Significance | In the future, booster immunization of older children and young adults with acellular vaccine may impact the epidemiology of pertussis in the US. |

| | |
|-------------------------------------|---|
| Question | How would you manage a woman with brownish discharge from one of her breasts? |
| Topic | Breast cancer |
| Evaluation; Significance | Cytology of the nipple discharge is rarely useful. |
| Note | The significance of cytology is negative. |

13.7.2 Limitation

| | |
|-------------------------------------|--|
| Question | What are the causes of hypomagnesemia? |
| Topic | Hypomagnesemia |
| Evaluation; Significance | Magnesium in the 0.5 to 0.7 mmol/L range may be life-threatening in certain disease contexts, such as acute myocardial infarction or congestive heart failure, where there is already a risk of fatal arrhythmia. |
| Note | The significance of the condition, not the medication. |
| Prevalence study | A study of 11,000 white urban Americans aged 45 to 64 years (probability sampling) found 2.5% with magnesium <0.7 mmol/L and 5% with magnesium <0.75 mmol/L; |
| Limitation | In general, studies are limited by variations in analytic techniques and differences in defining the lower limit for normal serum magnesium |

| | |
|--------------------|---|
| Question | Does a Short Symptom Checklist Accurately Diagnose ADHD? |
| Topic | ADHD in children |
| Evaluation | The DSM-IV SNAP checklist (available at www.adhd.net/snap-iv-form.pdf ; scoring at www.adhd.net/snap-iv-instructions.pdf), based on the newer diagnostic criteria, has not been adequately evaluated. |
| Note | Not being fully evaluated is one aspect of evaluation. |
| *Limitation | Gather data from multiple sources, Sorting out children with ADHD, bipolar disorder, or learning disabilities from lively or distractible children is not a simple matter. Often the objective rating scales miss the more passive, less disruptive, inattentive ADHD children while over-diagnosing high-energy children as having ADHD. |

13.7.3 Criterion / Standard

| | |
|---------------------------|--|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Criterion/Standard | The effect size from stimulant medication in these studies averaged 0.8 for symptom relief and between 0.4 and 0.5 for academic achievement. (Effect size is the difference between the means of the experimental and control groups expressed in standard deviations. An effect size of 0.2 is considered small, 0.5 is medium, and 0.8 is considered moderate to large.) |

| | |
|---------------------------|--|
| Question | Does a Short Symptom Checklist Accurately Diagnose ADHD? |
| Topic | ADHD in children |
| Criterion/Standard | Typically, the gold standard was a clinical diagnostic interview, usually conducted by a clinical psychologist, as well as supporting data from schools and parents. |

13.7.4 Comparative Evaluation

| | |
|---|--|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Significance; Comparative evaluation | Nonpharmacologic therapies, such as behavior therapy, school-based interventions, and family therapy, are not as effective as stimulants but may add modest benefit to the effects of medication. |
| Medical trial; Comparative evaluation; Research design | <p>A large randomized trial of 579 children with ADHD (20% girls) aged 7 to 9.9 years compared outcomes of 4 treatment strategies: stimulant medication, intensive behavioral treatment, combined stimulant medication and behavioral interventions, and standard community care. All children met the DSM-IV criteria for ADHD Combined Type (the most common type of ADHD in this age group). The stimulant medication strategy included an initial dose titration period followed by monthly 30-minute visits. Intensive behavioral treatment involved child, parent, and school personnel components of therapy. Combination therapy added the regimens for medication and behavioral treatment together. Standard community care consisted of usual (nonsystematic) care, evaluated at 6 different sites.</p> <p>After 15 months of treatment, children in the medication group and the combined treatment groups showed more improvement in ADHD symptoms than children given intensive behavioral treatment or those who received standard community care. When combined with medication, those treated with behavioral therapy showed slight improvement in social skills, anxiety, aggression, oppositional behavior, and academic achievement over medication alone. At the conclusion of the study, 74% of the 212 children on medication were successfully maintained on methylphenidate alone, 10% required dextroamphetamine, and no children required more than one medication. This study found that higher doses of medication with more frequent office follow-up and regular school contact were important features of successful treatment. Only 40% of families were able to complete the intensive behavioral therapy.</p> |

13.8 [Method / Solution]

This category addresses the methodological aspects regarding a topic. It covers *Method/Approach*, *Instrument*, and *Technique/Style*. *Solution* is more generic, which can be a Method, a technique, or an instrument.

[Method / Solution] is a relevance category whose definition is highly domain-specific. In other words, this relevance type applies to various subject domains meaning different things. In clinical medicine, “method” is often referred to *Medical treatment* (e.g., “Stimulant medication therapy”, “topical acyclovir 5% cream applied 5 times a day”) or *Diagnostic method* (e.g., “ThinPap”, “ACTeRS scales”); whereas in fine arts, “method” is often defined by *Style or Genre*, as further discussed with illustration later in the section.

- . **Method or instrument**
 - . . Method / Approach
 - . . . Guideline (M¹²)
 - . . . Research design (M)
 - . . . Medical treatment (M)
 - . . . Diagnostic method (M)
 - Diagnostic indicator (M)
 - . . Instrument
 - . . . Material / Medium (I)
- . **Technique or style**
 - . . Technique
 - . . Style / Genre (I)
 - . . . Design / Composition (I)
 - . . . Detail (I)

¹² M: Indication of new relevance categories introduced through analyzing *medical* dataset; H: Indication of new relevance categories introduced through analyzing oral *history* dataset; I: Indication of new relevance categories introduced through analyzing *image* tags.

. **Solution**

13.8.1 Method / Approach

| | |
|------------------------|---|
| *Topic | Survivors' impact on their children and grandchildren |
| Method/Approach | MV reflects on her wartime experiences and remembers anti-Semitic epithets directed against her by Ukrainians in Mogilev-Podol'skii. She explains that she is giving her testimony for the benefit of her children and grandchildren. |
| Note | Giving testimony is a method/approach to affect or benefit her children and grandchildren (topic). |

| | |
|------------------|---|
| *Question | Does a Short Symptom Checklist Accurately Diagnose ADHD? |
| Topic | ADHD in children |
| Guideline | Information from ACTeRS scales has helped me treat these children, but I prefer to have both parents, if possible, independently complete the form. Obtaining scales from a Special Education teacher or psychologist, when available, in addition to the primary classroom teacher, is invaluable. |

| | |
|------------------|--|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Guideline | The American Academy of Pediatrics recommends that clinicians: 1) manage ADHD as a chronic illness, 2) collaborate with parents, the child, and school personnel to define specific desired outcomes, 3) use stimulant or behavioral therapy to improve these outcomes; if one stimulant is not effective at the highest feasible dose, try another, 4) reevaluate the diagnosis, treatment options, adherence, and possible coexisting conditions if treatment is not achieving the desired outcomes, and 5) follow-up regularly with parents, child, and teachers to monitor for progress and adverse effects. |

| | |
|---|--|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Medical trial; Comparative evaluation; Research design | <p>A large randomized trial of 579 children with ADHD (20% girls) aged 7 to 9.9 years compared outcomes of 4 treatment strategies: stimulant medication, intensive behavioral treatment, combined stimulant medication and behavioral interventions, and standard community care. All children met the DSM-IV criteria for ADHD Combined Type (the most common type of ADHD in this age group). The stimulant medication strategy included an initial dose titration period followed by monthly 30-minute visits. Intensive behavioral treatment involved child, parent, and school personnel components of therapy. Combination therapy added the regimens for medication and behavioral treatment together. Standard community care consisted of usual (nonsystematic) care, evaluated at 6 different sites.</p> <p>After 15 months of treatment, children in the medication group and the combined treatment groups showed more improvement in ADHD symptoms than children given intensive behavioral treatment or those who received standard community care. When combined with medication, those treated with behavioral therapy showed slight improvement in social skills, anxiety, aggression, oppositional behavior, and academic achievement over medication alone. At the conclusion of the study, 74% of the 212 children on medication were successfully maintained on methylphenidate alone, 10% required dextroamphetamine, and no children required more than one medication. This study found that higher doses of medication with more frequent office follow-up and regular school contact were important features of successful treatment. Only 40% of families were able to complete the intensive behavioral therapy.</p> |

13.8.2 Technique or Style

The topical category of “Style or genre” is heavily used in the analysis of image tags, which further enriched the category by introducing two sub-categories of “Design/Composition” and “Detail”. The following image shown in Figure 12-17 is a good example to illustrate the different emphases of these style-related categories:

- **Style or genre:** the emphasis is *general*, broad, and inclusive
 - **Design or composition:** emphasize the *global* features of an image
 - **Detail:** focuses on the *local* features of an image, e.g., raking light



Figure 12-17 The Martyrdom of Saint Bartholomew.
Artist: Jusepe de Ribera. 1634. Spanish. (ID: 207)

| *Tags | Indication of the tags | Relevance code |
|---|---|---|
| Christian symbolism, Baroque art, Spanish art –17 th Century, European, | General style or genre of the artwork | [Style or Genre] |
| X-shaped composition, Diagonal composition, Chiaroscuro, | The global design or composition of the artwork | [Style or Genre] Design or Composition |
| raking light | The local stylish feature of the artwork | [Style or Genre] Detail |

13.9 [Purpose / Motivation]

Motivation and *Purpose/Goal* correspond to *Cause* and *Effect*. In a sense, *Motivation* gives the volitional cause for the topic or event, whereas *Purpose/Goal* provides the effect or end result to achieve.

- . **Purpose**

- . . Used for (M)

- . . Goal

- . **Motivation**

13.9.1 Purpose

| | |
|----------------|---|
| *Topic | Sobibor death camp |
| Purpose | JF remembers that he avoided being selected for transfer to Sobibor with the help of Bernard Falkenberg. JF recalls how he found out that Sobibor was built for extermination purposes. |

| | |
|--------------------------|---|
| *Question | What is the most effective treatment for ADHD in children? |
| Topic | ADHD in children |
| Purpose: Used for | Atomoxetine, a specific norepinephrine reuptake inhibitor, is an FDA-approved alternative to stimulants for ADHD treatment in children and adolescents. |

| | |
|----------------------|--|
| Question | Does acyclovir help herpes simplex virus cold sores if treatment is delayed? |
| Topic | HSV |
| Purpose: Goal | The clearest indication of appropriate timing for HSV 1 treatment with acyclovir comes from a well-designed, double-blinded RCT of 174 adults with a history of culture confirmed HSV labialis who initiated self-treatment with acyclovir 400 mg or placebo 5 times a day for 5 days. |
| Note | Indication of the purpose of the medical trial. |

13.9.2 Motivation

***Topic** Children removed from their parents

Motivation *Audio detail:* “There was a whole organization with students who helped to bring the children to safe hiding places, volunteers who wanted to hide Jewish children during the war, really dangerous because they could have been killed. People had mixed motives. There were quite a few couples who didn't have children. It was different in those days to get an adopted child. It was a good opportunity, if they were some Jews children and hopefully or not if the parents didn't return they could keep the child. They wanted as young as possible very often. They didn't always get what they wanted. There was a big demand for big girls, they fitted very well, certainly in the North of Holland people were blond and blue eyed and it would be less obvious if you mixed them with the rest of children; also dark little Jewish boys hidden, boys were more dangerous because of circumcision.”

Note This passage reveals the motivations for adopting Jewish children during the war.

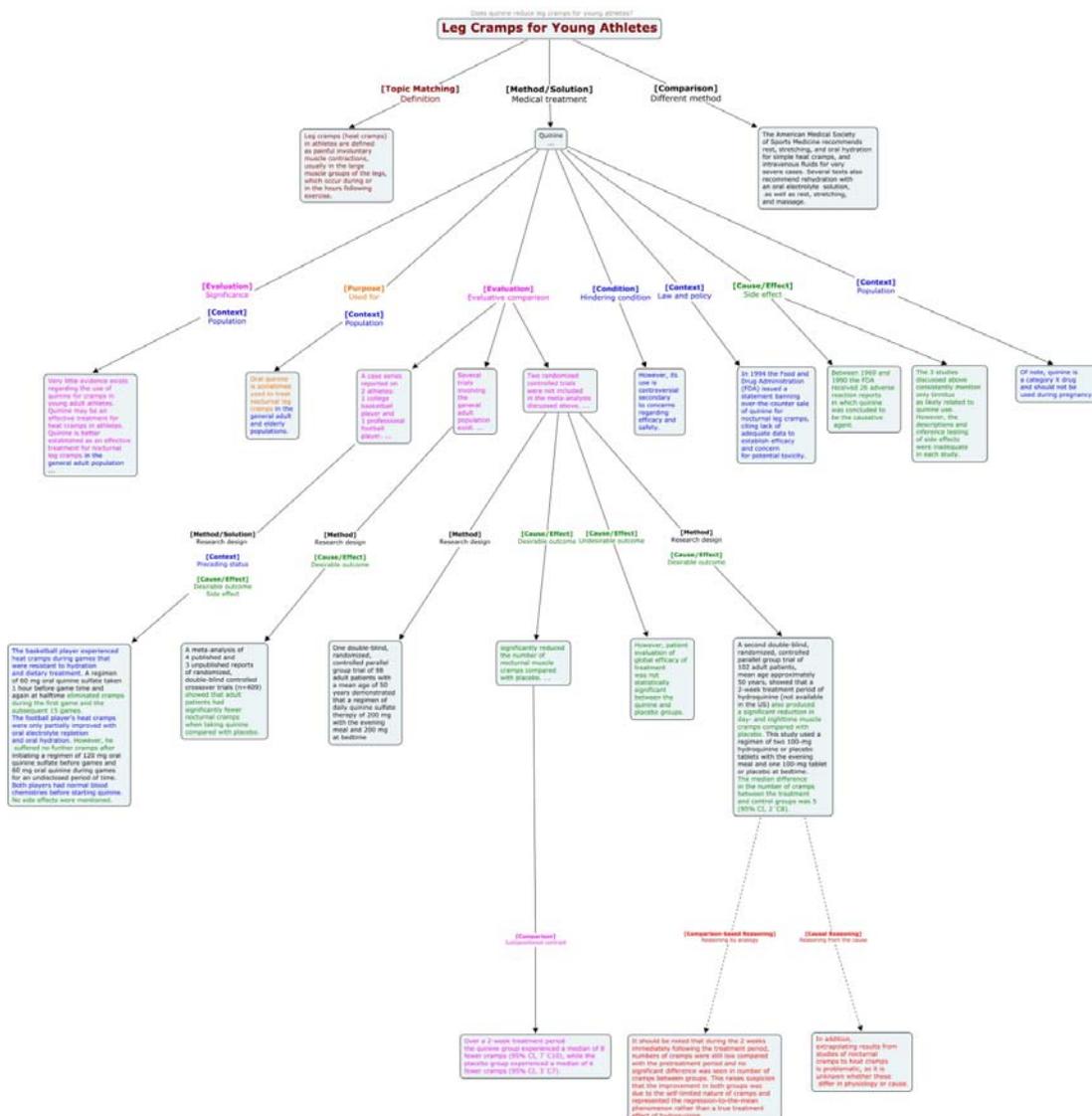
Appendix E: Full Coding Maps of Clinical Answers

Given the limited space, the full coding maps of four clinical answers are not displayed in Chapter 12. They are presented in the following:

ID 1005: Does Quinine Reduce Leg Cramps For Young Athletes?

The Journal of Family Practice, January 2005, Vol. 54, No. 1

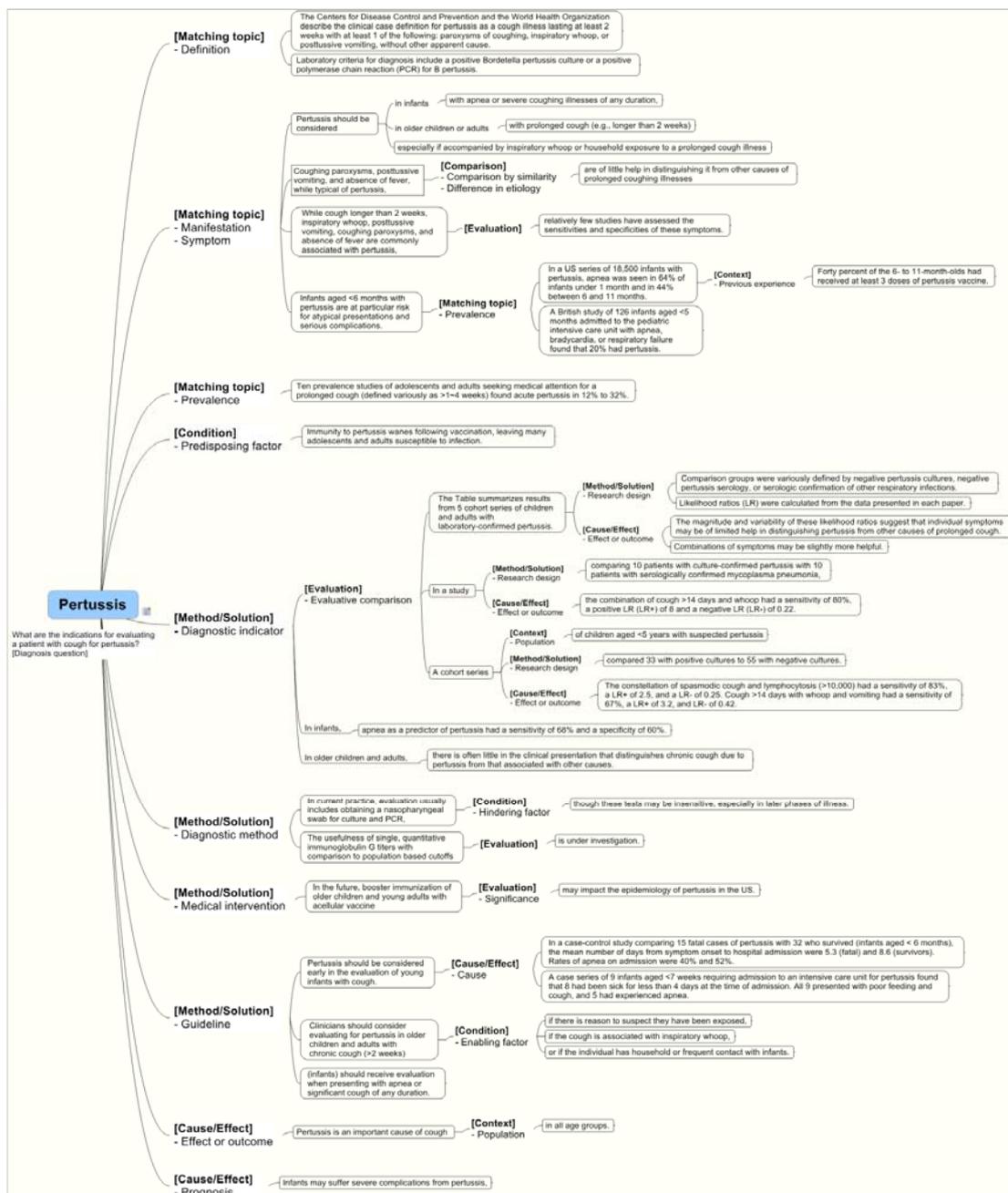
http://www.jfponline.com/content/2005/01/jfp_0105_00076.asp



ID 2001: What are the indications for evaluating a patient with cough for pertussis?

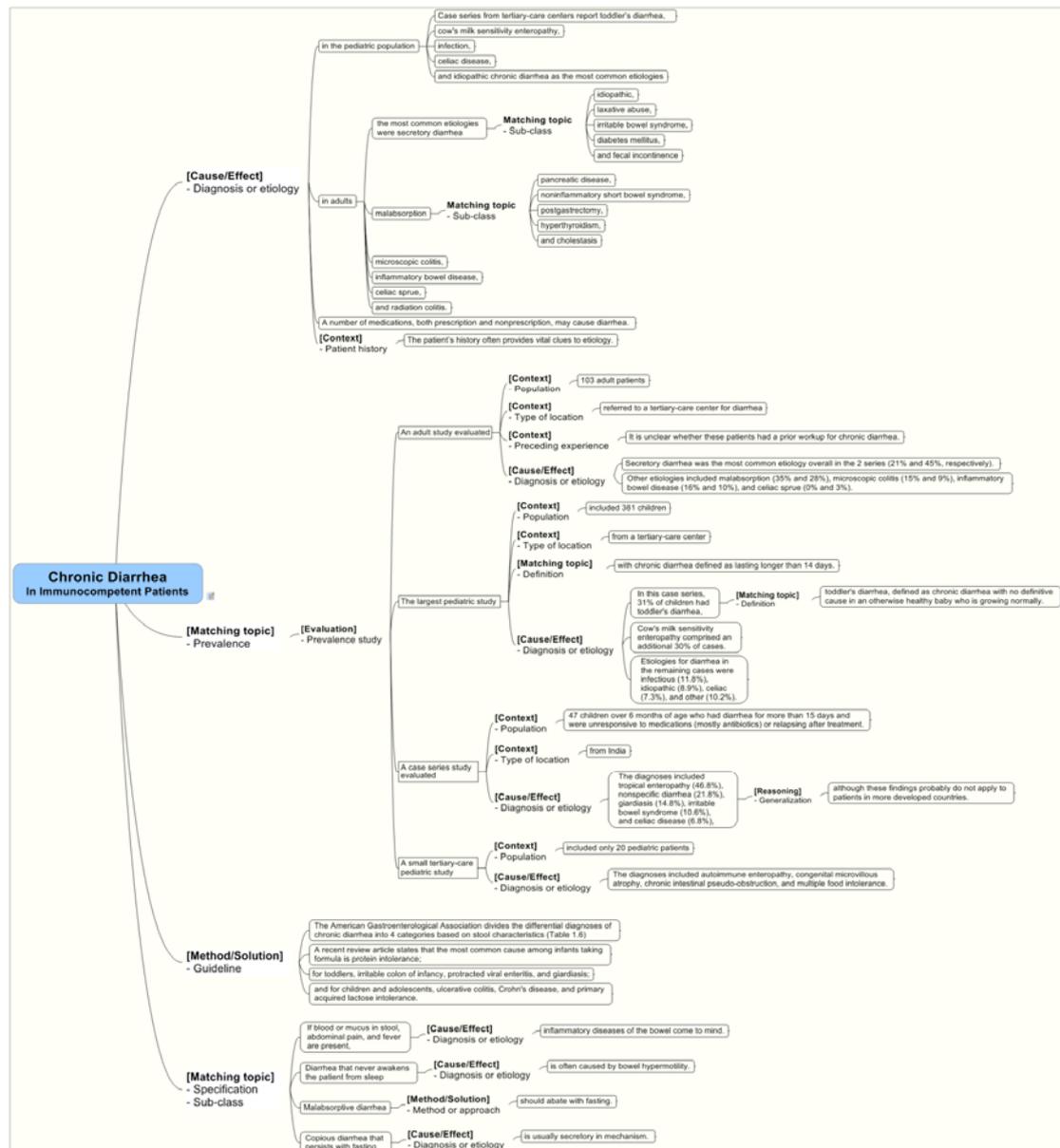
The Journal of Family Practice, January 2005, Vol. 54, No. 1

http://www.jfponline.com/content/2005/01/jfp_0105_00074.asp



ID 2008: What is the differential diagnosis of chronic diarrhea in immunocompetent patients? The Journal of Family Practice, MARCH 2002, Vol. 51, No. 3

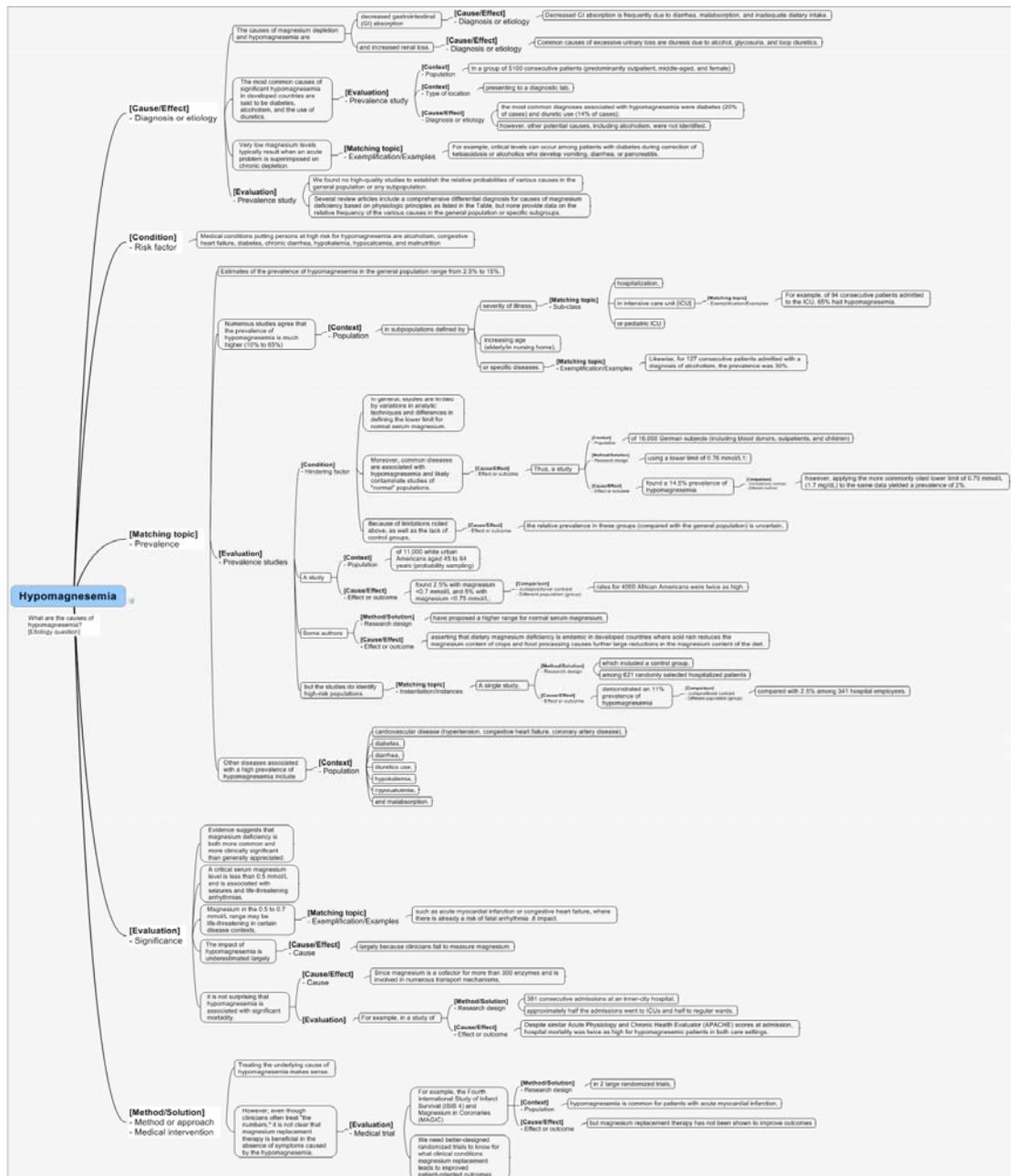
http://www.jfponline.com/content/2002/03/jfp_0302_0268c.asp



ID 4001: What are the causes of hypomagnesemia?

The Journal of Family Practice, February 2005, Vol. 54, No. 2

http://www.jfponline.com/content/2005/02/jfp_0205_00174.asp



Appendix F: CLiMB Art Image Tags Analysis

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|---|---|-------------------|-------------------|--|
| 203 | blend of Byzantine and Western elements | 1 | Method/Style or Genre; Comparison: Classification | | | Set:: Member | Reasoning/Generic inference: Assign to a class |
| 203 | Byzantine Art, Byzantine | 1 | Method/Style or Genre; Comparison: Classification | | | Set:: Member | Reasoning/Generic inference: Assign to a class |
| 203 | Western perspective | 1 | Method/Style or Genre; Comparison: Classification | | | Set:: Member | Reasoning/Generic inference: Assign to a class |
| 203 | Western patron | 1 | Method/Style or Genre; Comparison: Classification | Context/Biographic info/Sponsor | | Set:: Member | Reasoning/Generic inference: Assign to a class |
| 203 | Greek | x | Context/Biographic info/Artist | | | | |
| 203 | Italy | x | Context/Biographic info/Nationality or original area | | | | |
| 203 | c13th, thirteenth century | x | Context/Biographic info/Time or period*** | | | | |
| 203 | Late medieval | x | Context/Time or period; Context/Biographic info | Method/Style or Genre; Comparison: Classification | | Set:: Member | Reasoning/Generic inference: Assign to a class |
| 203 | cake | | | | | | |
| 203 | child | 2 | Matching topic/Image content/Focal (Reference) | | | Part::Whole | |
| 203 | Jesus Christ, jesus, Christ, infant Christ, | 2 | Matching topic/Image content/Focal (Reference) | | | Part::Whole | Reasoning/Generic inference: Assign to a class |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|-----------------|---|--------------|---|--|--------------------------|-----------------------------------|--|
| 203 | Christ blessing, sign of blessing, blessing, | 2 | Matching topic/Image content/Focal (Elaboration: Adv. attribute) | | | Part::Whole; Adv. Attribute | Reasoning/Generic inference: Assign to a class |
| 203 | Hodegetria-the Virgin, Queen of Heaven, Virgin Mary, Hodegetria, madonna, Madonna and Child, Mary, | 2 | Matching topic/Image content/Focal (Reference) | | | Part::Whole | Reasoning/Generic inference: Assign to a class |
| 203 | Seated Madonna | 2 | Matching topic/Image content/Focal (Elaboration: Adv. attribute) | | | Part::Whole; Adv. Attribute | Reasoning/Generic inference: Assign to a class |
| 203 | seated | 1 | Matching topic/Image content/Focal (Elaboration: Adv. attribute) | | | Adv. Attribute | |
| 203 | the Hodegetria-the Virgin who, by indicating the Child, "shows the way." | 2 | Matching topic/Image content/Focal (Interpretation) | Matching topic/Image content/Focal (Elaboration: Adv. attribute) | | Part::Whole; Adv. Attribute | Reasoning/Generic inference: Assign to a class |
| 203 | Virgin's throne, throne, | 2 | Matching topic/Image content/Peripheral (Reference) | | | Part::Whole | Reasoning/Generic inference: Assign to a class |
| 203 | Saints | 2 | Matching topic/Image content/Peripheral (Reference) | | | Part::Whole | Reasoning/Generic inference: Assign to a class |
| 203 | halo, halos, | 2 | Matching topic/Image content/Peripheral (Reference) | | | Part::Whole | Reasoning/Generic inference: Assign to a class |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|-----------------|--|--------------|---|---|--------------------------|-----------------------------|--|
| 203 | imperial regalia | 2 | Matching topic/Image content/Peripheral (Reference) | | | Part::Whole | |
| 203 | Drapery (garments) | 1 | Matching topic/Image content/Peripheral (Reference) | | | Part::Whole | |
| 203 | delicate gold striations defining the folds of cloth; gold striations defining the folds of cloth, | 1 | Method/Style or Genre/Detail | Matching topic/Image content/Peripheral (Elaboration: Adj. attribute) | | Part::Whole; Adj. attribute | |
| 203 | Gold background | 1 | Method/Style or Genre/Design or composition | Matching topic/Image content/Peripheral (Reference) | | Part::Whole | |
| 203 | icon | 3 | Purpose/Used for; Comparison: Classification | Method/Style or Genre; Comparison: Classification | | Set:: Member | Reasoning/Generic inference: Assign to a class |
| 203 | religious | 2;3 | Matching/Theme; Comparison: Classification | Purpose/Used for; Comparison: Classification | | Set:: Member | Reasoning/Generic inference: Assign to a class |
| 203 | Hieratic image | 3 | Purpose/Used for; Comparison: Classification | | | Set:: Member | Reasoning/Generic inference: Assign to a class |
| 203 | Devotional image | 3 | Purpose/Used for; Comparison: Classification | Method/Style or Genre; Comparison: Classification | | Set:: Member | Reasoning/Generic inference: Assign to a class |
| 203 | Personal devotion | 3 | Purpose/Used for; Comparison: Classification | Context/Biographic info/Sponsor | | Set:: Member | Reasoning/Generic inference: Assign to a class |
| 203 | Painting | 1 | Method/ technique | | | Set:: Member | Reasoning/Generic inference: Assign to a class |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|-----------------------------|-------|--|--|-------------------|-------------------|--|
| 204 | boy; child; children; | 2 | Matching topic/Image content/Focal (Reference) | | | Part::Whole | Reasoning/Generic inference: Assign to a class |
| 204 | mother and child | 2 | Matching topic/Image content/Focal (Reference) | | | Part::Whole | Reasoning/Generic inference: Assign to a class |
| 204 | woman; women; | 2 | Matching topic/Image content/Focal (Reference) | | | Part::Whole | Reasoning/Generic inference: Assign to a class |
| 204 | embraces | 2 | Matching topic/Image content/Focal (Elaboration: Adv. Attribute) | | | Adv. Attribute | |
| 204 | costume | 2 | Matching topic/Image content/Peripheral (Reference) | | | Part::Whole | |
| 204 | head coverings | 2 | Matching topic/Image content/Peripheral (Reference) | | | Part::Whole | |
| 204 | gloves | 2 | Matching topic/Image content/Peripheral (Reference) | | | Part::Whole | |
| 204 | textiles | 2 | Matching topic/Image content/Peripheral (Reference) | | | Part::Whole | |
| 204 | jacquard | 2 | Matching topic/Image content/Peripheral (Reference) | | | Part::Whole | |
| 204 | jewelry | 2 | Matching topic/Image content/Peripheral (Reference) | | | Part::Whole | |
| 204 | cold | 3 | Effect/Reaction/Feeling | Matching topic/Image content (Elaboration: Adj. Attribute) | | Adj. Attribute | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|------------|-------|---|--|-------------------|-------------------|-------------------|
| 204 | cruel | 3 | Effect/Reaction/Feeling | Matching topic/Image content (Elaboration: Adj. Attribute) | | Adj. Attribute | |
| 204 | detached | 3 | Effect/Reaction/Feeling | Matching topic/Image content (Elaboration: Adj. Attribute) | | Adj. Attribute | |
| 204 | hardness | 3 | Effect/Reaction/Feeling | Matching topic/Image content (Elaboration: Adj. Attribute) | | Adj. Attribute | |
| 204 | elegance | 2 | Matching topic/Image content (Elaboration: Adj. Attribute) | | | Adj. Attribute | |
| 204 | elongation | 2 | Matching topic/Image content (Elaboration: Adj. Attribute) | | | Adj. Attribute | |
| 204 | lavish | 2 | Matching topic/Image content (Elaboration: Adj. Attribute) | | | Adj. Attribute | |
| 204 | opulence | 2 | Matching topic/Image content (Elaboration: Adj. Attribute) | | | Adj. Attribute | |
| 204 | wealth | 2 | Matching topic/Image content (Elaboration: Adj. Attribute) | | | Adj. Attribute | |
| 204 | red | 1 | Matching topic/Image content/peripheral (Elaboration: Adj. Attribute) | | | Adj. Attribute | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|-----------------|---|--------------|---|---|--------------------------|-----------------------------|--|
| 204 | raking light | 1; 2 | Method/Style or Genre/Detail | Matching topic/Image content/peripheral (Elaboration: Adj. Attribute) | | Part::Whole; Adj. Attribute | |
| 204 | figure | 1 | Method/Style or Genre; Comparison: Classification | | | Set:: Member | |
| 204 | group portraits; portrait; portraiture; | 1 | Method/Style or Genre; Comparison: Classification | | | Set:: Member | |
| 204 | Mannerism | 1 | Method/Style or Genre; Comparison: Classification | | | Set:: Member | |
| 204 | Florentine painting | 1 | Method/Style or Genre; Comparison: Classification | | | Set:: Member | |
| 204 | Italian art--16th Century; Italian art; | x | Method/Style or Genre; Comparison: Classification | Context/Country; Context/Time period | | Set:: Member | |
| 204 | Agnolo Bronzino; Bronzina; | x | Context/Biographic info/Artist | | | | |
| 204 | Medici court; Medici; | x | Context/Social cultural political background | | | | |
| 207 | nude body | 2 | Matching/Image content: Focal (Reference) | | | Part:: Whole | |
| 207 | old man; man; old; | 2 | Matching/Image content: Focal (Reference) | | | Part:: Whole | |
| 207 | old masters | ?? | | | | | |
| 207 | martyrdom; martyr; | 2 | Matching topic/Theme; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 207 | mystical experience; mysticism; mystical; | 2 | Matching topic/Theme; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|--|--|--|--------------------------------|--|
| 207 | biblical | 2 | Matching topic/Theme; Comparison: Classification | Context/Framework***; Context/Scope/Member::Set*** | | Member::Set | Reasoning/Generic inference: Assign to a class |
| 207 | Christ's sacrifice and crucifixion; Christ metaphor; | 2 | Comparison/Metaphor and analogy; Different experiencer; Difference in experience*** | | | | |
| 207 | Christian symbolism; symbolism; | 2 | Method/Style or genre | Matching topic/Theme; Comparison: Classification | Context/Framework***; Context/Member::Set | Set::Member | Reasoning/Generic inference: Assign to a class |
| 207 | bearded; beard; bearded man; | 2 | Matching/Image content: Focal (Elaboration: Adj. attribute) | | | Part::Whole; Adj. attribute | |
| 207 | Saint Bartholomew; St. Bartholomew; saint; saints; | 2 | Matching/Image content: Focal (Reference) | | | Part:: Whole | |
| 207 | physical anguish; anguish; | 2 | Matching/Image content: Focal (Elaboration: Adj. attribute) | | | Part::Whole; Adj. attribute | |
| 207 | intensity | 2 | Matching/Image content (Elaboration: Adj. attribute) | | | Adj. attribute | |
| 207 | profound emotion; emotional; | 2 | Matching/Image content: Focal (Elaboration: Adj. attribute) | | | Part::Whole; Adj. attribute | |
| 207 | expressive hands | 2 | Matching/Image content: Focal (Elaboration: Adv. attribute) | | | Part::Whole; Adv. Attribute | |
| 207 | gestures | 2 | Matching/Image content: Focal (Elaboration: Adv. attribute) | | | Part::Whole; Adv. Attribute | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|-----------------|--------------------------------------|--------------|--|---|--------------------------|------------------------------------|--|
| 207 | confronts | 2 | Matching/Image content: Focal (Elaboration: Adv. attribute) | | | Part::Whole; Adv. Attribute | |
| 207 | begging | ?? | | | | | |
| 207 | eyes lifted to God | 2 | Matching/Image content: Focal (Elaboration: Adv. attribute) | | | Part::Whole; Adv. Attribute | |
| 207 | executioner; executioners; | 2 | Matching/Image content: Focal (Reference) | | | Part:: Whole | |
| 207 | flayed alive; flayed; flaying; | 2 | Matching/Image content: Focal (Elaboration: Adj. attribute) | | | Part::Whole; Adj. attribute | |
| 207 | torture | 2 | Matching/Image content: Focal (Elaboration: Adj. attribute) | | | Part::Whole; Adj. attribute | |
| 207 | knife | 2 | Matching/Image content: Focal (Reference) | | | Part:: Whole | |
| 207 | whetstone | 2 | Matching/Image content: Focal (Reference) | | | Part:: Whole | |
| 207 | lurking | 2 | Matching/Image content: Peripheral (Elaboration: Adv. attribute) | | | Part:: Whole; Adv. Attribute | |
| 207 | luminous; light; | 1; 2 | Method/Style or genre/Design or composition | Matching/Image content (Elaboration: Adj. attribute) | | Adj. attribute | |
| 207 | raking light | 1; 2 | Method/Style or genre/Design or composition | Matching/Image content (Elaboration: Adj. attribute) | | Adj. attribute | |
| 207 | symbolic use of light | 1 | Method/Style or genre/Design or composition; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|---|--|-------------------|-------------------|--|
| 207 | dramatic lighting | 1; 2 | Method/Style or genre/Design or composition | Matching/Image content (Elaboration: Adj. attribute) | | Adj. attribute | |
| 207 | dark | 1; 2 | Method/Style or genre/Design or composition | Matching/Image content (Elaboration: Adj. attribute) | | Adj. attribute | |
| 207 | deep shadows; shadows; | 1; 2 | Method/Style or genre/Design or composition | Matching/Image content: Peripheral (Reference) | | Part::Whole | |
| 207 | Tenebrism | 1 | Method/Style or Genre; Comparison/Design or composition; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 207 | chiaroscuro | 1 | Method/Style or Genre; Comparison/Design or composition; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 207 | contrast | 2;1 | Matching/Image content (Elaboration: Adj. attribute) | Method/Style or genre/Design or composition | | | |
| 207 | diagonal composition; diagonals; | 1 | Method/Style or Genre; Comparison/Design or composition*** | | | | |
| 207 | dramatic composition | 1 | Method/Style or Genre; Comparison/Design or composition | | | | |
| 207 | X-shaped composition; forms a cross; cross; | 1 | Method/Style or Genre; Comparison/Design or composition*** | | | | |
| 207 | pulls the viewer into the scene | 1 | Effect/Effect or outcome*** | | | | |
| 207 | anatomy | ?? | | | | | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|--|---|-------------------|-------------------|--|
| 207 | realism; unremitting realism; | 1 | Method/Style or genre; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 207 | Jusepe de Ribera; Ribera; | x | Context/Biographic info/Artist | | | | |
| 207 | spiritual ecstasy; spirituality; | 2 | Context/Biographic info/Artist/Religious influence | Matching/Theme | | | |
| 207 | religious fervor | 2 | Context/Biographic info/Artist/Religious influence | Matching/Theme | | | |
| 207 | religious | 2; 3 | Matching/Theme; Comparison: Classification | Purpose/Used for; Comparison: Classification | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 207 | 1634; 17th century; | x | Context/Time or period | | | | |
| 207 | Baroque art; Baroque; | 1 | Method/Style or genre; Comparison: Classification | Context/Time or period | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 207 | Spanish art--17th Century; Spanish art; | 1 | Method/Style or genre; Comparison: Classification | Context/Biographi c info/Nationality or original area; Context/Time or period | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 207 | Spain; Spanish; | x | Context/Biographic info/Nationality or original area | | | | |
| 207 | European | x | Method/Style or genre; Comparison: Classification; Context/Scope/Member::S et*** | Context/Country | | Member::Set | Reasoning/Generic inference: Assign to a class |
| 207 | Italy | x | Context/Biographic info/Artist/Previous personal experience | | | | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|---|--|-------------------|-----------------------------------|--|
| 207 | Naples | x | Context/Biographic info/Artist/Previous personal experience | | | | |
| 207 | bound figures; bound; figure; | 1 | Method/Style or genre/Design or composition; Comparison: Classification | Method/Style or genre; Comparison: Classification | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 207 | painting; paintings; | 1 | Method/Technique; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 207 | influence of Caravaggio's dramatic lighting; influence of Caravaggio; influence; Caravaggio; Caravaggesque; | 1 | Method/Style or genre; | Cause*** | | | Cause-based reasoning/Inferring from earlier events*** |
| 218 | African American; african-american; African-Americans; blacks; southern blacks; | 2 | Matching/Image content: Focal (Reference) | | | Part::Whole | |
| 218 | two old fellows outside in the neighborhood | 2 | Matching/Image content: Focal (Elaboration) | | | Part::Whole | |
| 218 | man; male; men; | 2 | Matching/Image content: Focal (Reference) | | | Part::Whole | |
| 218 | person | 2 | Matching/Image content: Focal (Reference) | | | Part::Whole | |
| 218 | waiting | 2 | Matching/Image content: Focal (Elaboration: Adv. attribute) | | | Part::Whole; Adv. Attribute | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|-----------------|-----------------------------|--------------|---|--------------------------|--------------------------|-----------------------------------|--------------------------|
| 218 | sitting | 2 | Matching/Image content: Focal (Elaboration: Adv. attribute) | | | Part::Whole; Adv. Attribute | |
| 218 | thinking | 2 | Matching/Image content: Focal (Elaboration: Adv. attribute) | | | Part::Whole; Adv. Attribute | |
| 218 | women | 2 | Matching/Image content: Focal (Reference) | | | Part::Whole | |
| 218 | family | 2 | Matching/Image content (Reference) | | | Part::Whole | |
| 218 | brick | 2 | Matching/Image content: Peripheral (Reference) | | | Part::Whole | |
| 218 | chicken | 2 | Matching/Image content: Peripheral (Reference) | | | Part::Whole | |
| 218 | fence | 2 | Matching/Image content: Peripheral (Reference) | | | Part::Whole | |
| 218 | pail | 2 | Matching/Image content: Peripheral (Reference) | | | Part::Whole | |
| 218 | grass | 2 | Matching/Image content: Peripheral (Reference) | | | Part::Whole | |
| 218 | field | 2 | Matching/Image content: Peripheral (Reference) | | | Part::Whole | |
| 218 | hills | 2 | Matching/Image content: Peripheral (Reference) | | | Part::Whole | |
| 218 | window | 2 | Matching/Image content: Peripheral (Reference) | | | Part::Whole | |
| 218 | shack; house; houses; | 2 | Matching/Image content: Peripheral (Reference); Context/Physical environment | | | Part::Whole | |
| 218 | street | 2 | Matching/Image content: Peripheral (Reference); Context/Physical environment | | | Part::Whole | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|--|-------|--|---|-------------------|-----------------------------|--|
| 218 | summer | 2 | Matching/Image content: Peripheral; Context/Physical environment | | | | Inference |
| 218 | rural landscape; rural; landscape; | 1 | Method/Style or genre; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 218 | rectangles | 1 | Matching/Image content (Reference) | | | | |
| 218 | pattern | 1; 2 | Matching/Image content (Reference) | Method/Style or genre/Design or composition | | | |
| 218 | repetition | 1 | Matching/Image content (Reference) | | | | |
| 218 | color | 1 | Matching/Image content (Reference) | | | | |
| 218 | confusion | 3 | Effect/Reaction or feeling*** | Matching/Image content: Focal (Elaboration: Adj. attribute) | | Part::Whole; Adj. Attribute | |
| 218 | abstract | 3 | Effect/Reaction or feeling | Method/Style or genre; Comparison: Classification | | | Reasoning/Generic inference: Assign to a class |
| 218 | abstractions | 1 | Method/Style or genre; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 218 | impressionistic | 1 | Method/Style or genre; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 218 | jazz painting | 1 | Method/Style or genre; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 218 | Modernism | 1 | Method/Style or genre; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|--|---|-------------------|-------------------|--|
| 218 | expressionist | 1 | Method/Style or genre; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 218 | Tomorrow I May Be Far Away | 2 | Matching/Theme: Title | | | | |
| 218 | memories; memory; | 2 | Matching/Theme (Abstraction)*** | | | | |
| 218 | elevation of the everyday; everyday; | 2 | Matching/Theme (Abstraction)*** | | | | |
| 218 | motif | 2 | Matching/Theme (Abstraction) | | | | |
| 218 | African American cultural history; cultural history; | 2 | Matching/Theme; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 218 | American art--20th century; American art; | 1 | Method/Style or genre; Comparison: Classification | Context/Biographic info: Time or period | | | Reasoning/Generic inference: Assign to a class |
| 218 | 1964 | x | Context/Biographic info: Time or period | | | | |
| 218 | 20th century; c20th; Twentieth Century; | 1 | Method/Style or genre; Comparison: Classification | Context/Biographic info: Time or period | | | Reasoning/Generic inference: Assign to a class |
| 218 | African-American artists | x | Context/Biographic info: Artist; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 218 | Romare Bearden | x | Context/Biographic info: Artist | | | | |
| 218 | United States | 2 | Context/Physical environment/Country | | | | |
| 218 | mecklenburg county | 2 | Context/Physical environment/Country | | | | |
| 218 | September 2, 1911 | x | Context/Biographic info: Artist | | | | |
| 218 | childhood | x | Context/Biographic info: Artist | | | | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|-----------------|---------------------------|--------------|------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 218 | vacation | x | Context/Biographic info: Artist | | | | |
| 218 | vacations | x | Context/Biographic info: Artist | | | | |
| 218 | slavery | x | Context/Biographic info: Artist | | | | |
| 218 | Great Migration | x | Context/Biographic info: Artist | | | | |
| 218 | the Great Migration | x | Context/Biographic info: Artist | | | | |
| 218 | Jim Crow laws | x | Context/Biographic info: Artist | | | | |
| 218 | equal access | x | Context/Biographic info: Artist | | | | |
| 218 | New York City | x | Context/Biographic info: Artist | | | | |
| 218 | Harlem | x | Context/Biographic info: Artist | | | | |
| 218 | Charlotte, North Carolina | x | Context/Biographic info: Artist | | | | |
| 218 | Charlotte | x | Context/Biographic info: Artist | | | | |
| 218 | North Carolina | x | Context/Biographic info: Artist | | | | |
| 218 | Lutherville, Maryland | x | Context/Biographic info: Artist | | | | |
| 218 | Pittsburgh, Pennsylvania | x | Context/Biographic info: Artist | | | | |
| 218 | Pennsylvania | x | Context/Biographic info: Artist | | | | |
| 218 | Macklenburg | x | Context/Biographic info: Artist | | | | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|---|--|-------------------|-------------------|--|
| 218 | collage; collages; cuttings of preprinted images, hand-painted papers, foils, and fabrics; | 1 | Method/Style or genre; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 218 | magazine and newspaper cuttings | 1 | Method/Instrument/Materi al or medium | | | | |
| 218 | magazines | 1 | Method/Instrument/Materi al or medium | | | | |
| 218 | sample catalogs | 1 | Method/Instrument/Materi al or medium | | | | |
| 218 | painted papers | 1 | Method/Instrument/Materi al or medium | | | | |
| 218 | wallpaper | 1 | Method/Instrument/Materi al or medium | | | | |
| 218 | Graphite | 1 | Method/Instrument/Materi al or medium | | | | |
| 218 | Charcoal | 1 | Method/Instrument/Materi al or medium | | | | |
| 218 | Spray Paint | 1 | Method/Instrument/Materi al or medium | | | | |
| 218 | mosaic style painting | 1 | Method/Style or genre; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 218 | mosaic style collage | 1 | Method/Style or genre; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 218 | sixties collage | 1 | Method/Style or genre; Comparison: Classification | Context/Biographi c info: Time or period | | | Reasoning/Generic inference: Assign to a class |
| 218 | sixties cubism | 1 | Method/Style or genre; Comparison: Classification | Context/Biographi c info: Time or period | | | Reasoning/Generic inference: Assign to a class |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|--|-------|---|-------------------------------|-------------------|-------------------|--|
| 218 | Cubism; cubist; faceting; fracturing; perspective; | 1 | Method/Style or genre; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 218 | frontality | 1 | Method/Style or genre/Design or composition | | | | |
| 218 | Projections; Projections series; | 1 | Method/Style or genre; Comparison: Classification | Context/Scope: Member::Set | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 218 | paintngs; painting; | 1 | Method/Technique; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 218 | art reproductions | 1 | Method/Technique; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 218 | figure; figures; | 1 | Method/Style or genre; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 218 | surface manipulation | 1 | Method/Technique; Comparison: Classification | | | | |
| 218 | surface patterning | 1 | Method/Technique; Comparison: Classification | | | | |
| 218 | Mixed Media | x | Context/Biographic info: Artist | | | | |
| 218 | variety of media | x | Context/Biographic info: Artist | | | | |
| 218 | black-and-white images | x | Context/Biographic info: Artist | | | | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|--|-------------------|-------------------|-------------------|-------------------|
| 218 | watercolor, gouache, oil, painting, drawing, monotype, edition prints, photography, designs for record albums, costumes and stage sets, book illustration, and one known wood sculpture | x | Context/Biographic info: Artist | | | | |
| 219 | Dress Robes; robe; | 2 | Matching/Image content: Peripheral (Reference) | | | Part::Whole | |
| 219 | Dress wigs | 2 | Matching/Image content: Peripheral (Reference) | | | Part::Whole | |
| 219 | England | 2 | Context/Physical environment/Country*** | | | | |
| 219 | London | 2 | Context/Physical environment/Country | | | | |
| 219 | London House of Lords? House of Lords; | 2 | Matching/Image content: Peripheral (Reference); Context/Physical environment | | | | Inference |
| 219 | Architecture Coffers | 2 | Matching/Image content: Peripheral (Reference); Context/Physical environment | | | | |
| 219 | Architecture Oculi | 2 | Matching/Image content: Peripheral (Reference); Context/Physical environment | | | | |
| 219 | building | 2 | Matching/Image content: Peripheral (Reference); Context/Physical environment | | | | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|--|-------------------|-------------------|-------------------|-------------------|
| 219 | courts | 2 | Matching/Image content: Peripheral (Reference); Context/Physical environment | | | | |
| 219 | hall | 2 | Matching/Image content: Peripheral (Reference); Context/Physical environment | | | | |
| 219 | Interior public; interior; | 2 | Matching/Image content: Peripheral (Reference); Context/Physical environment | | | | |
| 219 | Fittings Curtains | 2 | Matching/Image content: Peripheral (Reference); Context/Physical environment | | | | |
| 219 | black shields | 2 | Matching/Image content: Peripheral (Reference); Context/Physical environment | | | | |
| 219 | solemn | 2 | Matching/Image content (Elaboration: Adj. attribute) | | | Adj. attribute | |
| 219 | spotlight | 2 | Matching/Image content: Peripheral (Reference) | | | | |
| 219 | male; men; | 2 | Matching/Image content: Focal (Reference) | | | Part::Whole | |
| 219 | Earl of Chatham, William Pitt; William Pitt the Elder; Earl of Chatham; 1st Earl of Chatham; earl; chatham; Pitt; | 2 | Matching/Image content: Focal (Reference) | | | Part::Whole | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|-----------------|--|--------------|--|--------------------------------------|--------------------------|--------------------------|--|
| 219 | one of Britain's leading political moderates | 2 | Matching/Image content: Focal (Elaboration: Adj. Attribute) | | | Part::Whole | |
| 219 | Death scenes; death; | 2 | Matching/Theme | | | | |
| 219 | illness | 2 | Matching/Image content: Focal (Elaboration: Adj. Attribute) | | | Adj. Attribute | |
| 219 | dying | 2 | Matching/Image content: Focal (Elaboration: Adj. Attribute) | | | Adj. Attribute | |
| 219 | doctor | 2 | Matching/Image content: Peripheral (Reference) | | | Part::Whole | |
| 219 | debate | 2 | Matching/Image content (Elaboration: Adv. attribute) | | | Adv. Attribute | |
| 219 | fifty-five noblemen; noblemen; | 2 | Matching/Image content: Focal (Reference) | | | | |
| 219 | group; party; | 2 | Matching/Image content: Focal (Reference) | | | | |
| 219 | political figures; politicians; politician; statesman; | 2 | Matching/Image content: Focal (Reference) | | | | |
| 219 | politics | 2 | Matching/Theme | | | | |
| 219 | American War of Independence; War of Independence; | 2 | Context/Political context | | | | |
| 219 | American after Brit subject | 2 | Matching/Theme | | | | |
| 219 | aristocracy | 2 | Context/Political context | | | | |
| 219 | colonialism | 2 | Context/Political context | | | | |
| 219 | oil painting | 1 | Method/Technique; Comparison: Classification | Method/Instrument/Material or medium | | Set::Member | Reasoning/Generic inference: Assign to a class |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|--|-------|---|-------------------|-------------------|-------------------|--|
| 219 | paintings | 1 | Method/Technique; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 219 | preliminary compositional sketch; sketch; Painting oil/pencil sketch; | 1;3 | Method/Style or genre; Comparison: Classification | Purpose/Used for | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 219 | squaring; Painting with pencil grid; | 1 | Method/Technique; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 219 | stroke | 1 | Method/Style or genre/Detail | | | | |
| 219 | technique | 1 | Method/Technique | | | | |
| 219 | engraving | 1 | Method/Technique; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 219 | Portraits Group; figures; portrait; | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 219 | Neo-classical | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 219 | 7 April 1778; 7th April 1778; c18th; | 2 | Context/Time or period | | | | |
| 219 | 18th English | 2 | Context/Time or period; Context/Country | | | | |
| 219 | American Historical Drawing; American Historical Print; Historical Painting 18th c.; | 2 | Matching/Theme; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|-----------------------------------|-------|---|---|-------------------|-----------------------------------|--|
| 219 | American; America; | x | Context/Biographic info/Nationality or original area | | | | |
| 219 | Boston | x | Context/Biographic info/Nationality or original area | | | | |
| 219 | Europe | x | Context/Biographic info/Artist/Previous experience | | | | |
| 219 | John Singleton Copley; Copley; | x | Context/Biographic info: Artist | | | | |
| | | | | | | | |
| \$\$\$ | \$\$\$\$\$ | | | | | | |
| 222 | boy | 2 | Matching/Image content: Focal (Reference) | | | Part::Whole | |
| 222 | boat; Boats; canoe; | 2 | Matching/Image content: Peripheral (Reference) | | | Part::Whole | |
| 222 | stag; dear; deer; | 2 | Matching/Image content: Focal (Reference) | | | Part::Whole | Reasoning/Generic inference: From part to whole*** |
| 222 | horns | 2 | Matching/Image content: Focal (Reference) | | | Part::Whole | |
| 222 | hound; dog; | 2 | Matching/Image content: Focal (Reference) | | | | |
| 222 | hunting; hunt; hunter; | 2 | Matching/Image content: Focal (Elaboration: Adv. attribute) | | | Part::Whole; Adv. Attribute | |
| 222 | Hound Hunter | 2 | Matching/Theme: Title | Matching/Image content: Focal (Reference) | | Part:: Whole | |
| 222 | river; stream; | 2 | Matching/Image content: Peripheral (Reference); Context/Physical environment | | | Part::Whole | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---------------------------------------|-------|--|---|-------------------|-------------------|--|
| 222 | autumn | 2 | Matching/Image content: Peripheral; Context/Physical environment | | | | |
| 222 | foliage | 2 | Matching/Image content: Peripheral (Reference); Context/Physical environment | | | | |
| 222 | nature | 2 | Matching/Theme; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 222 | cruelty | 3 | Reaction or feeling*** | | | | |
| 222 | humanity | 3 | Reaction or feeling*** | | | | |
| 222 | figure | 1 | Method/Style or genre; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 222 | Painting | 1 | Method/Technique; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 222 | watercolor | 1 | Method/Style or genre; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 222 | 19th century | x | Context/Time or period | | | | |
| 222 | impressionist | 1 | Method/Style or genre; Comparison: Classification | | | | Reasoning/Generic inference: Assign to a class |
| 222 | American | x | Context/Biographic info: Nationality or origin area | Method/Style or genre; Comparison: Classification | | | Reasoning/Generic inference: Assign to a class |
| 222 | technical | 1 | Method/Technique | | | | |
| 222 | antlers | x | Context/Subsequent processing*** | | | | |
| 222 | Homer, Winslow; Homer; Winslow; | x | Context/Biographic info: Artist | | | | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|--|---|-------------------|-------------------|--|
| 222 | recluse | x | Context/Biographic info: Artist | | | | |
| 222 | Adirondacks; Adironacks; | 2 | Context/Physical environment | | | | |
| 222 | Caribbean | x | Context/Biographic info: Artist | | | | |
| | | | | | | | |
| \$\$\$ | \$\$\$\$\$ | | | | | | |
| 224 | abstract art; abstract ; abstractions; Abstract Expressionism; Abstract Expressionist, background; abstract representation; abstract painting; | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 224 | Alma Woodsey Thomas; Alba; Alma Thomas; Thomas; | x | Context/Biographic info: Artist | | | | |
| 224 | artists group she belongs to | x | Context/Biographic info: Artist | | | | |
| 224 | Washington DC, artists; Washington, DC artists; Washington, D.C.; | x | Context/Biographic info: Nationality or original area | Method/Style or genre; Comparison: Classification | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 224 | New York School? | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|-----------------|---|--------------|---|---|--------------------------|--------------------------|--|
| 224 | West Coast? | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 224 | Regionalist | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 224 | woman artist | x | Context/Biographic info: Artist | | | | |
| 224 | African American artists | x | Context/Biographic info: Artist | | | | |
| 224 | female artist (if it is); female artists; | x | Context/Biographic info: Artist | | | | |
| 224 | Shaw Junior High | x | Context/Biographic info: Artist | | | | |
| 224 | Columbus, Georgia | x | Context/Biographic info: Artist | | | | |
| 224 | American Art--20th Century; American Art--20th Century; American; | 1 | Method/Style or genre; Comparison: Classification | Context/Biographic info: Time or period | | | Reasoning/Generic inference: Assign to a class |
| 224 | contemporary | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 224 | modern; modernist; | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 224 | post-modern, | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|--|--|---|-------------------|--|
| 224 | musical composition; composition; music; song; synaesthesia; cantata; visual cantata; visual rhythm; | 2;3;1 | Matching/Theme; Comparison: by analogy*** | Effect/Reaction or feeling | Method/Style or genre/Design or composition | | |
| 224 | rhythmic arrangement; rhythmic arrangement; | 1;2;3 | Method/Style or genre/Design or composition | Matching/Theme; Comparison: by analogy*** | Effect/Reaction or feeling | | |
| 224 | Red Rose Cantata | 2 | Matching/Theme: Title | | | | |
| 224 | childhood memories; childhood impressions; | 2 | Matching/Theme (Abstraction)*** | | | | |
| 224 | painting; paintings; | 1 | Method/Technique; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 224 | wallpaper, | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 224 | pattern | 1; 2 | Matching/Image content (Reference) | Method/Style or genre/Design or composition | | | |
| 224 | leopard print | 1 | Method/Style or genre/Design or composition; Comparison: by similarity*** | | | | |
| 224 | lyrical repetition of color and shape | 1;2 | Method/Style or genre/Design or composition; Comparison: by analogy*** | Matching/Theme; Comparison: by analogy*** | | | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|--|---|-------------------|-------------------|-------------------|
| 224 | nature | 2 | Matching/Theme (Abstraction)*** | | | | |
| 224 | petals | 2 | Matching/Image content: Focal (Abstraction) *** | | | | |
| 224 | red punctuated by white intervals | 1 | Method/Style or genre/Design or composition (Reference)*** | Method/Style or genre/Design or composition | | | |
| 224 | intervals | 1 | Matching/Image content (Reference) | Method/Style or genre/Design or composition | | | |
| 224 | color | 1 | Matching/Image content (Reference) | | | | |
| 224 | red | 1 | Matching/Image content (Reference) | | | | |
| 224 | white | 1 | Matching/Image content (Reference) | | | | |
| 224 | repetition | 1 | Matching/Image content (Reference) | | | | |
| 224 | variations | 1 | Matching/Image content (Reference) | | | | |
| 224 | vertical splashes of red; vertical splashes; vertical; splashes; | 1 | Matching/Image content (Reference) | Method/Style or genre/Design or composition | | | |
| 224 | shape | 1 | Matching/Image content (Reference) | Method/Style or genre/Design or composition | | | |
| 224 | spots, | 1 | Matching/Image content (Reference) | Method/Style or genre/Design or composition | | | |
| 224 | dots | 1 | Matching/Image content (Reference) | Method/Style or genre/Design or composition | | | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|---|---|---|-------------------|--|
| 224 | lines | 1 | Matching/Image content (Reference) | Method/Style or genre/Design or composition | | | |
| 224 | brushstrokes | 1 | Method/Style or genre/Detail | | | | |
| 224 | musical | 3;2;1 | Effect/Reaction or feeling | Matching/Theme; Comparison: by analogy*** | Method/Style or genre/Design or composition | | |
| 224 | rhythmic | 3;2;1 | Effect/Reaction or feeling | Matching/Theme; Comparison: by analogy*** | Method/Style or genre/Design or composition | | |
| 224 | Harmony | 3 | Effect/Reaction or feeling | Matching/Theme (Abstract)*** | | | |
| 224 | contrast | 3 | Effect/Reaction or feeling | | | | |
| 224 | tension | 3 | Effect/Reaction or feeling | | | | |
| \$\$\$ | \$\$\$\$\$ | | | | | | |
| 225 | African Americans | 2 | Matching/Image content: Focal (Reference); Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 225 | mothers and children; woman; women; children; | 2 | Matching/Image content: Focal (Reference): | | | | |
| 225 | toys | 2 | Matching/Image content: Peripheral (Reference) | | | | |
| 225 | candlelight | 2 | Matching/Image content: Peripheral (Reference) | | | | |
| 225 | furniture | 2 | Matching/Image content: Peripheral (Reference) | | | | |
| 225 | stove | 2 | Matching/Image content: Peripheral (Elaboration: Adv. attribute) | | | | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|--|---|-------------------|-------------------|--|
| 225 | wood-burning stoves | 2 | Matching/Image content: Peripheral (Elaboration: Adv. attribute) | | | Adv. Attribute | |
| 225 | smoking | 2 | Matching/Image content: Peripheral (Elaboration: Adv. attribute) | | | Adv. Attribute | |
| 225 | pipe | 2 | Matching/Image content: Peripheral (Elaboration: Adv. attribute) | | | | |
| 225 | rag rug; rugs; | 2 | Matching/Image content: Peripheral (Elaboration: Adv. attribute) | | | | |
| 225 | domestic interiors; domestic scenes; domestic; Interior; interiors; | 2 | Matching/Theme; Comparison: Classification*** | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 225 | orderly | 2;3 | Matching/Image content (Elaboration: Adj. attribute) | Effect/Reaction or feeling | | Adj. attribute | |
| 225 | spacious | 2;3 | Matching/Image content (Elaboration: Adj. attribute) | Effect/Reaction or feeling | | Adj. attribute | |
| 225 | comfortable | 3;2 | Effect/Reaction or feeling | Matching/Image content (Elaboration: Adj. attribute) | | | |
| 225 | contentment | 3;2 | Effect/Reaction or feeling | Matching/Image content (Elaboration: Adj. attribute) | | | |
| 225 | warm | 3;2 | Effect/Reaction or feeling | Matching/Image content (Elaboration: Adj. attribute) | | | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|-----------------|----------------------------------|--------------|---|---|--------------------------|--------------------------|--|
| 225 | patterns | 1; 2 | Matching/Image content (Reference) | Method/Style or genre/Design or composition | | | |
| 225 | paintings | 1 | Method/Technique; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 225 | folk art | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 225 | naive art | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 225 | American art--Early 20th century | 1 | Method/Style or genre; Comparison: Classification | Context/Biographic info: Time or period | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 225 | Pippen | x | Context/Biographic info: Artist | | | | |
| 225 | slave quarters | x | Context/Biographic info: Artist | | | | |
| 225 | poverty | x | Context/Biographic info: Artist | | | | |
| 225 | slavery | x | Context/Biographic info: Artist | | | | |
| 225 | perseverance | x | Context/Biographic info: Artist | | | | |
| 225 | Pennsylvanian artists | x | Context/Biographic info: Nationality or original area | Method/Style or genre; Comparison: Classification | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 225 | self-taught artists | x | Context/Biographic info: Artist | | | | |
| \$\$\$ | \$\$\$\$\$ | | | | | | |
| 226 | New York City; New York; | 2 | Matching/Image content: Focal (Reference); Context/Scope: Part::whole*** | | | Whole::Part | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|--|-------|---|-------------------|-------------------|-------------------|--|
| 226 | Greenwich Village | 2 | Matching/Image content: Focal (Reference) | | | | |
| 226 | Sixth Avenue | 2 | Matching/Image content: Focal (Reference) | | | | |
| 226 | city; downtown; urban; | 2 | Matching/Image content: Focal (Reference) | | | | |
| 226 | cityscape; cityscapes; | 1 | Method/Style or genre; Comparison: Classification | | | Member::Set | Reasoning/Generic inference: Assign to a class |
| 226 | streetscapes | 1 | Method/Style or genre; Comparison: Classification | | | Member::Set | Reasoning/Generic inference: Assign to a class |
| 226 | skyscrapers | 2 | Matching/Image content (Reference) | | | | |
| 226 | skyline | 2 | Matching/Image content (Reference) | | | | |
| 226 | Woolworth Building | 2 | Matching/Image content: Peripheral (Reference)*** | | | | |
| 226 | triangular loft building | 2 | Matching/Image content: Focal (Reference) | | | | |
| 226 | flatiron | 2 | Matching/Image content (Reference) | | | | |
| 226 | commercial buildings | 2 | Matching/Image content (Reference) | | | | |
| 226 | office buildings | 2 | Matching/Image content (Reference) | | | | |
| 226 | water tower; retail water tower painting; retail; | 2 | Matching/Image content: Peripheral (Reference)*** | | | | |
| 226 | highrises | 2 | Matching/Image content: Focal (Reference) | | | | |
| 226 | buildings | 2 | Matching/Image content: Focal (Reference) | | | | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|---|-------------------|-------------------|-------------------|-------------------|
| 226 | built environment | 2 | Matching/Image content: Focal (Reference) | | | | |
| 226 | soaring | 2 | Matching/Image content: Focal (Elaboration: Adj. attribute) | | | Adj. attribute | |
| 226 | loft | 2 | Matching/Image content: Focal (Elaboration: Adj. attribute) | | | Adj. attribute | |
| 226 | elevated train tracks; tracks; elevated railways; railway; | 2 | Matching/Image content: Focal (Reference) | | | | |
| 226 | elevated train; train; trains; | 2 | Matching/Image content: Focal (Reference) | | | | |
| 226 | public transportation | 2 | Matching/Image content: Focal (Reference) | | | | |
| 226 | automobiles | 2 | Matching/Image content: Focal (Reference) | | | | |
| 226 | streetlamp | 2 | Matching/Image content: Peripheral (Reference) | | | | |
| 226 | city lighting; electrical lighting; lights; | 2 | Matching/Image content: Focal (Reference) | | | | |
| 226 | shimmering | 2 | Matching/Image content: Focal (Elaboration: Adj. attribute) | | | Adj. attribute | |
| 226 | reflections | 2 | Matching/Image content (Reference) | | | | |
| 226 | reflections off wet pavement | 2 | Matching/Image content (Elaboration: Adj. attribute) | | | Adj. attribute | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---------------------|-------|--|---------------------|-------------------|-------------------|--|
| 226 | night scenes | 2 | Matching/Image content: Focal (Reference/Summarization)***; Comparison: Classification | | | Member::Set | Reasoning/Generic inference: Assign to a class |
| 226 | night | 2 | Matching/Image content; Context/Physical environment*** | | | | |
| 226 | winter evening | 2 | Matching/Image content; Context/Physical environment*** | | | | |
| 226 | foggy | 2 | Matching/Image content (Elaboration: Adj. attribute); Context/Physical environment*** | | | Adj. attribute | |
| 226 | darkness | 2 | Matching/Image content (Elaboration: Adj. attribute); Context/Physical environment*** | | | Adj. attribute | |
| 226 | humid | 2 | Matching/Image content (Elaboration: Adj. attribute); Context/Physical environment*** | | | Adj. attribute | |
| 226 | dreary | 3 | Reaction or feeling | | | | |
| 226 | gritty | 1,3 | Method/Style or genre/Design or composition | Reaction or feeling | | | |
| 226 | steeper perspective | 1 | Method/Style or genre/Design or composition | | | | |
| 226 | combined views | 1 | Method/Style or genre/Design or composition | | | | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|--|-------|---|---|-------------------|-------------------|--|
| 226 | personal | 3 | Reaction or feeling | | | | |
| 226 | memoir | 2 | Matching/Theme | | | | |
| 226 | oil painting | 1 | Method/Technique; Comparison: Classification | Method/Instrument/Material or medium | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 226 | painting | 1 | Method/Technique; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 226 | canvas | 1 | Method/Instrument/Material or Medium | | | | |
| 226 | Realist | 1 | Method/Style or genre; Comparison: Classification | | | Member::Set | Reasoning/Generic inference: Assign to a class |
| 226 | Ash Can School | 1 | Method/Style or genre; Comparison: Classification | | | Member::Set | Reasoning/Generic inference: Assign to a class |
| 226 | American Art--20th Century; American art; | 1 | Method/Style or genre; Comparison: Classification | Context/Biographic info: Time or period | | Member::Set | Reasoning/Generic inference: Assign to a class |
| 226 | John Sloan; Sloan; | x | Context/Biographic info: Artist | | | | |
| 226 | Robert Henri | x | Context/Biographic info: Artist | | | | |
| | | | | | | | |
| \$\$\$ | \$\$\$\$\$ | | | | | | |
| 228 | apples | 2 | Matching/Image content (Reference) | | | | |
| 228 | pear | 2 | Matching/Image content (Reference) | | | | |
| 228 | watermelon | 2 | Matching/Image content (Reference) | | | | |
| 228 | melons | 2 | Matching/Image content (Reference) | | | | |
| 228 | fruit | 2 | Matching/Image content (Summarization)*** | | | Member::Set | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|---|---|-------------------|-------------------|--|
| 228 | foodstuffs | 2 | Matching/Image content (Summarization)*** | | | Member::Set | |
| 228 | wine | 2 | Matching/Image content (Reference) | | | | |
| 228 | wine carafe | 2 | Matching/Image content (Reference) | | | | |
| 228 | pewter | 2 | Matching/Image content (Reference) | | | | |
| 228 | pewter plate | 2 | Matching/Image content (Reference) | | | | |
| 228 | table | 2 | Matching/Image content (Reference) | | | | |
| 228 | interior | 2 | Matching/Image content (Reference) | | | | |
| 228 | still life; still-life; | 2 | Matching/Image content (Abstraction) | | | | |
| 228 | abundance | 3; 2 | Effect/Reaction or feeling | Matching/Theme | | | |
| 228 | melancholy | 3 | Effect/Reaction or feeling | | | | |
| 228 | style of caravaggio; Caravaggio; style; | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 228 | French | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 228 | Italian | 1 | Method/Style or genre; Comparison: Classification | Context/Biographic info: Nationality or original area | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 228 | chiaroscuro | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 228 | baroque | 1 | Method/Style or genre; Comparison: Classification | Context/Biographic info: Time or period | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 228 | naturalistic | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|---|-------|--|--------------------------------------|-------------------|-------------------|--|
| 228 | composition | 1 | Method/Style or genre/Design or composition | | | | |
| 228 | Oil painting | 1 | Method/Technique; Comparison: Classification | Method/Instrument/Material or medium | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 228 | painting | 1 | Method/Technique; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 228 | C17th | x | Context/Biographic info: Time or period | | | | |
| 228 | Pensionante del Saraceni; Carlo Saraceni; boarder of Saraceni; Saraceni; | x | Context/Biographic info: Artist | | | | |
| 228 | anonymous | x | Context/Biographic info: Artist | | | | |
| 228 | connoisseurship | x | Context/Biographic info: Artist | | | | |
| 228 | francophile | x | Context/Biographic info: Artist | | | | |
| | | | | | | | |
| \$\$\$ | \$\$\$\$\$ | | | | | | |
| 230 | Angel | 2 | Matching/Image content: Focal (Reference) | | | | |
| 230 | archangel | 2 | Matching/Image content: Focal (Reference) | | | | |
| 230 | Gabriel | 2 | Matching/Image content: Focal (Reference) | | | | |
| 230 | Annunciation | 2 | Matching/Theme *** | | | | |
| 230 | wings | 2 | Matching/Image content: Focal (Reference) | | | | |
| 230 | Brocade | 2 | Matching/Image content (Reference) | | | | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|----------|------------------|-------|---|---|-------------------|-------------------|--|
| 230 | gold leaf | 2 | Matching/Image content: Peripheral (Reference) | | | | |
| 230 | lily | 2 | Matching/Image content: Peripheral (Reference) | | | | |
| 230 | gold | 1;2 | Method/Style or genre/Design or composition | Matching/Image content: Focal (Reference) | | | |
| 230 | religious | 2;3 | Matching/Theme; Comparison: Classification | Purpose/Used for; Comparison: Classification | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 230 | figure | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 230 | Diptych | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 230 | panel | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 230 | gilded; gilding; | 1 | Method/Style or genre/Design or composition | Method/Technique | | | |
| 230 | punches | 1 | Method/Technique | | | | |
| 230 | paint | 1 | Method/Instrument/Material or medium | | | | |
| 230 | Sienna | 1 | Method/Instrument/Material or medium | | | | |
| 230 | Italian | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 230 | Italy | x | Context/Biographic info: Nationality or original area | | | | |
| 230 | Sieneese | x | Context/Social cultural background*** | Context/Biographic info: Nationality or original area | | | |

| Image ID | Tag | Level | Functional role-1 | Functional role-2 | Functional role-3 | Semantic relation | Mode of Reasoning |
|-----------------|---|--------------|---|--|--|--------------------------|--|
| 230 | Byzantine | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 230 | Gothic | 1 | Method/Style or genre; Comparison: Classification | | | Set::Member | Reasoning/Generic inference: Assign to a class |
| 230 | Renaissance; Renaissance (or whatever the proper art period would be); | x | Context/Social cultural background*** | Context/Biographi c info: Time or period | Method/Style or genre; Comparison: Classification | Set::Member | Reasoning/Generic inference: Assign to a class |
| 230 | 1333 | x | Context/Biographic info: Time or period | | | | |
| 230 | Simone Martini; Martini; | x | Context/Biographic info: Artist | | | | |

Appendix G: User Study Design

User studies will be conducted to investigate whether the typology intuitively makes sense to average users. It focuses on users and their tasks. Interviews and user studies are conducted to investigate users' reactions and interactions with the developed typology of topical relevance relationships. A formal user study on a larger scale is anticipated.

Previous Work: Qualitative Interviews of Relevance Assessors

Participants

From 2003 to 2006, 12 relevance assessors involved in the search-guided relevance assessments in the MALACH project. They were graduate students recruited from the College of Information Studies and the Department of History at the University of Maryland, College Park. Among the seven assessors who participated in the interviews, one is with library science background and works as a librarian, five are from the history department majoring in areas of European history, and one is with both backgrounds from the joint program (HiLS) between the two departments.

Data Collection

On a volunteer basis, I conducted qualitative interviews with seven of the MALACH relevance assessors. Four interviews were conducted, transcribed and analyzed in 2003, which was later published in Huang & Soergel (2004). Following the same approach but a slightly improved protocol, three additional interviews were conducted in 2006. These interviews will be transcribed and analyzed, together with findings from the earlier ones, to shed light on understanding the user's perspective on topical relevance relationships.

The MALACH relevance assessors were interviewed on their experiences and interaction with the different topical relevance relationships. The interviews were semi-structured as guided by main interview questions developed before hand. Most of the questions are open and emphasize the participants' understanding and experience of assessing multiple types of topical relevance and its subsequent impact on their daily information behavior.

The interviews were focused but open-ended communication between the interviewer and the interviewees, involving a wide range of qualitative interview techniques, such as probing for clarification and elaboration, follow-up questions to seek deeper and more thoughtful answers, filling in narrative blanks, following up on contradictions (Rubin & Rubin, 1995). All the interviews were audio-taped to capture the rich original information from the participants. Field notes were also taken along with the process of interviews.

The interview transcriptions and field notes together yield rich data for subsequent qualitative analysis.

Planned User Studies

Participants

Graduate students currently enrolled in the graduate program in the College of Information Studies at University of Maryland, College Park. This is a sample based on convenience consideration (Lindlof & Taylor, 2002).

Study Design

Part A: to explore whether the developed typology intuitively makes sense to the participant

A1 *Evaluation of using the typology to organize search results*

On an interface, the typology is used to organize a list of information items retrieved for a topic. The typology of topical relevance relationships is used here as an information organization device. The participant's feedbacks and evaluation of the typology-based result organization will be collected.

An interface mock-up for displaying search results will be developed using Microsoft Visio (a project visualization tool, see detail at http://office.microsoft.com/en-us/visio/default.aspx?nd_loc=us). The interface mock-up is built only to show search result organization and no real "search" takes place during the study. Two topics will be contrived to allow some comparisons in the participant's opinions. A Google search for the two topics will be performed before hand. For each topic, the retrieved information items are organized in two forms on the interface:

1. A run-on list provided by Google
2. Organize into relevance categories of the typology, e.g., having expandable titles indicating "Direct evidence", "Indirect evidence", "Comparison", "Context", "Evaluation", and so forth, with the results listed under these categories accordingly

After shown to both forms of result organization for the two topics, the participant will be asked to compare and evaluate the result organizations. To cancel out the order effect, experimental design will be considered by dividing participants into four groups along two dimensions:

- 1) Form of organization: run-on list /relevance category
- 2) Sequencing of the two topics

The following table shows the aspects addressed in the evaluation.

| |
|--|
| <p>Evaluate the arguments on a 5-point scale: Strongly disagree — Disagree — Neutral — Agree — Strongly agree</p> <ol style="list-style-type: none">1. Comparing the list and the relevance-category organization of the search results, which result organization do you prefer to use?<ul style="list-style-type: none">• The category result makes it easier to find a specific item that you are interested in.• Using the run-on list you can identify the interested items from the results faster.• The category result gives a better overview of what information is available for a particular topic.• You are more comfortable using the run-on list for organizing results if you are searching for an unfamiliar subject.• The category result allows you to learn more about a topic within a shorter time.• What are the pros and cons of each result organization? (open-ended question)2. How much do the result categories make sense to you?<ul style="list-style-type: none">• The categories make sense to me immediately and it does not take long for me to comprehend them.• The categories are clearly delineated.• The meaning of the categories is confusing to me.• What makes it confusing and difficult to understand? (open-ended question)• What categories are missing? (open-ended question)3. Are the result categories useful?<ul style="list-style-type: none">• The categories are helpful for organizing search results.• The categories are useful for exploring an unfamiliar subject.• How much do you think they help to structure your thinking and reasoning |
|--|

about the topic? How (open-ended question)?

- How much do you think they facilitate people's learning about unfamiliar subjects (open-ended question)?
- From your point of view, what is the value of these categories for information seeking and retrieval? (open-ended question)

In addition to the quantitative evaluation, open questions and follow-up comments, feedbacks, and suggestions are solicited from the participant.

A2 *Assignment of the topical relevance types*

Given the typology and 10 topic-information pairs, the participant will be asked to specify the topical relevance relationship (according to the typology) pertaining between the topic and the information in each pair. How well they do on the assignment task indicates the extent to which the typology makes sense to them.

The topic-information pairs need to be constructed before hand. For each topic, pieces of relevant information based on different types of topical relevance relationships is gathered or devised, e.g., context evidence and comparative evidence. A topic and related pieces of information are paired together. The specific topic relevance relationship between the topic and the information is also identified according to the typology; it will be used as the standard to evaluate the accuracy of the participant's assignments. For a given topic, there can be several pieces of relevance information paired with it, as based on different relevance relationships. The topic-information pairs will be tested in a pilot study in the fall.

Part B: to explore the effects of different topical relevance on the participant's perspectives of understanding a topic, completing a task, making a decision, or solving a problem; Part B investigates the interaction of the typology with the user and the user's task

B1 *Follow-up in-depth interviews and focus-group discussion*

The group of participants who perform the assignment task will be followed up by in-depth interviews and focus-group discussion 2~3 weeks later. They will be asked to apply the knowledge from the typology to their daily information activities and problem solving in the following 2~3 weeks after the assignment task. During this period of time, participants are also encouraged to reflect and take notes on their experience. One-hour in-depth qualitative interview will be conducted with each participant. The interviews will be guided by open questions regarding the participants' experience with applying the typology for their own tasks. In addition to the in-depth interviews, two one-hour focus-group sessions will be planned with 5~7 people for each group to elicit further insights from group interaction. Both the interviews and focus-group sessions will be audio/video taped, transcribed, and analyzed.

B2 Evaluation of non-direct-matching relevant information, with the absence of direct-matching information

The participant will be given a topic and some task scenarios associated with the topic that involve problem solving and decision making. A piece of non-direct-matching information (e.g., indirect, context, comparison) on the topic is provided to the participant. After looking at the information, the participant will be asked whether the given piece of non-direct information is helpful for dealing with the task scenarios at hand, with the absence of direct-matching information.

The rationale underlying this task is that people are already used to receiving and using relevant information that is directly matching the topic. It is known that direct relevance is well received and important for user's tasks. However, it is not known yet, with the absence of direct evidence, how other types of relevant information interact with the user and her tasks.

The effect of non-direct relevant information on the user's perception and tasks will be evaluated in a questionnaire containing both quantitative items and open-ended questions/comments. It includes the following:

- Do you know about the topic before this task? (pre-survey control question, on a 5-point scale)
- Do you think this piece of information relevant to the topic?
(on a 5-point scale)
 - In what way is it relevant to the topic? (open-ended question)
- Does the information change your knowledge/perspective on the topic? (on a 5-point scale)
 - Specifically, how does it change your understanding of the topic? (open-ended question)
- Is this information helpful for dealing with the particular task scenario?
(on a 5-point scale)
 - In what way is it useful? (open-ended question)
- Taking the task scenario into real life, will you make your decision based on the given piece of information? (on a 5-point scale)
 - If you do, how likely will you change your decision later on?
(on a 5-point scale)
- If this is the only information available on the topic, what decision will you make?
(open-ended question)
 - How confident are you of the decision? (on a 5-point scale)

The user task scenarios and topic-information pairs need to be prepared before hand.

The topic-information pairs may be re-used from the assignment task but the participant should never be exposed to the chosen topics before.

B3 *Evaluation of non-direct-matching relevant information, with the presence of direct-matching information*

Similar design to B2 task, except that direct-matching information is shown along with the topic and task scenarios and non-direct relevant information is provided to the participant as additional information. The purpose is to seek understanding of how non-direct relevant information *affects* the participant's perspective on a topic, a task, and a problem. Is the participant's overall understanding of the topic and her decision for the task *changed* by seeing more context, indirect evidence, comparative cases, etc.?

The participant will be instructed to answer a few questions before she is shown with the additional non-direct information. Accordingly, the questionnaire is revised to serve this purpose:

-----Only showing direct evidence-----

- Do you know about the topic before this task?
(pre-survey control question, on a 5-point scale)
- Do you think this piece of information relevant to the topic?
(on a 5-point scale)
 - In what way is it relevant to the topic? (open-ended question)
- Taking the task scenario into real life, will you make your decision based on the given piece of information? (on a 5-point scale)
 - If you do, how likely will you change your decision later on?

(on a 5-point scale)

- If this is the only information available on the topic, what decision will you make?

(open-ended question)

- How confident are you of the decision? (on a 5-point scale)

-----After showing additional non-direct evidence-----

- Do you think the additional information relevant to the topic?

(on a 5-point scale)

- In what way is it relevant to the topic? (open-ended question)

- Does it *affect* your earlier knowledge/perspective on the topic after you have seen the additional information? (on a 5-point scale)

- Specifically, how does it *affect* your earlier understanding of the topic? (open-ended question)

- How much does it *change* your earlier perspective?

(on a 5-point scale)

- Is the additional information helpful for dealing with the particular task scenario?

(on a 5-point scale)

- In what way is it useful? (open-ended question)

- How much does the additional information affect your earlier decision or solution for the task? (on a 5-point scale)

- How much does it affect your confidence on your earlier decision or solution, more, less, or no change in confidence?

(on a 5-point scale)

- Are you more decisive or more indecisive of the task by having the additional

information? (on a 5-point scale)

- How likely will you *revise* or *change* your decision and solution for the task by seeing this additional piece of information?

(on a 5-point scale)

- If there is any revision or change, why do you make the revision or change?

(open-ended question)

- If there is any revision or change, what is the revision and change?

(open-ended question)

If the sample of participants is big enough in B2 and B3 (over 25 each group), statistical comparisons (e.g., *t-test*, *ANOVA*) will be made between B2 group (the controlled group) and B3 group (the treatment group) on the same quantitative items in both questionnaires.

Appendix H: Theory-Grounded Typology of Topical Relevance Relationships with Definitions and Annotations

RT

- the process / mechanism involves the particular type of reasoning or primarily implemented by the particular type of reasoning;
- elements of the particular type of reasoning, e.g. classification reasons;
- specific applications of a particular type of reasoning in a domain)

ST/ ST/ ST

- definition from another literature/domain
- definition in a specific domain

..... indicates the category occurs in more than one place in the scheme

[color] indicates the main facet for the particular category

Functional role (Function-based)

▶ Matching or allowing inference on the topic

. Matching topic / direct relevance

ST Topic matching relationship [information science]{Green & Bean, 1995}

DF Three major subcategories are identified as topic matching relationships: *Reference*, *definition*, and *attributes*. Topic matching corresponds to the sole relationship type assumed by traditional content-oriented retrieval theory [information science]{Green & Bean, 1995} /DF /ST

ET (Patient) Problem [medicine]{PICO; Florance, 1992}

DF The primary problem, disease, or co-existing conditions [medicine]{PICO; Florance, 1992} /DF /ET

ET Fault [medicine]{illness script}

DF Invasion of tissue by pathogenic organism, inadequate nutrient supply, inability of tissue to survive, etc. [medicine]{illness script} /DF /ET

ET Hypothesis [communication]{Relevance theory}[medicine]{author}

DF scientific hypotheses [communication]{Relevance theory} /DF

DF diagnostic hypotheses [medicine]{author} /DF /ET

RT ^Backward inference (Abduction) /RT

RT Direct evidence /RT

RT ^Claim (Conclusion) /RT

. . Reference

ST Reference [information science]{Green & Bean, 1995}

DF the cited passage mentions or makes reference to the subject heading (user topic). This subcategory corresponds to a

general, undelineated user request—“I want to know about X”
[information science]{Green & Bean, 1995} /DF /ST

ST Image content [image meaning]{CLiMB}

DF Text that mentions the depicted object, discusses the subject matter, and describes what the artwork looks like, or contains
[image meaning]{CLiMB} /DF /ST

ST Common referent [image function]{Brody, 1984; Marsh & White, 2003}

DF the text and image share the same symbolic source of meaning
[image function]{Brody, 1984; Marsh & White, 2003} /DF /ST

Definition

ST Definition [information science]{Green & Bean, 1995}[education]{Kavale, 1980}[image function]{Ilson, 1987; Marsh & White, 2003}

DF the cited passage defines the topic of the user need and corresponds to user requests of “What is meant by X?”, or more simply, “What is X?” [information science]{Green & Bean, 1995} /DF

DF defining the purpose, function, or use of the named object or phenomenon [education]{Kavale, 1980} /DF

DF determine or identify the essential qualities or meaning [image function]{Ilson, 1987; Marsh & White, 2003} /DF /ST

RT ^Classification /RT

RT ^Generalization (Induction) /RT

Restatement

ST Restatement [rhetoric]{RST}

DF *N+S*: S restates N, where S and N are of comparable bulk; N is more central to W's purposes than S is

Effect: R recognizes S as a restatement of N

[rhetoric]{RST} /DF

EX *N*: A well groomed car reflects its owner.

S: The car you drive says a lot about you.

/EX /ST

ST Reiteration [image function]{Brody, 1984; Levin, 1981; Nikolajeva & Scott, 2000; Schriver, 1997}

DF images reinforce the text by essentially repeating its content in visual form; the image repeats substantial identical content presented in the text [image function]{Brody, 1984; Levin, 1981; Nikolajeva & Scott, 2000; Schriver, 1997} /DF /ST

Paraphrase

ST Paraphrase [education]{Revised Bloom} {Wittrock, 1989}

DF put understanding into own words [education]{Wittrock, 1989} /DF /ST

RT Interpretation /RT

Clarification

- ST Clarification [education]{Revised Bloom; Wittrock, 1989}[image function]{Hancher, 1992}
- DF the standard purpose of illustration in dictionaries [image function]{Hancher, 1992} /DF /ST
- RT Interpretation /RT
- . . . Translation
 - ST Translation [education]{Revised Bloom}[image function]{Ilson, 1987; Marsh & White, 2003}
 - DF converts from one form to another [image function]{Ilson, 1987; Marsh & White, 2003} /DF /ST
- . . . Representation
 - ST Representation [education]{Revised Bloom} [image function]{Berinstein, 1997}
 - DF graphical representation of the textual information (concepts and numbers) [image function]{Berinstein, 1997} /DF /ST
- . . . **Interpretation**
 - ST Explanation (meaning) [rhetoric]{author} /ST
 - ST Interpretation [rhetoric]{RST}[education]{Revised Bloom}[image meaning]{CLiMB}[image function]{David, 1998; Hilderley & Rafferty, 1997; Levin, 1981}
 - DF *N+S*: S relates N to a framework of ideas not involved in N itself and not concerned with W's positive regard
Effect: R recognizes that S relates N to a framework of ideas not involved in the knowledge presented in N itself
 [rhetoric]{RST} /DF
 - EX *N*: Steep declines in capital spending commitments and building permits, along with a drop in the money stock pushed the leading composite index down for the fifth time in the past 11 months...
S: Such a decline is highly unusual at this stage in an expansion.
 /EX
 - DF Changing from one form of representation (e.g., numerical) to another (e.g., verbal) (e.g., Paraphrase important speeches and documents) [education]{Revised Bloom} /DF
 - DF Text in which the author provides his or her interpretation of the work [image meaning]{CLiMB} /DF
 - DF the image organizes the text difficult to understand and provides illustrations of complex ideas in concrete form
 [image function]{David, 1998; Hilderley & Rafferty, 1997; Levin, 1981} /DF /ST
- RT Paraphrase /RT
- RT Clarification /RT
 - . . . Organization
 - ST Organization [image function]{Brody, 1984; David, 1998; Levin, 1981; Marsh & White, 2003}
 - DF images provide visual organization for the text, e.g., to illustrate procedures; the image forms into a coherent unity or functioning whole, including *advance organizers* [image

[rhetoric]{RST} /DF

EX *N*: The body of a long entertaining text on telegrams had 43 units on the subject, followed by this summary of 5 units:

S: It seems a while since there's been a neatly worded dispatch from the field. (This was followed by 4 units of elaboration.)

/EX

DF abstracting the key points and main ideas [education]{Wittrock, 1989} /DF /ST

ST Reduction / condense [image function]{Schwarcz, 1982; Marsh & White, 2003}

DF reduce to essential elements or ignore some aspects of the text in order to emphasize others [image function]{Schwarcz, 1982; Marsh & White, 2003} /DF /ST

Abstraction

ST Abstraction [education]{Revised Bloom}

DF Abstracting a general theme or major point(s) (e.g., Write a short summary of the events portrayed on a videotape)

[education] {Revised Bloom} /DF /ST

RT ^Generalization (Induction) /RT

Elaboration

ST Elaboration [rhetoric]{RST}[image meaning]{Salway et al. 2003}[image function]{Schwarcz, 1982; Schriver, 1997}

DF *N+S*: *S* presents additional detail about the situation or some element of subject matter which is presented in *N* or inferentially accessible in *N* in one or more of the ways listed below. In the list, if *N* presents the first member of any pair, then *S* includes the second: set :: member, abstraction :: instance, whole :: part, process :: step, object :: attribute, generalization :: specific

Effect: *R* recognizes *S* as providing additional detail for *N*. *R* identifies the element of subject matter for which detail is provided.

[rhetoric]{RST} /DF

EX *N*: *City*, in Sweden, will be the site of the 1969 International Conference on Computational Linguistics, September 1-4.

S1: It is expected that some 250 linguists will attend from Asia, West Europe, East Europe including Russia, and the United States.

S2: The conference will be concerned with the application of mathematical and computer techniques to the study of natural languages, the development of computer programs as tools for linguistic research, and the application of linguistics to the development of man-machine communication systems.

/EX

DF information about what can be *seen* in this image—**elaboration**;

information about what this image could *mean*—extension; and information about the *history* of this image—enhancement

[image meaning]{Salway et al. 2003} /DF

- DF the image reinforces, elaborates or instantiates the text, by adding supplementary information [image function]{Schwarcz, 1982; Schriver, 1997} /DF /ST
 - ST Image content [image meaning]{CLiMB}
 - DF Text that mentions the depicted object, discusses the subject matter, and describes what the artwork looks like, or contains [image meaning]{CLiMB}/DF /ST
 - Amplification
 - ST Amplification [image function]{Nikolajeva & Scott, 2000; Schwarcz, 1982; Stam, 1989}
 - DF the image goes into greater depth about something in the text than is explicitly stated [image function]{Nikolajeva & Scott, 2000; Schwarcz, 1982; Stam, 1989} /DF /ST
 - Extension
 - ST Extension [image meaning]{Salway et al. 2003}[image function]{Schwarcz, 1982; Brody, 1984}
 - DF information about what this image could *mean* [image meaning]{Salway et al. 2003} /DF
 - DF the image goes beyond what is presented in the text to advance a point, adding new information [image function]{Schwarcz, 1982; Brody, 1984} /DF /ST
 - Specialization or specification
 - ST Specialization or specification [education]{Rumelhart & Ortony, 1977}[image function]{Schwarcz, 1982}
 - DF instantiating the schema with special details and features of a specific case [education]{Rumelhart & Ortony, 1977} /DF
 - DF the illustration brings out information about the story embedded in the text [image function]{Schwarcz, 1982}/DF /ST
 - ST ^Generalization :: specific [rhetoric]{RST}
 - DF Elaborating the general by giving specifics /DF /ST
 - Exemplification
 - ST Exemplification [education]{Revised Bloom}[image function]{Brody, 1984; Stam, 1989; Marsh & White, 2003}
 - DF Finding a specific example or illustration of a concept or principle (e.g., Give examples of various artistic painting styles) [education]{Revised Bloom} /DF
 - DF the image presents a paragon that captures the essential meaning of a concept [image function]{Brody, 1984; Stam, 1989; Marsh & White, 2003} /DF /ST
 - ST Example [education]{Wittrock, 1989}
 - DF giving examples [education]{Wittrock, 1989} /DF /ST
 - Illustration
 - ST Illustration [education]{Revised Bloom} /ST
 - Instantiation
 - ST Instantiation [education]{Revised Bloom} /ST
 - ST ^Abstraction :: instance {RST} /ST

- ST ^Set :: member [rhetoric]{RST}
- DF Elaboration of set by member or elaboration of type by token /DF /ST
- ST ^Type :: token [information science]{Green & Bean, 1995}
- DF the user topic (as represented by a subject heading) and the topic of the cited passage are related class and class member. It corresponds to user requests such as “Give me an example of X.” [information science]{Green & Bean, 1995} /DF /ST
- ^Class :: subclass (taxonomy)
- DF Elaboration of class with subclass /DF
- ST ^Class :: subclass (taxonomy) [information science]{Green & Bean, 1995}
- DF the user topic (as represented by a subject heading) and the topic of the cited passage are related as class and subclass [information science]{Green & Bean, 1995} /DF /ST
- ^Whole :: part (partonomy)
- DF Elaboration of whole with part /DF
- ST ^Whole :: part [rhetoric]{RST} /ST
- ST ^Partonomy [information science]{Green & Bean, 1995}
- DF *Partonomy* (x is a part of y): the user topic (as represented by a subject heading) and the topic of the cited passage are in part-whole relationship, for example, what sub-activities an activity or process is composed of. It corresponds to the user request of “What does X consist of?” [information science]{Green & Bean, 1995} /DF /ST
- ^Process :: step
- DF Elaboration of process with step /DF
- ST ^Process :: step [rhetoric]{RST}[information science]{Green & Bean, 1995} /ST
- ^Object :: attribute
- DF Elaboration of object with attribute /DF
- ST ^Object :: attribute [rhetoric]{RST} /ST
- ST ^Attributes [information science]{Green & Bean, 1995}[medicine]{Florance, 1992}
- DF the cited passage expresses either adjectival or adverbial modifications of the user topic. This subcategory corresponds to such user requests as “What are the characteristics of X?” or “What is X like?” [information science]{Green & Bean, 1995} /DF /ST
- RT Definition /RT
- ^Adjectival
- ST ^Adjectival [information science]{Green & Bean, 1995} /ST
- ^Characteristics

DF An item of information I_j is relevant to a conclusion h in relation to premiss e if the degree of confirmation, or probability, of h on evidence e and I_j is greater or less than the degree of confirmation, or probability, on e alone. [information science]{Wilson, 1973} /DF /ST

RT ^Claim (Conclusion) /RT

RT +^Generic inference /RT

. **Direct evidence vs. circumstantial (indirect) evidence**

. Direct evidence

ST Direct evidence [law]{*State v Famber*, 358 Mo 288, 214 SW2d 40}

DF *Direct evidence* is testimony or other proof which expressly or straight-forwardly proves the existence of a fact. Direct evidence is evidence which, if believed, proves the existence of the fact in issue without inference or presumption. It is evidence which comes from one who speaks directly of his or her own knowledge on the main or ultimate fact to be proved, or who saw or heard the factual matters which are the subject of the testimony. It is not necessary that this direct knowledge be gained through the senses of sight and hearing alone, but it may be obtained from any of the senses through which outside knowledge is acquired, including the senses of touch or pain.

[law]{*State v Famber*, 358 Mo 288, 214 SW2d 40} /DF /ST

RT Direct situational relevance [information science]{Wilson, 1973} /RT

DF If an item of information I_j is itself a member of a concern set, we shall say that it is directly relevant situationally

[information science]{Wilson, 1973} /DF

RT Matching topic / direct relevance /RT

RT ^Without reasoning /RT

. Circumstantial (indirect) evidence

ST Circumstantial (indirect) evidence [law] {*State v Famber*, 358 Mo 288, 214 SW2d 40} {Stong, 1999} {Wigmore, 1983}

DF circumstantial evidence is evidence that, without going directly to prove the existence of a fact, gives rise to a logical inference that such fact does exist. [law] {*State v Famber*, 358 Mo 288, 214 SW2d 40} /DF

DF Circumstantial evidence may also be testimonial, but even if the circumstances depicted are accepted as true, additional reasoning is required to reach the desired conclusion.”

[law]{Stong, 1999} /DF

DF *Circumstantial evidence* is evidence of an indirect nature, “from which the truth of the matter asserted is desired to be *inferred*.” [law]{Wigmore, 1983} /DF /ST

RT Indirect situational relevance [information science]{Wilson, 1973} /RT

DF If an item of information I_j is relevant but itself not a member of a concern set, we shall say that it is indirectly relevant situationally [information science]{Wilson, 1973} /DF

RT Consequence [medicine]{illness script} /RT

DF Signs, symptoms, complaints [medicine]{illness script} /DF

RT Evidence (medical) [medicine]{Florance, 1992} /RT

RT [^]Backward inference (Abduction) /RT

- **Supportive vs. contradictory evidence**
- • Supportive evidence
- • Contradictory evidence
- RT Rebuttal /RT
- RT Contradictory contrast /RT

► **Context relevance**

• **Background**

ST Background [rhetoric]{RST}

DF *N*: R won't comprehend *N* sufficiently before reading text of *S*

N+S: *S* increases the ability of *R* to comprehend an element in *N*

Effect: *R*'s ability to comprehend *N* increases

[rhetoric]{RST} /DF

EX *N*: ZPG's 1985 Urban Stress Test, created after months of persistent and exhaustive research, is the nation's first survey of how population-linked pressures affect U.S. cities. It ranks 184 urban areas on 11 different criteria ranging from crowding and birth rates to air quality and toxic wastes.

S: The Urban Stress Test translates complex, technical data into an easy-to-use action tool for concerned citizens, elected officials and opinion leaders.

/EX /ST

• **Scope**

ST Scope [image function]{Hancher, 1992}

DF defined as the degree to which an image illustration shows a concept in a particular context, such as the way an object is used for a given function [image function: dictionary design]{Hancher, 1992}/DF /ST

• **Framework**

ST Framework [rhetoric]{RST}

DF *S*: *S* is not unrealized

N+S: *S* sets a framework in the subject matter within which *R* is intended to interpret *N*

Effect: *R* recognizes that *S* provides the framework for interpreting *N*

[rhetoric]{RST} /DF

EX *N*: Probably the most extreme case of Visitors Fever I have ever witnessed was a few summers ago

S: when I visited relatives in the Midwest.

/EX /ST

• **Assumption or expectation**

ST Assumption or expectation [communication]{Relevance theory}

DF The set of premises used in interpreting an utterance (apart from the premise that the utterance in question has been produced) constitutes what is generally known as the *context*. A context is a psychological construct, a subset of the hearer's assumptions about the world. [communication]{Relevance theory} /DF /ST

RT Grounds (Evidence / data) /RT

• **Biographic information**

ST Biographic information [image meaning]{CLiMB}

DF Text that provides information about the artist, the patron, or other people involved in creating the work, or who have a direct and meaningful link to the work after it was created [image meaning]{CLiMB} /DF /ST

Preparation

ST Preparation [rhetoric]{RST}

DF $N+S$: S precedes N in the text; S tends to make R more ready, interested or oriented for reading N

Effect: R is more ready, interested or oriented for reading N

[rhetoric]{RST} /DF

EX N : (the body of the article)

S : (a title): Bouquets in a basket - with living flowers

/EX /ST

ST Stage-setting [image function] {Schriver, 1997}

DF the image forecasts the content or theme of the text [image function] {Schriver, 1997} /DF /ST

ST Instruction (preparation) [image function]{Berinstein, 1997} /ST

Environmental setting

RT \wedge Whole :: part (paronymy) /RT

Physical environment

ST Physical environment [communication]{Relevance theory}[history]{MALACH}

DF information about the immediate physical environment [communication]{Relevance theory} /DF /ST

Social, political, cultural background

ST Social, political, cultural background [communication]{Relevance theory}[history]{MALACH} /ST

ST Historical context [image meaning]{CLiMB}

DF Text describing the social or historical context in which the depicted work was created, including who commissioned it, or the impact of the image on the social or historical context of the time [image meaning]{CLiMB}/DF /ST

RT Historical context /RT

By time sequence

ST Sequence [rhetoric]{RST}

DF $N+N$: There is a succession relationship between the situations in the nuclei

Effect: R recognizes the succession relationships among the nuclei.

[rhetoric]{RST}

/DF

EX N : Peel oranges,

S : and slice crosswise. [The given text yields 5 nuclei.]

/EX /ST

ST By time sequence [image function]{Stovall, 1997}

DF the image gives the time-based sequence of the event presented in text [image function: journalism]{Stovall, 1997} /DF /ST

Historical context

ST Historical context {author} /ST

Preceding historical event

ST Preceding historical event {author} /ST

- Subsequent historical event
 - ST Subsequent historical event {author} /ST
 - Personal sequence
 - ST Personal sequence {author} /ST
 - Preceding personal experience
 - ST Preceding personal experience [communication]{Relevance theory}[history]{MALACH} /ST
 - Subsequent personal experience
 - ST Subsequent personal experience [history]{MALACH} /ST
- Condition**
 - ST Condition [rhetoric]{RST}
 - DF S: S presents a hypothetical, future, or otherwise unrealized situation (relative to the situational context of S)
 - N+S: Realization of N depends on realization of S
 - Effect: R recognizes how the realization of N depends on the realization of S
 - [rhetoric]{RST} /DF
 - EX N: Employees are urged to complete new beneficiary designation forms for retirement or life insurance benefits
 - S: whenever there is a change in marital or family status.
 - /EX /ST
 - Enabling or hindering condition (factor)
 - ST Enabling or hindering factor [history]{MALACH} /ST
 - RT +Cause and effect /RT
 - RT +^Causal-based reasoning /RT
 - Enabling condition (factor)
 - ST Risk factor [medicine]{author} /ST
 - ST Enabling condition [medicine]{illness script; Florance, 1992}
 - DF Predisposing factors, boundary conditions, hereditary factors, etc.
 - [medicine]{illness script; Florance, 1992} /DF /ST
 - ST Enablement [rhetoric]{RST}
 - DF N: presents an action by R (including accepting an offer), unrealized with respect to the context of N
 - N+S: R comprehending S increases R's potential ability to perform the action in N
 - Effect: R's potential ability to perform the action in N increases
 - [rhetoric]{RST} /DF
 - EX N: Training on jobs: A series of informative, inexpensive pamphlets and books on worker health discusses such topics as filing a compensation claim, ionizing radiation, asbestos, and several occupational diseases.
 - S: For a catalog and order form write WIOES, 2520 Milvia St., Berkeley, CA 95704.
 - /EX /ST
 - Predisposing factor
 - ST Predisposing factor [medicine]{illness script}
 - DF Previous health condition, Previous disease, Medication, Substance use, Provoking factor
 - [medicine]{illness script} /DF /ST
 - Boundary factor

- ST Boundary factor [medicine]{illness script}
 - DF Age, sex, etc. [medicine]{illness script} /DF /ST
 - ST Patient population [medicine]{PICO}
 - DF defining the patient as a member of a population, in terms of sex, age, ethnic group, risk profile, and other characteristics judged to be clinically important. [medicine]{PICO} /DF /ST
 - Hindering condition (factor)
 - ST Hindering condition (factor) [history]{MALACH} /ST
 - Protective factor
 - ST Protective factor [medicine]{author} /ST
 - Unconditional
 - ST Unconditional [rhetoric]{RST}
 - DF *S*: S conceivably could affect the realization of N
 - N+S*: N does not depend on S
 - Effect*: R might have assumed that N depends on S but now R recognizes that N does not depend on S
 - [rhetoric]{RST} /DF
 - EX *N*: in no event shall the author or distributors be liable to any party for direct, indirect, special, incidental, or consequential damages arising out of the use of this software, its documentation, or any derivatives thereof
 - S*: even if the author has been advised of the possibility of such damage.
 - /EX /ST
 - Exceptional condition
 - ST Unless [rhetoric]{RST}
 - DF *N+S*: S affects the realization of N; N is realized provided that S is not realized
 - Effect*: R recognizes that N is realized provided that S is not realized
 - [rhetoric]{RST} /DF
 - EX *N*: The following terms apply to all files associated with the software
 - S*: unless explicitly disclaimed in individual files.
 - /EX /ST
- RT Otherwise /RT
- RT ^Rebuttal /RT

►Comparison relevance

- ST Comparison-based mechanisms [education]{Kavale, 1980}
 - DF comparing [education]{Kavale, 1980} /DF /ST
- ST Comparing [education]{Revised Bloom}
 - DF Detecting correspondences between two ideas, objects, and the like (e.g., Compare historical events to contemporary situations), e.g., contrasting, mapping, matching [education]{Revised Bloom} /DF /ST
- ST Comparison [image meaning]{CLiMB}[image function]{Brody, 1984; Ilson, 1987; Marsh & White, 2003}[medicine]{PICO}
 - DF Text that discusses the art object in reference to one or more other works to compare or contrast the imagery, technique, subject matter, materials, etc. [image meaning]{CLiMB} /DF

DF the image sets off similar or dissimilar information; making explicit intended elements of comparison between objects depicted in text; emphasize points of similarity between image and text [image function]{Brody, 1984; Ilson, 1987; Marsh & White, 2003} /DF

DF A comparison of two or more interventions, to decide between two drugs, between a drug and placebo, or between two diagnostic tests [medicine]{PICO} /DF /ST

ST Treatment-alternative [medicine]{Florance, 1992} /ST

RT +^Comparison-based reasoning /RT

. **Comparison by similarity vs. by difference**

. . Comparison by similarity

ST Similarity-based mechanisms [education]{Langley, 1981} /ST

RT ^Reasoning by analogy /RT

. . . Metaphor and analogy

ST Metaphor and analogy [education]{Gentner, 1980; Vosniadou & Brewer, 1987; Wittrock, 1989}

DF using analogies and metaphors from a different domain to construct a new schema of knowledge [education]{Gentner, 1980; Vosniadou & Brewer, 1987; Wittrock, 1989} /DF

DF XXX [image] /DF /ST

ST Analogy [image function]{Brody, 1984} /ST

ST Metaphor [image function]{Shklovsky, 1989; Ilson, 1987}

DF rhetorical strategies used to break through the sales resistance by providing novel and arresting ideas and images [image function: advertising]{Shklovsky, 1989; Ilson, 1987} /DF /ST

RT +Transformation /RT

. . . Classification

ST Classification [education]{Kavale, 1980; Wittrock, 1989}

DF relating an item to a broader conceptual category [education]{Kavale, 1980; Wittrock, 1989} /DF /ST

ST Classifying [education]{Revised Bloom}

DF Determining that something belongs to a category (e.g., concept or principle) (e.g., Classify observed or described cases of mental disorders), e.g., categorizing, subsuming /DF /ST

RT Matching or mapping /RT

RT Definition /RT

RT ^Rule-based reasoning (Deduction) /RT

RT ^Classificatory reasons /RT

. . Comparison by difference (Contrast)

ST Differentiation or discrimination [education]{Carey, 1985}

DF recognizing the critical differences between knowledge schemas [education]{Carey, 1985} /DF /ST

ST Contrast [rhetoric]{RST}{author}[education]{Revised Bloom}[image function]{Ilson, 1987; Marsh & White, 2003}

DF N+N: No more than two nuclei; the situations in these two nuclei are (a) comprehended as the same in some respects (b) comprehended as

differing in some respects and (c) compared with respect to one or more of these differences

Effect: R recognizes the incomparability and the difference(s) yielded by the comparison is being made

[rhetoric]{author} /DF

DF *N+N:* No more than two nuclei; the situations in these two nuclei are (a) comprehended as the same in many respects (b) comprehended as differing in a few respects and (c) compared with respect to one or more of these differences

Effect: R recognizes the incomparability and the difference(s) yielded by the comparison is being made

[rhetoric]{RST} /DF

EX *N:* Animals heal,
S: but trees compartmentalize.

/EX

DF the image makes explicit intended elements of contrast between objects depicted in text; emphasize points of difference between image and text [image function]{Ilson, 1987; Marsh & White, 2003} /DF /ST

RT ^Reasoning by contrast /RT

. . . Contradictory contrast

DF The two being compared are not of equal status; one is more at the center of attention or it is more preferred to the other. /DF

ST Contradictory [image function]{Nikolajeva & Scott, 2000}

DF the text and image are in opposition for a rhetorical purpose [image function]{Nikolajeva & Scott, 2000} /DF /ST

ST Antithesis [rhetoric]{RST}

DF *N:* W has positive regard for N

N+S: are in contrast; because of the incompatibility that arises from the contrast, one cannot have positive regard for both of those situations; comprehending S and the incompatibility between the situations increases R's positive regard for N

Effect: R's positive regard for N is increased

[rhetoric]{RST} /DF

EX *N:* We should limit our involvement in defense and weaponry to matters of process, such as exposing the weapons industry's influence on the political process.
S: But I don't think endorsing a specific nuclear freeze proposal is appropriate for CCC.

/EX /ST

RT Contradictory evidence /RT

. . . Juxtapositional contrast

DF The two being compared are of equal status; both are equally attended to and neither is particularly preferred. /DF

ST Juxtapositional [image function]{Schriver, 1997}

DF the overall message is conveyed through a clash or tension between the image and text [image function: advertising]{Schriver, 1997} /DF /ST

. **By factor that is different**

ST By factor that is different [history]{MALACH} /ST

. . Different external factor

- ST Different external factor [history]{MALACH} /ST
 - Different time
 - ST Different time [history]{MALACH} /ST
 - Different place
 - ST Different place [history]{MALACH} /ST
 - Different participant
 - ST Different participant [history]{MALACH} /ST
 - Different actor
 - ST Different actor [history]{MALACH} /ST
 - Different experiencer
 - ST Different subject acted upon [history]{MALACH} /ST
 - Different act or experience
 - ST Different act or experience [history]{MALACH} /ST
 - Different act
 - ST Different act [history]{MALACH} /ST
 - Different experience
 - ST Different experience [history]{MALACH} /ST

►Cause and effect

- ST Causal relation [rhetoric]{RST} /ST
- RT +^Enabling or hindering condition (factor) /RT
- RT +^Causal-based reasoning /RT

- Cause

- ST Cause [rhetoric]{RST} /ST
 - RT ^Forward inference (Deduction) /RT

- Volitional cause

- ST Volitional cause [rhetoric]{RST}

DF *N*: *N* is a volitional action or else a situation that could have arisen from a volitional action
N+S: *S* could have caused the agent of the volitional action in *N* to perform that action; without the presentation of *S*, *R* might not regard the action as motivated or know the particular motivation; *N* is more central to *W*'s purposes in putting forth the *N-S* combination than *S* is.

Effect: *R* recognizes *S* as a cause for the volitional action in *N*
[rhetoric]{RST} /DF

EX *N*: Thinking that perhaps the counsel was simplistic, coming from an unmarried person,

S: one of them asked, "Are you married?"

/EX /ST

- RT Motivation /RT

- Non-volitional cause

- ST Non-volitional cause [rhetoric]{RST}

DF *N*: *N* is not a volitional action

N+S: *S*, by means other than motivating a volitional action, caused *N*; without the presentation of *S*, *R* might not know the particular cause of the situation; a presentation of *N* is more central than *S* to *W*'s purposes in putting forth the *N-S* combination.

Effect: R recognizes S as a cause of N

[rhetoric]{RST} /DF

EX N: maybe that's why sparky lived so long.

S: remember all those vegetables you slipped under the table?

/EX /ST

• **Consequence**

• ST Consequence [rhetoric]{RST} /ST

• RT ^ Backward inference (Abduction) /RT

• • Volitional result

• ST Volitional result [rhetoric]{RST}

DF S: S is a volitional action or a situation that could have arisen from a volitional action

N+S: N could have caused S; presentation of N is more central to W's purposes than is presentation of S;

Effect: R recognizes that N could be a cause for the action or situation in S

[rhetoric]{RST} /DF

EX N: when hundreds of people lined up to be among the first applying for jobs at the yet-to-open Marriott Hotel. The hotel's help-wanted announcement - for 300 openings - was a rare opportunity for many unemployed.

S: Farmington police had to help control traffic recently

/EX /ST

ST Intended consequence [rhetoric]{author} /ST

RT Purpose /RT

• • Non-volitional result

• ST Non-volitional result [rhetoric]{RST}

DF S: S is not a volitional action

N+S: N caused S; presentation of N is more central to W's purposes in putting forth the N-S combination than is the presentation of S.

Effect: R recognizes that N could have caused the situation in S

[rhetoric]{RST} /DF

EX N: The blast, the worst industrial accident in Mexico's history, destroyed the plant and most of the surrounding suburbs.

S: Several thousand people were injured, and about 300 are still in hospital.

/EX /ST

ST Unintended consequence [rhetoric]{author} /ST

• • Otherwise

• ST Otherwise [rhetoric]{RST}

DF N: N is an unrealized situation

S: S is an unrealized situation

N+S: realization of N prevents realization of S

Effect: R recognizes the dependency relation of prevention between the realization of N and the realization of S

[rhetoric]{RST} /DF

EX N: Project leaders should submit their entries for the revised brochure immediately.

S: Otherwise the existing entry will be used.

/EX /ST

[rhetoric]{RST} /DF

EX *N*: send for our free "Flexi-Finder" selection guide and the name of the supplier nearest you.

S: To see which Syncom diskette will replace the ones you're using now,

/EX /ST

ST Outcome (desired) [medicine]{PICO}

DF A particular desirable outcome; for example, what is to be accomplished, measured, improved, or affected. More specifically, such outcomes may be to relieve or eliminate the symptoms, to reduce the number of adverse events, to improve or recover function, to prevent disability, and to save time, money and effort, and so on. [medicine]{PICO} /DF /ST

RT Volitional result /RT

RT ^Backward inference (Abduction) /RT

□ Method / Solution

• Method or instrument

ST Means [rhetoric]{RST}

DF *N*: an activity

N+S: *S* presents a method or instrument which tends to make realization of *N* more likely

Effect: *R* recognizes that the method or instrument in *S* tends to make realization of *N* more likely

[rhetoric]{RST} /DF

EX *N*: the visual system resolves confusion

S: by applying some tricks that reflect a built-in knowledge of properties of the physical world.

/EX /ST

• Method / approach

ST Method / approach [rhetoric]{RST} /ST

• Instrument

ST Instrument [rhetoric]{RST} /ST

• Technique or style

ST Implementation [image meaning]{CLiMB}

DF Text that explains artistic methods used to create the work, including the style, any **technical problems, new techniques** or approaches, etc. [image meaning]{CLiMB} /DF /ST

• Technique

ST Technique [image meaning]{CLiMB} /ST

• Style

ST Style [image meaning]{CLiMB} /ST

• Solution

ST Solution [rhetoric]{RST}

DF *S*: *S* presents a problem

N+S: *N* is a solution to the problem presented in *S*;

Effect: *R* recognizes *N* as a solution to the problem presented in *S*

[rhetoric]{RST} /DF

EX *N*: One difficulty ... is with sleeping bags in which down and feather fillers are used as insulation. This insulation has a tendency to slip toward the bottom.

S: You can redistribute the filler. ...

/EX /ST

ST Intervention [medicine]{PICO}

DF The main intervention, prognostic factor, including therapy (drug prescription, surgery order, etc.); prevention; diagnostic testing; etc. [medicine]{PICO} /DF /ST

ST Treatment [medicine]{Florance, 1992} /ST

►Evaluation

ST Evaluation [rhetoric]{RST}

DF *N+S*: S relates N to degree of W's positive regard toward N.

Effect: R recognizes that S assesses N and recognizes the value it assigns [rhetoric]{RST} /DF

EX *N*: Features like our uniquely sealed jacket and protective hub ring make our discs last longer. 2. And a soft inner liner cleans the ultra-smooth disc surface while in use. [These 2 form a single span, using Joint.]
S: It all adds up to better performance and reliability.

/EX /ST

• Significance

ST Significance [image meaning]{CLiMB}

DF Text pointing to the specific art historical significance of the image [image meaning]{CLiMB} /DF /ST

►Ungrouped functional relationships

• Matching or mapping

DF Matching can be based on similarity, e.g., matching animals with similar features, which is related to classification, or it could be based on contextual contiguity, e.g., matching gloves and hands, socks and feet [education]{author} /DF

ST Matching or mapping [education]{Revised Bloom}

DF Detecting correspondences between two ideas, objects, and the like (e.g., Compare historical events to contemporary situations), e.g., contrasting, **mapping**, **matching** [education]{Revised Bloom} /DF /ST

RT +Comparison by similarity /RT

• Elicit emotion

ST Elicit emotion [image function]{Berinstein, 1997; Marsh & White, 2003}

DF the image encourages emotional response from reader through display of content or style that is especially arresting or disturbing [image function]{Berinstein, 1997; Marsh & White, 2003} /DF /ST

• Inspiration

ST Inspiration [image function]{Schwarcz, 1982}

DF the image illustration uses the text as a starting point, then veers away to introduce new content; the new content adheres to the spirit of the original story [image function]{Schwarcz, 1982} /DF /ST

RT Metaphor and analogy /RT

RT +Transformation /RT

Argumentation role (Argument-based)

►Grounds (Evidence / Data)

ST Grounds (Evidence / Data) [argumentation]{Toulmin, 1958}

DF premises, facts, or data that are used as the foundation to support the claim of an argument [argumentation]{Toulmin, 1958} /DF /ST

RT Assumption or expectation /RT

►Warrant (Justification)

ST Warrant (Justification) [argumentation]{Toulmin, 1958}

DF rules, principles, conventions, or rationales that justify the movement from the data / grounds to the claim (destination). The warrant for arguments varies from field to field: in natural sciences, “laws of nature” function as warrants; in legal arguments, statutes, precedents, and rules are used as warrants; in medical diagnosis, diagnostic descriptions provide warrants [argumentation]{Toulmin, 1958} /DF /ST

RT +^Generic inference /RT

• Backing

ST Backing [argumentation]{Toulmin, 1958}

DF credentials that are provided to back up the warrant. Backing is needed when the warrant itself is not sufficiently convincing; backing enhances the credibility and reliability of the warrant [argumentation]{Toulmin, 1958} /DF /ST

►Claim (Conclusion)

ST Claim (Conclusion) [argumentation]{Toulmin, 1958}

DF the “destination” of an argument, i.e., the conclusion one wants to arrive at, a discovery one wants to induce, or an assertion one wants to make [argumentation]{Toulmin, 1958} /DF /ST

RT Matching topic / direct relevance /RT

RT Hypothesis /RT

• Rebuttal

ST Rebuttal [argumentation]{Toulmin, 1958}

DF exceptions, reservations, or restrictions which can be legitimately applied to the claim. Rebuttals are often given in this way: the claim is true, *unless* such-and-such (the rebuttal) [argumentation]{Toulmin, 1958} /DF /ST

RT Contradictory evidence /RT

RT Exceptional condition /RT

►Propositional relevance

ST Propositional relevance [argumentation]{Walton, 1982}

DF There are three specific types of propositional relevance. Each of them can be reduced to the propositional structure of arguments in the disputation.

Premissary relevance: concerned with identifying redundant and useless premises and invalid premises (the fallacy of *ad misericordiam*) in arguments;

Conclusional relevance: concerned with identifying useless conclusions, or the “fallacy that consists in proving a conclusion *other than* the one that should be proved” (Walton, 1982: 60). There are multiple conclusions established in the process of disputation: the

ultimate conclusion and interim conclusions established along the way
“leading towards” the ultimate conclusion;

Pertinence: a proposition is pertinent (*pertinens*) if and only if it either follows from or is inconsistent with any subset of the initial and subsequent propositions. “A statement that is *pertinens* is one either that logically follows from what precedes (*sequens*) or is logically repugnant to what precedes (*repugnans*)” (Green, 1963: 54). “For a proposition to be pertinent, it may have a logical relationship with the initial proposition or subsequent propositions either singly or taken together.” (Walton, 1982: 63) [argumentation]{Walton, 1982} /DF /ST

Mode of reasoning (Reasoning-based)

►Without reasoning

ST No reasoning required [from analysis]{author}

DF Covers the case of direct relevance, where the information given answers the question directly, without inference or with minimal inference [from analysis]{author} /DF /ST

RT ^Direct evidence /RT

RT ^Topic matching / Direct relevance /RT

►Generic inference

DF Undifferentiated inference, further refined by specific modes of reasoning in particular cases [from analysis]{author} /DF

ST Inference [education]{Witrock, 1989}

DF drawing logical conclusions based on premises and evidence [education]{Witrock, 1989} /DF /ST

ST Inferring [education]{Revised Bloom}

DF Drawing a logical conclusion from presented information (e.g., In learning a foreign language, infer grammatical principles from examples), e.g., concluding, extrapolating, interpolating, predicting [education]{Revised Bloom} /DF /ST

RT ^Claim (Conclusion) /RT

RT ^Prediction /RT

ST Justify [rhetoric]{RST}

DF N+S: R's comprehending S increases R's readiness to accept W's right to present N

Effect: R's readiness to accept W's right to present N is increased

[rhetoric]{RST} /DF

EX N: Let's be clear:

S: I personally favor the initiative and ardently support disarmament negotiations to reduce the risk of war. But I don't think endorsing a specific nuclear freeze proposal is appropriate for CCC. We should limit our involvement in defense and weaponry to matters of process, such as exposing the weapons industry's influence on the political process.

/EX /ST

RT Rule-based reasoning (Deduction) /RT

RT ^Warrant /RT

RT +^Evidence /RT

►Rule-based reasoning vs. Generalization

. Rule-based reasoning (Deduction)

ST Reasoning from classification [argumentation]{Toulmin, Rieke, & Janik, 1984} {author}

DF Arguments from *classification*, in which the typical properties of plants, prize cattle, or whatever are used as the basis for claims about them [argumentation]{Toulmin, Rieke, & Janik, 1984} /DF

DF Use class inheritance to warrant the claim. Typical properties of a certain category are used as the basis for claims about instances within that category. Reasoning from classification is not discussed in detail by Toulmin et al. We can think of arguments from classification as generalization functioning in the opposite direction. Whereas generalization follows the process of *inductive reasoning*,

arguments from classification involves *deductive reasoning*.

[argumentation]{author} /DF /ST

ST Reasoning from principle [argumentation]{Rieke, 1984} /ST

ST Logical relevance [information science]{Cooper, 1971}

DF A stored sentence (either in system memory or the user's memory) is logically relevant to the user's information need if and only if: (1) It is in a minimal premiss set for some component statement of the tree representing that need; and (2) There exist stored premises sets for all component statements in the tree (except the origin) which are ancestors of this component statement. [information science]{Cooper, 1971} /DF /ST

RT ^Warrant /RT

RT ^Prediction /RT

RT Generic inference /RT

RT ^Forward inference (Deduction) /RT

. . . Types of reasons (rules)

. . . . Classificatory reasons

ST Classificatory reasons [law]{Hage, 1997}

DF Classificatory reasons are reasons why a concept is applicable to a particular situation. Legal definitions and all other stipulative definitions provide a basis for classificatory reasons. (However, not all classificatory reasons need to be based on explicit definitions; prototypical effect applies to classificatory rules.) [law]{Hage, 1997} /DF

EX The fact that John took Mary's purse is the reason why John is a thief. /EX

EX The fact that soldier X ran away as soon as the enemy appeared is a reason to consider/assume X is a coward. /EX /ST

RT ^Classification /RT

RT ^Definition /RT

. . . . Anankastic reasons

ST Anankastic reasons [law]{Hage, 1997}

DF Anankastic reasons are facts that make other facts necessary or (im)possible. Anankastic reasons also include reasons why something can happen, or why somebody has a particular *capability* or *power* [law]{Hage, 1997} /DF

EX The fact that I drop this stone is the anankastic reason why the stone *must* fall. /EX

EX The attribution of legislative power by the central government makes it possible that the municipal council makes by-laws. /EX /ST

RT ^Grounds (Evidence / data) /RT

. . . . Deontic reasons

ST Deontic reasons [law]{Hage, 1997}

DF Deontic reasons are rules, goals, or norms for the existence of duties and obligations, prohibitions, etc. The conclusions of deontic reasons are *facts* or particular deontic situations. *Deontic rules, goals, or norms* indicate

under which circumstances something is prohibited, permitted, or obligated, or when somebody has a duty. [law]{Hage, 1997} /DF

EX The fact that taking Mary's purse would be theft is the reason why John is legally prohibited to take the purse. /EX

EX The fact that Eric promised to visit Derek is the reason why Eric has a duty to visit Derek. /EX /ST

Epistemic reasons

ST Epistemic reasons [law]{Hage, 1997}

DF Epistemic reasons are first and foremost reasons to make inferences, or for holding beliefs. Epistemic reasons in the first instance do not deal with the world itself, but with our knowledge of the world. They are reasons why our knowledge should include this, but not include that. Viewed in this way, epistemic reasons are closely related to *rules of evidence* [law]{Hage, 1997} /DF

EX The fact that some masked person comes running out of a bank building, brandishing a gun, while the alarm system of the bank is working, is a reason (possibly even more than one) to *assume* that he is a bank robber. Of course these facts do not make him into a robber; they are only clues that allow the conclusion that he (tried to) rob the bank. /EX

EX The fact that Gloria's car is before her apartment is a reason to assume that Gloria is not to her work. /EX /ST

RT ^Evidence /RT

Extrapolation or Interpolation

Extrapolation

ST Extrapolation [education]{Revised Bloom} /ST

Interpolation

ST Interpolation [education]{Revised Bloom} /ST

Generalization (Induction)

ST Reasoning from generalization [argumentation]{Toulmin, Rieke, & Janik, 1984} {author}

DF Where people or objects are sufficiently alike, it becomes possible to group them into populations, or "kinds," and to make general claims about them. Whereas arguments from analogy typically involve claims based on a close comparison between a few specific instances, arguments from generalization involve examining a sufficiently large and representative sample of the "kind" in question...So critics of reasoning from generalization will be greatly influenced by the nature of the sample on which it is based, particularly by the relationship between that sample and the larger population about which the subsequent claim is to be made. ...Determining whether a large enough sample is presented is usually a function of the test of whether the addition of more instances requires modification of the claim: *are there contrary instances?*...Selection of sample groups is done within established guidelines to permit the claim that what is true of the sample is true

of the entire population. [argumentation]{Toulmin, Rieke, & Janik, 1984} /DF

DF Reasoning from generalization permits the claim: what is true about a sufficient number of the individual cases is true about all (or most) members of the entire group. Generalizing from individual cases or a sample to the entire population or inducing a general rule for all cases is the process of *induction*. [argumentation]{author} /DF /ST

ST Generalization-based mechanisms [education]{Kavale, 1980; Rumelhart & Ortony, 1977} /ST

RT ^Definition /RT

RT ^Abstraction /RT

• Schema induction

ST Schema induction [education]{Rumelhart & Norman, 1981; Rumelhart & Ortony, 1977}

DF discovering the generic features or regularities across similar phenomena [education]{Rumelhart & Norman, 1981; Rumelhart & Ortony, 1977} /DF /ST

►Causal-based reasoning

RT +^Cause and effect /RT

RT +^Enabling or hindering condition (factor) /RT

• Forward inference (Deduction)

ST Reasoning from cause [argumentation]{Toulmin, Rieke, & Janik, 1984}

DF Arguments from cause require, first and foremost, a causal generalization asserting that if such-and-such a cause is observed, its effect can be expected to follow [argumentation]{Toulmin, Rieke, & Janik, 1984} /DF /ST

RT +Rule-based reasoning (Deduction) /RT

RT ^Prediction /RT

RT +^Cause /RT

RT ^Motivation /RT

• Inferring from cause to event

ST Inferring the event from its cause [history]{MALACH} /ST

• Inferring from earlier events to a later event

ST Inferring the event from earlier events [history]{MALACH} /ST

• Inferring from the action to reaction

ST Inferring reaction from action [history]{MALACH} /ST

• Backward inference (Abduction)

ST Reasoning from sign [argumentation]{Toulmin, Rieke, & Janik, 1984} {author}

DF Whenever a sign and its referent can reliably be expected to occur together, the fact that the sign is observed can be used to support a claim about the presence of the objector situation the sign refers to. In the law, circumstantial evidence often sets up an argument from sign. Lacking direct proof of the defendant's guilt, the state may present a series of signs of guilt... Similarly many aspects of medical diagnosis rely on reasoning from sign ... The central question is, simply, just how certainly any sign is associated with what it is supposed to signal. [argumentation]{Toulmin, Rieke, & Janik, 1984} /DF

DF The essence of reasoning from sign (evidence) is abduction, or backward inference, which is also identified as topical reasoning in Huang & Soergel (2006). Abduction is “inference to the best explanation” (Hobbs, Stickel, Appelt, & Martin, 1993), in which one chooses the hypothesis that would, if true, best explain the evidence. Signs or evidence function in such a way that they are *pointing to* a fact (cause) without *explicitly saying* it. Reasoning from sign (evidence) thus comes with a degree of *implicitness*. In the law, direct witness is often not available and most trials are based on *circumstantial evidence*. [argumentation] {author} /DF /ST

ST Sign relationship as warrant [law] {Freeman & Farley, 1996}

DF The sign relationship is associated with *reasoning from sign* (Toulmin, Rieke, & Janik, 1984) where the antecedent and the subsequent are associated and co-occurring but not necessarily one causing the other. [law] {Freeman & Farley, 1996} /DF /ST

RT ^Circumstantial (indirect) evidence /RT

RT ^Hypothesis /RT

RT +^Explanation (causal) /RT

RT +^Consequence /RT

RT ^Purpose /RT

- . . . Inferring from the consequence to the event
- . . . ST Inferring an event from its consequence [history] {MALACH} /ST
- . . . Inferring from later events to the event
- . . . ST Inferring an event from later events [history] {MALACH} /ST
- . . . Inferring from reaction to the action
- . . . ST Inferring action from reaction to it [history] {MALACH} /ST

► **Comparison-based reasoning**

RT +^Comparison relevance /RT

. **Reasoning by analogy**

ST Arguments from analogy [argumentation] {Toulmin, Rieke, & Janik, 1984} {author}

DF In “arguing from analogy,” we assume that there are enough similarities between two things to support the claim that what is true of one is also true of the other... What happened with one dam may reasonably be expected with another one that *shares characteristics relevant to the claim being made* and does not have *differences that would destroy the analogy*...

No two phenomena are exactly alike, so the comparisons involved in all analogies are more-or-less imperfect. The key question is how *close* the analogy is, and an analogy will be judged as “closer” when the points of comparison between two objects are greater in number, are more directly relevant to the claim being supported, and are countered by fewer relevant points of difference

[argumentation] {Toulmin, Rieke, & Janik, 1984} /DF

DF Use the *analogy* to warrant the claim, similar to *resemblance arguments* (Ramage & Bean, 1992), *case-based reasoning* (Schank, 1982) and *analogical reasoning* (Barker, 1989). Comparisons lie at the heart of this type of reasoning. Assume X is true about A.

Enough similarities are perceived between case A and case B to support the claim: X is also true about B [argumentation]{author} /DF /ST

ST Analogical reasoning [argumentation]{Barker, 1989} /ST

ST Resemblance arguments [argumentation]{Ramage & Bean, 1992}

DF X is/is not like Y; in effect, the “like” statement is a definitional claim in which both X and Y are said to belong to class Z {Ramage & Bean, 1992} /DF /ST

RT ^Definition /RT

RT ^Classification /RT

ST Case-based reasoning [argumentation]{Schank, 1982} /ST

ST Exemplary reasoning [argumentation]{Brewer, 1996}

DF The pattern of analogical argument includes three steps: (1) abduction in a context of doubt to arrive at an “analogy-warranting rule” (AWR); (2) confirmation or disconfirmation of the AWR; (3) application of the AWR [argumentation]{Brewer, 1996} /DF /ST

ST Analogical (legal) arguments [law]{Weinreb, 2005}

DF

(5) A (the source) has characteristics p , q , and r ;

(6) B (the target) has characteristics p , q , and r ;

(7) A has also characteristic s ;

(8) Therefore, B has characteristic s .

But propositions (1)—(3) do not sustain (4), without an additional premiss:

(3a) If anything that has characteristics p , q , and r has characteristic s , then everything that has characteristics p , q , and r has characteristic s .

With the addition of (3a), it is possible to construct a valid syllogism.

More simply stated:

(3b) Anything that has characteristics p , q , and r has characteristic s ;

(2) B has characteristics p , q , and r ;

(4) Therefore B has characteristic s .

[law]{Weinreb, 2005} /DF /ST

ST Legal reasoning by example [law]{Levi, 1948}

DF legal reasoning is essentially a three-step process: the judge perceives the similarity between a past case (the precedent) and a pending case; next she announces the rule of law inherent in the past case; then based on the similarities and differences between the cases, she makes the rule of law applicable to the pending case. As such, legal decisions are made in a consistent fashion that conforms to prior adjudication [law]{Levi, 1948} /DF /ST

RT +^Comparison by similarity /RT

Reasoning by contrast

ST Reasoning from opposites [argumentation]{Toulmin, Rieke, & Janik, 1984} {author}

DF Arguments from *opposites*, in which things that are known to be radically different in some given respect are presumed to be equally

different in some other respect [argumentation]{Toulmin, Rieke, & Janik, 1984} /DF

DF Use the *contrast* to warrant the claim. [argumentation]{author} /DF /ST

RT ^Antithesis /RT

RT ^Comparison by difference (Contrast) /RT

►Transitivity-based reasoning

ST Transitivity of the conditional [argumentation]{Propositional logic}

DF $((p \rightarrow q) \wedge (q \rightarrow r)) \vdash (p \rightarrow r)$
if p then q ; if q then r ; therefore, if p then r
[argumentation]{Propositional logic} /DF /ST

►Dilemma-based reasoning

ST Arguments from dilemma [argumentation]{Toulmin, Rieke, & Janik, 1984}

DF The argument from dilemma, according to Toulmin, Rieke, & Janik (1984), refers to arguments with a claim resting upon two and only two possible explanations and the two explanations are equally bad
[argumentation]{Toulmin, Rieke, & Janik, 1984} /DF /ST

• Constructive dilemma

ST Constructive dilemma [argumentation]{Propositional logic}

DF $((p \rightarrow q) \wedge (r \rightarrow s) \wedge (p \vee r)) \vdash (q \vee s)$
If p then q ; and if r then s ; but either p or r ; therefore either q or s
[argumentation]{Propositional logic} /DF /ST

• Destructive dilemma

ST Destructive dilemma [argumentation]{Propositional logic}

DF $((p \rightarrow q) \wedge (r \rightarrow s) \wedge (\neg q \vee \neg s)) \vdash (\neg p \vee \neg r)$
If p then q ; and if r then s ; but either not q or not s ; therefore either not p or not r
[argumentation]{Propositional logic} /DF /ST

Semantic relationships (Content-based)

►Paradigmatic relationships

- . **Class :: subclass (taxonomy)**
 - ST Class :: subclass (taxonomy) [information science]{Green & Bean, 1995}
 - DF the user topic (as represented by a subject heading) and the topic of the cited passage are related as class and subclass [information science]{Green & Bean, 1995} /DF /ST
 - RT ^Elaboration /RT
- . **Set :: member**
 - ST Set :: member [rhetoric]{RST} /ST
 - ST Type :: token [information science]{Green & Bean, 1995}
 - DF the user topic (as represented by a subject heading) and the topic of the cited passage are related class and class member. It corresponds to user requests such as “Give me an example of X.” [information science]{Green & Bean, 1995} /DF /ST
 - RT ^Exemplification /RT
- . **Abstraction :: instance**
 - ST Abstraction :: instance [rhetoric]{RST} /ST
 - ST ^Instantiation /ST
- . **Generalization :: specific**
 - ST Generalization :: specific [rhetoric]{RST} /ST
 - ST ^Specialization or specification /ST
- . **Whole :: part (partonomy)**
 - ST Whole :: part (partonomy) [rhetoric]{RST} /ST
 - ST Partonomy [information science]{Green & Bean, 1995}
 - DF *Partonomy* (x is a part of y): the user topic (as represented by a subject heading) and the topic of the cited passage are in part-whole relationship, for example, what sub-activities an activity or process is composed of. It corresponds to the user request of “What does X consist of?” [information science]{Green & Bean, 1995} /DF /ST
 - RT ^Elaboration /RT
 - RT ^Environmental setting /RT
- . **Process :: step**
 - ST Process :: step [rhetoric]{RST}[information science]{Green & Bean, 1995} /ST
- . **Object :: attribute**
 - ST Object :: attribute [rhetoric]{RST} /ST
 - ST Attributes [information science]{Green & Bean, 1995}[medicine]{Florance, 1992}
 - DF the cited passage expresses either adjectival or adverbial modifications of the user topic. This subcategory corresponds to such user requests as “What are the characteristics of X?” or “What is X like?” [information science]{Green & Bean, 1995} /DF /ST
 - RT ^Elaboration /RT
 - RT ^Definition /RT
- . **Adjectival**
 - ST Adjectival [information science]{Green & Bean, 1995} /ST

- . . . **Precipitating conditions:** Conditions occurring before action is performed
- . . . **Enabling conditions:** Conditions permitting action to be performed
- . . . **Agent:** Personality that performs action
- . . . **Instrument:** Tool used by personality to perform action
- . . . **Need:** Lack that requires action
- . . . **Impediment:** Barrier to action
- . . . **Work = Force. Speed. Time**
- . . . **Impediment:** Barrier to action
- . . . **Force:** Structure in which action is performed
- . . . **Temporal conditions:** Time when action occurs
- . . . **Magnitude:** Size, quantity of entity
- . . . **Need:** Lack that requires action
- . . . **Perseverance**
- . . . **Force:** Structure in which action is performed
- . . . **Verdict/judgment:** Decision of an evaluating body
- . . . **Impediment:** Barrier to action
- . . . **Debt**
- . . . **Debt:** Amount owed
- . . . **Debtor:** Personality that owes
- . . . **Payment:** Amount paid to reduce debt
- . . . **Judgment**
- . . . **Evidence:** Support for a proposition
- . . . **Verdict/judgment:** Decision of an evaluating body
- . . . **Balance/equilibrium**
- **Force:** Structure in which action is performed
- **Counterforce:** Structure in which counterbalancing action is performed
- . . . **Metaphors:** Structural equivalence across domains

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