

# Engagement in Medical Research Discourse





Department of Languages and Literatures, Faculty of Arts

# Engagement in Medical Research Discourse

A Multisemiotic Discourse-Semantic Study of Dialogic Positioning

Daniel Lees Fryer



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## List of Abbreviations

AIM	<i>Annals of Internal Medicine</i>
BMJ	<i>British Medical Journal</i>
EAP	English for academic purposes
EFL	English as a foreign language
ELV	epistemic lexical verb
EMM	epistemic modality marker
GSP	global selection probability
ICMJE	International Committee of Medical Journal Editors
IMRaD	Introduction, Methods, Results, and Discussion
IRR	inter-rater reliability
JAMA	<i>Journal of the American Medical Association</i>
LAN	<i>Lancet</i>
LSP	local selection probability
MeSH	Medical Subject Heading
MRAC	Medical Research Article Corpus
NEJM	<i>New England Journal of Medicine</i>
RA	research article
RF	relative frequency (per 1000 words)
RCT	randomized controlled trial
SFL	Systemic Functional Linguistics

## **Abstract**

This study investigates how medical researchers engage with a background of prior and anticipated utterances in a collection of highly cited English-language medical research articles. Taking a multisemiotic, systemic-functional approach, I examine the verbal, visual, and mathematical resources used by medical research writers to construe, engage with, and position themselves in relation to a dialogic background of different voices, positions, and propositions. I explore the dialogic functions of those resources and how they are integrated or combined. I also consider how those resources are distributed across different parts of the medical research article and to what extent their use might reflect some of the disciplinary practices of medical research.

The study shows that engagement can be realized by a broad and diverse set of verbal, mathematical, and visual resources. Verbal modality, projection, and concession, visual prominence and depiction-style, and mathematical probability, approximation, and prediction combine to construe a dialogic space that, on the whole, is more ‘heteroglossic’ than ‘monoglossic’ (i.e. multi- or other-voiced rather than single-voiced) and more dialogically ‘expansive’ than ‘contractive’; that is, it opens up rather than closes down the dialogic space for alternative positions and propositions in the discourse. From a genre perspective, engagement resources have different distributions across the various stages and phases of the medical research article, which tend to construe a dialogically ‘expansive’ Introduction and Discussion and a dialogically ‘contractive’ Methods and Results, although there is considerable variation across generic stages and phases and among individual research articles. The intersemiotic analysis shows how verbal, visual, and mathematical engagement resources are generally integrated to complement and reinforce the meanings construed by each semiotic. Less commonly, they diverge or they combine to make meanings that are not explicitly carried by any one semiotic, creating moments of potential dialogic tension. These changing dialogic spaces are crucial to building and maintaining alliances with the reader. They are also part of what makes the medical research article a hybrid text, one that, from a disciplinary perspective, construes varying writer–reader relations and knowledge

structures (e.g. hard–soft, regional–singular, hierarchic–horizontal) as the text unfolds.

The implications of this study are three-fold. Firstly, the study contributes to theoretical developments in the fields of social semiotics, systemic functional theory, and discourse analysis more generally. Secondly, it contributes to the growing body of discourse- and corpus-analytic studies of medicine and medical research discourse. Thirdly, the findings may have practical applications in academic literacy programmes.

**Key words:** engagement, medical research discourse, social semiotics, systemic functional theory, dialogic theory, linguistics, semiosis, multisemiosis, multimodality, intersemiosis, intermodality, corpus analysis, genre, disciplinarity, ideology

## Short Summary in Swedish

I den här studien undersöks hur forskare inom medicin använder verbala, matematiska och visuella medel för att skriva medicinska vetenskapliga artiklar som inkluderar eller exkluderar andra "röster" i texten, t. ex. läsaren och litteraturen. Studien visar att medicinska vetenskapliga artiklar generellt inkluderar andra röster, men att inkludering och exkludering varierar i olika delar av texterna. Dessa variationer är väsentliga för att skapa och upprätthålla förbindelser till läsaren, och för att förmedla trovärdighet. Studien bidrar till teoretiska utvecklingar inom socialsemiotik och diskursanalys av medicinsk forskning, och resultatet kan också tillämpas inom akademiskt skrivande.

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# 1 Introduction

## 1.1 Background

According to Bakhtin (1981 [1935], 281) and Vološinov (1973 [1929], 95), the meaning of any given utterance can only be understood against a background of other related utterances, a background that is made up of contradictory and complementary opinions, points of view, and value judgments. Every utterance enters into dialogue with a background of prior and anticipated utterances and is “filled with the echoes and reverberations of [those] utterances” (Bakhtin 1986, 91). Together, they form a “*continuous process of verbal communication*” that is “generative [...] of a given social collective” (Vološinov 1973 [1929], 95, emphasis in original). A book, for example, as a verbal performance in print, “orients itself with respect to previous performances in the same [social] sphere” and “*engages* [...] in ideological colloquy of large scale: it responds to something, objects to something, affirms something, anticipates possible responses and objections, seeks support, and so on” (Vološinov 1973 [1929], 95, emphasis added).

In academic research writing, authors engage with and position themselves in relation to a specific background of prior and anticipated utterances that includes the literature and the putative reader (Hood 2010). That background of prior and anticipated voices can be construed verbally, through the resources of language, as well as nonverbally, using resources such as graphs, tables, diagrams, and mathematical formulae (Lynch and Woolgar 1990, Lemke 1998, Baldry and Thibault 2006). This is an integral part of the social practice of communicating research, in participating in the “academic conversation” (see, for example, Hyland 2000, 2005). In this thesis, I investigate how part of a given social collective—that of medical research writers—construes, engages with, and positions itself in relation to a background of prior and anticipated utterances.

There are a number of key reasons why medical research is of particular interest here. Modern medicine occupies a prominent sociohistorical position in most societies (Gotti and Salager-Meyer 2006, 10) and, with its focus on health and wellbeing, there are few disciplines

and practices that can be said to have such a fundamental social, cultural, and political influence on human life (see, for example, Comaroff 1982, 55, Gordon 1988b, 20, Fairclough 1992, 128, Gadamer 1996, Lupton 2003, 1, Gotti and Salager-Meyer 2006, 10–11). For Lock (1988, 8), “the study of health, illness, and medicine provides us with one of the most revealing mirrors for understanding the relationship between individuals, society, and culture”.

Medicine is variably described—popularly, professionally, and historically—as a science *and* an art (e.g. Foucault 1973 [1963], Gordon 1988a, Gadamer 1996, Vihla 1999, Malterud 2001, Horden 2011). On the one hand, modern medicine involves systematic experimentation and observation; on the other, it is a practice that may be partly based on tacit knowledge and the individual experiences and intuitions of patients and practitioners (Gordon 1988b). Due to its historical development, and its classification and treatment of patient and disease in both biological/physiological and social terms (see Navarro 1976b, Lock 1988, Lupton 2003, Kottke 2011, Matthiessen 2013), modern medicine appears to be at the intersection of the formal, natural, social, and human sciences (Matthiessen 2013, 459–461), a cross- or interdisciplinary field that potentially traverses knowledge-community categories such as “hard” and “soft”, or “pure” and “applied” (see Biglan 1973, Becher 1994, 152).

The paradigmatic site for the contextualization of knowledge in modern medicine is the medical research article (MacDonald 2002) and, increasingly, the *English-language* medical research article (see Maher 1986, and Ferguson 2007 more generally for English as the current “international language of science”). This particular text-type, with its highly formalized generic structure (see Sollaci and Pereira 2004), represents, according to the International Committee of Medical Journal Editors (ICMJE 2008), “a direct reflection of the process of scientific discovery”. “It [the medical research article] creates the ‘intellectual field’ of medical epistemology in which knowledge is produced” (MacDonald 2002, 451) and is thus a primary site through which expert knowers engage (Maton 2007, 2014).

Exploring how knowers engage with each other through medical research articles—and the verbal, mathematical, and visual resources



those texts employ—might therefore have important epistemological and pedagogic implications, contributing, on the one hand, to an understanding of some of the mechanisms involved in the social construction of knowledge in this field (Bernstein 1999, Vihla 1999, Lupton 2003), and helping, on the other, to enable certain academics, particularly those new to the field and those outside of the so-called Anglophone centre (see Lillis and Curry 2010), to participate in their chosen disciplinary discourses.

## **1.2 Aims and Research Questions**

The overall aim of this thesis is to investigate how medical researchers engage with a background of prior and anticipated utterances, as construed visually, verbally, and mathematically in a collection of highly cited English-language medical research articles. The main research questions are as follows.

- What visual, verbal, and mathematical resources do medical-research writers use in order to construe, engage with, and position themselves in relation to a background of prior and anticipated utterances?
- What roles or functions do those resources have, and how are they typically integrated or combined?
- How are those resources distributed across research articles?
- To what extent might the use of those resources reflect, or refract, the disciplinary practices of medical research?

In order to tackle these questions, I adopt several interrelated theoretical approaches, drawing in various ways on dialogic theory, social semiotics, systemic functional linguistics, multimodality, and anthropological and sociocultural approaches to health and illness, as well as methods and analytic techniques from corpus linguistics. As a consequence of applying some of those theories and methods to medical research discourse, I propose a number of modifications or refinements that might be useful for related studies.

### **1.3 Organization of the Thesis**

The thesis is organized as follows. Chapter 2 provides an overview of dialogic theory and social semiotics, and discusses the complementarity of those two traditions. This discussion serves as the basis for chapter 3 and the development of a conceptual framework for analysing types and means of engagement. Chapter 4 presents and discusses previous studies of medical research, situating the thesis in a wider linguistic, multimodal, and discourse-analytic context, and thus providing a deeper rationale for the study. Chapter 5 accounts for the material and methods used in the thesis, and includes a critique of said material and methods. Chapters 6–8 present study findings. The first of these, chapter 6, discusses verbal and mathematical engagement; the second, chapter 7, discusses visual engagement; and the third, chapter 8, acts as a synthesis of the previous two, discussing the synergy of visual, verbal, and mathematical engagement in text. In chapter 9, I summarize and conclude the thesis, commenting on the engagement framework, its use and relevance for the discourse-analytic study of medical research, and some of the practical implications of the work, particularly with regard to the field of academic literacies.

## 2 Dialogic Theory and Social Semiotics

In this chapter, I present and discuss two interrelated theories of language and communication. These two approaches form the basis for a conceptualization of engagement, in chapter 3, which in turn provides frameworks for the analyses in chapters 6–8. I begin with a summary of Bakhtinian dialogic theory (section 2.1). This is followed by a social semiotic account of language and other meaning-making resources (section 2.2) in which I highlight and discuss important complementarities between dialogic theory and social semiotics.

### 2.1 Dialogism and the Bakhtin Circle

Bakhtin (1981 [1935], 1986) and Vološinov (1973 [1929]), part of the so-called “Bakhtin Circle”, propose a dialogic theory of language, in which every utterance in some way refers to or responds to prior and anticipated utterances, as part of a socially situated, ongoing colloquy or dialogue among a given social collective, in an immediate and broader situation (see section 1.1).<sup>1</sup> For Bakhtin and Vološinov, utterances are units of speech communication, i.e. units of meaning, rather than formal units of language (Bakhtin 1986). Unlike the words, phrases, and clauses that partly encode them (Dentith 1995, 36, Fairclough 1992, 102), utterances correlate “directly or personally with the extraverbal context of reality (situation, setting, pre-history)” and “with the utterances of other speakers” (Bakhtin 1986, 73), and “are determined by the particular *situation* [...] and its *audience*” (Vološinov 1973 [1929], 96, emphasis in original).

An important concept with regard to the Bakhtin Circle’s dialogic view of language is “heteroglossia”. Bakhtin (1981 [1935]) uses the term (*raznorecie, raznorecivost’* in Russian; lit. “multi-speechedness” or “multi-

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<sup>1</sup> The “Bakhtin Circle” is a term commonly used to refer to the collective intellectual activities and works of Bakhtin, Vološinov, Medvedev, and others in 1920s and 1930s Soviet Russia (see Dentith 1995, Holquist 2002, Freedman and Ball 2004). The term also refers, at least obliquely, to an ongoing debate regarding the origin of certain works published under the names of Vološinov and Medvedev, and the disputed claim that those works may have been written by Bakhtin. For further discussion, see Dentith (1995, 8–10), Titunik (1986, 93–95, Preface in Vološinov 2012 [1976], xvii–xxi), Holquist (2002, 2, 207–209), and Clark and Holquist (1984, chapter 6), among others.

voicedness”; heteroglossia = “other-voicedness” in English) to describe the multiplicity and interrelation of voices encoded in an utterance. Utterances are heteroglossic in that they draw upon and transform certain prior utterances (cf. intertextuality; Kristeva 1984, Dentith 1995). They are, for Wertsch (1998, 78), an appropriation of the words of others, part of a process of “re-voicement” (Dore 1989, in Thibault 2004, 100–101), in which utterances from “other people’s mouths, in other people’s contexts, serving other people’s intentions” are made one’s own (Bakhtin 1981 [1935], 294)—“though never becoming wholly so” (Dentith 1995, 54). The specific meanings of those utterances are contextually unique, determined by a complex set of “social, historical, meteorological, [and] physiological” conditions (Holquist, in Bakhtin 1981 [1935], 428).

According to Vološinov (1973 [1929], 96), some of the most typical forms of the “outwardly actualized utterance” are the “full-fledged question, exclamation, command, [and] request”.<sup>2</sup> To these, Bakhtin (1986, 60–61) adds “short rejoinders”, “commentary”, “scientific statements”, and “the multivolume novel”, to name a few, and notes that all spheres of communication develop a repertoire of relatively stable types of utterances, or “speech genres”. These speech genres share similarities in terms of their thematic content, style, and composition (Bakhtin 1986, 60), and “differ depending on the situation, social position, and personal interrelations of the participants in the communication” (Bakhtin 1986, 79). Speech genres vary in terms of their formal and functional complexity, as the examples above from Bakhtin and Vološinov suggest, and they “differentiate and grow as the particular [cultural] sphere develops and becomes more complex” (Bakhtin 1986, 60).

According to Bakhtin (1986, 62), so-called “secondary” or “complex” speech genres, like “novels, dramas, all kinds of scientific research, major

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<sup>2</sup> Vološinov (1973 [1929]) makes a distinction between outer and inner speech, but both, in order to have meaning, are considered “*sociological* in character” (Vološinov 2012 [1976], 26). Vološinov (1973 [1929], 96) describes the relation thus: “The outwardly actualized utterance is an island rising from the boundless sea of inner speech”, where the “[s]ituation and audience make inner speech undergo actualization into some kind of specific outer expression that is directly included into an un verbalized behavioral context and in that context is amplified by actions, behavior, or verbal responses of other participants of the utterance”.

genres of commentary, and so forth” are “ideological”. That is, they reflect certain social and historical views of the world, a particular social group’s “system of ideas” (Freedman and Ball 2004, 4–5), its “values and accents” (Dentith 1995, 105; see also Vološinov 1973 [1929], 21–22), and “the realized, materialized, externally expressed social consciousness” of the “ideological environment” (Bakhtin and Medvedev 1978 [1928], 14).<sup>3</sup> Bakhtinian scholars Freedman and Ball (2004, 6) argue that this ideological environment mediates the “ideological self”, i.e. “how we develop our way of viewing the world, our system of ideas” (Freedman and Ball 2004, 5), and that the ideological self is oriented to, determined by, and in turn determines the ideological environment (Bakhtin and Medvedev 1978 [1928], 14, Freedman and Ball 2004, 5). For Bakhtin, then, utterances are “ideologemes” that reveal something of the ideologies of the speaker—the “ideologue”—and the cultural sphere—the “ideological environment” (Bakhtin 1981 [1935], 333, Holquist, in Bakhtin 1981, 429, Kristeva 1984, 36–38).

## 2.2 Social Semiotics

Social semiotics is a theory of signs in society, with a particular emphasis on meaning-making as social practice (see Hodge and Kress 1988, van Leeuwen 2005). Hodge and Kress (1988, 15, 18–19) and van Leeuwen (2005, 3–4) both acknowledge Vološinov’s (1973 [1929]) work as one of the bases for social semiotics, and there is considerable overlap between the two, not least in their conceptions of linguistics as a form of social action (see, for example, Vološinov 1973 [1929], 23, Dentith 1995, 21,

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<sup>3</sup> According to Holquist (in Bakhtin 1981 [1935], 429) and Freedman and Ball (2004, 4–5), “ideology”, as used by Bakhtin (1981 [1935]), and as generally used in Russian, refers to worldview or a system of ideas, and is not necessarily restricted to an overtly political, propagandistic, or dogmatic sense of the term, as it might in its more general sense in English. Political ideas or doctrines are included in this conception, but not to the exclusion of other parts of the idea system (Freedman and Ball 2004, 5, Hodge and Kress 1993, 6), such as religion, education, and the family (Althusser 2014 [1995]). For further discussion of ideology, see section 2.2.1.5.3.

Martin 1992, 575, Halliday 2013, 15), as “a mode of intervention in critical social practices” (Halliday 2003 [1993], 223).<sup>4</sup>

Some scholars, however, are critical of the “explanatory and descriptive power” of Vološinov’s and Bakhtin’s frameworks, particularly with regard to the concepts of utterance and speech genre (Hasan 1992, 503). Hasan (1992, 509–513) argues that Bakhtin and Vološinov do not provide an apparatus for distinguishing different orders of abstraction, that they do not sufficiently explicate the relation between text and context, and that their work generally reveals a disregard or “disdain” for language as system. This section provides an introduction to social semiotics that, in part, highlights some of the ways in which social semiotics might complement and add descriptive and explanatory power to the work of Bakhtin and Vološinov. These sections also provide much of the theoretical basis for this thesis.

### **2.2.1 Systemic Functional Linguistics: Language as Social Semiotic**

Systemic functional linguistics (SFL) models language as a social semiotic system (Halliday 1978). Language is considered a “systemic” resource, in which meaning, or “function”, is determined by choice, “by the selection of one option rather than another, among the set of options that are available in a given environment” (Halliday, in Martin 2013, v, see also, more generally, Halliday 1978, 2009).

#### **2.2.1.1 Semiotic Dimensions of Language**

SFL describes “natural, human, adult, verbal language” (Halliday and Matthiessen 2004, 20)—in contrast to “protolanguage”—in terms of several semiotic dimensions, including stratification, instantiation, metafunction, axis, and rank (see Halliday and Matthiessen 2004, Matthiessen 2007a, Matthiessen, Teruya, and Lam 2010). Together, these

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<sup>4</sup> Despite the explicitly Marxist approach of Vološinov’s *Marxism and the Philosophy of Language and Freudianism: A Marxist Critique* (Vološinov 1973 [1929], 2012 [1976]), Dentith (1995, 13–15) suggests that Bakhtin, writing in the political climate of Soviet Russia at the time, may partly have been “obliged to make an accommodation with Marxism” (Dentith 1995, 15). An overtly Marxist influence is perhaps less obvious in Bakhtin’s “Discourse in the Novel” and “The Problem of Speech Genres” (Bakhtin 1981 [1935], 1986) than in other works associated with the Bakhtin Circle.

dimensions provide a framework for the study of language in context. In the following sections, I briefly discuss each of these semiotic dimensions. A summary is provided in Table 2.1 and Figure 2.1.

Table 2.1. Semiotic dimensions of language in context, adapted from Halliday and Matthiessen (2004), Matthiessen (2007a), Matthiessen, Teruya, and Lam (2010), and Fryer (2019). Numbers in parentheses in the leftmost column refer to labels in Figure 2.1.

<b>Dimension</b>	<b>Type and relation</b>	<b>Orders</b>
Stratification (1)	Hierarchy of realization	context – content plane (semantics – lexicogrammar) – expression plane (phonology/graphology – phonetics/graphetics)
Instantiation (2)	Scale of generalization	potential – subpotential/instance-type – instance
Metafunction (3)	Simultaneous strands of meaning	ideational (logical + experiential) / interpersonal / textual
Axis (4)	Hierarchy of realization	paradigmatic – syntagmatic (system – structure)
Rank (5)	Hierarchy of composition	Examples: sequence – move/message/figure – element (for semantics) clause – phrase/group – word – morpheme (for lexicogrammar)

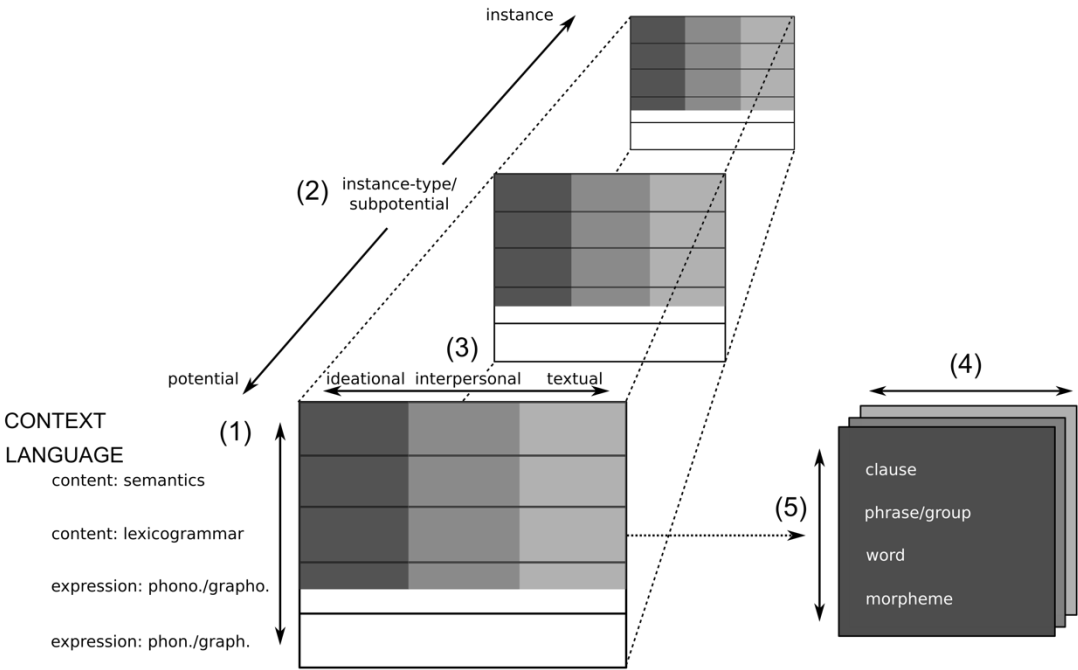


Figure 2.1. Semiotic dimensions of language in context, adapted from Halliday and Matthiessen (2004, 21). Numbers in parentheses refer to numbering in the leftmost column of Table 2.1.

**2.2.1.1.1 Stratification**

The study of language is typically organized into a number of intersecting fields of inquiry, including phonology, morphology, syntax, and semantics. In SFL, these different levels of symbolic abstraction, and the relations between those levels, are described in terms of stratification. At the lowest level of abstraction, i.e. the material base of language, are the strata of phonetics and phonology (or graphetics and graphology in the case of written language), the so-called “expression plane”; at higher levels of abstraction are the strata of lexicogrammar and semantics, the “content plane” (after Hjelmslev 1961 [1943], 1947). This stratified linguistic system is embedded in context (see dimension (1) in Table 2.1 and Figure 2.1). In some models of SFL, the stratum of context is itself further stratified, as register, genre, and ideology (see Martin 1992, 1993, and section 2.2.1.5).

The relations between strata are hierarchic, and the linking of one level of organization with another is referred to as “interstratal realization” (Halliday and Matthiessen 2004, 26). Patterns of choices at



one stratum are said to realize or redound with patterns of choices at the next (see section 2.2.1.1.4 on the role of choice in SFL). For example, with regard to the relation between strata in the content plane, meanings at the level of semantics can be “realized (coded, expressed) by, mapped onto, or projected through wordings” at the level of lexicogrammar (Matthiessen 1995, 4). So, a question, as a unit of meaning, is partly expressed or realized by a particular configuration of wordings, one that is likely different from that used to express or realize a statement or command.

### 2.2.1.1.2 Instantiation

Saussure’s (1959 [1915]) distinction between *langue* and *parole*, language as system and language as speech (or language in use), is generally treated as a matter of instantiation in SFL (see Halliday 1991, 2007 [1991], 2005 [1992]). Instantiation is a cline or continuum between the overall meaning potential of a language, i.e. language as system, and a particular instance of language as text, with repertoires of registers or text-types/genres between the potential–instance poles (see dimension (2) in Table 2.1 and Figure 2.1). For example, starting at the instance pole, we might study a single text. From there, as Halliday and Matthiessen (2004, 26) note, we can move along the cline of instantiation, making a series of linguistic generalizations as we study more and more texts, that take us ever closer to language as system. However, we never quite get there. The system is “a theoretical entity,” an abstract generalization, “to which we can assign certain properties and which we can invest with considerable explanatory power”, but which is always more than “the sum of all possible texts” (Halliday and Matthiessen 2004, 27, see also Halliday 1978, 109).<sup>5</sup>

Similarly, from the perspective of context, instantiation distinguishes between the overall “context of culture” (potential) and the

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<sup>5</sup> Martin and Rose (2007, 310) propose a cline of instantiation that extends the instance pole to include the “subjectified meanings” that emerge from individual readings of texts. According to Martin and Rose (2007, 310–311), those readings are of three basic types: compliant, resistant, and tactical. Compliant readings include those meanings in which the reader is generally in agreement with or not adverse to the positions of the textual voice; resistant readings are those in which the reader may be opposed to or disagree with the positions construed by the textual voice; and tactical readings are those in which a reader selects only those readings that are best suited to the reader’s own positions or interests.

specific “context of situation” (instance) (from Malinowski 1923, 1935), with different institutions and situation-types located between the two poles (cf. Vološinov’s immediate and broader situations, and Bakhtin’s concrete situation and cultural spheres; section 2.1). As with language, the overall context of culture is a theoretical construct, the total description of which necessarily lies beyond our reach (Halliday 1978, 109).

Figure 2.2 depicts the clines of instantiation for language and context, and the relations between them. For Halliday (2007 [1991], 275), the figure shows that the “context for an instance of language (text) is an instance of culture (situation). And the context for the system that lies behind each text (language) is the system which lies behind each situation—namely, the culture.”

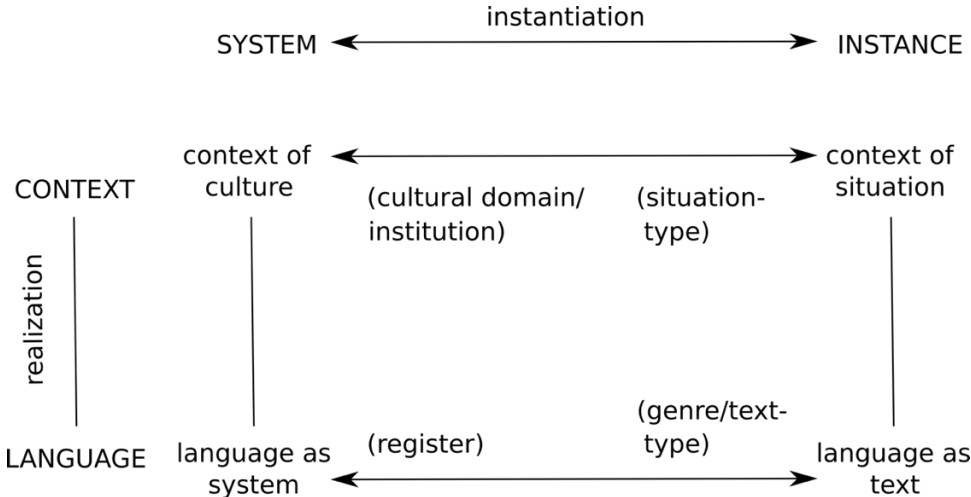


Figure 2.2. Language and context, system and instance, adapted from Halliday (2007 [1991], 275), Matthiessen (2015), and Mwinlaaru (2017).

**2.2.1.1.3 Metafunction**

According to Halliday and others, language has evolved to function or mean in a number of fundamental ways: it construes our experiences of the world, it enacts our social relations, and it organizes those meanings into coherent units (see Halliday 1968, 1974, 1978, Halliday and Matthiessen 2004, Matthiessen 2007a, Matthiessen, Teruya, and Lam 2010, inter alia). These three strands of meaning, commonly referred to as the ideational, interpersonal, and textual metafunctions, respectively, are simultaneously encoded in language, across strata (see dimension (3) in

Table 2.1 and Figure 2.1). When language is instantiated as text (see section 2.2.1.1.2), the “text is a product of all three [metafunctions]; it is a polyphonic composition in which different semantic melodies are interwoven, to be realized as integrated lexicogrammatical structures. Each functional component contributes a band of structure to the whole” (Halliday 1978, 112).

Martin (1992, 7 ff.) provides a number of examples of this metafunctional diversity. The clause *Marvin is parking the spaceship*, for example, construes a process of action (*parking*) involving two participants (*Marvin* and *the spaceship*). It also enacts part of an exchange, functioning as a statement (as opposed to a question or a command) that can be variously questioned, challenged, contradicted, accepted, and so on. Moreover, the clause is organized in such a way as to fit in or connect with a broader discourse, where *Marvin* is chosen as the “point of departure” (Halliday and Matthiessen 2004, 64) for the message rather than, say, *the spaceship*. All of those meanings are simultaneously encoded by the clause, and each clause element plays multiple roles in construing those meanings. Thus, *Marvin*, for example, functions simultaneously as Actor, Subject, and Theme (Martin 1992, 7).

#### 2.2.1.1.4 Axis

As noted above, in the SFL framework, language is considered a semiotic system. More precisely, it is referred to as “polysystemic”, i.e. a system of complementary systems (Matthiessen, Teruya, and Lam 2010, 161–162). Axis relates system and structure (cf. Firth 1962), by distinguishing between choice within a system and the chain or structure derived from selections within that system (Halliday 2002 [1963]). Axis is similar to Saussure’s (1959 [1915]) associative (paradigmatic) and syntagmatic relations, where the associative or paradigmatic refers to the “choice axis” (what could be or might have been) and syntagmatic to the “chain axis” (the interrelations of actualized elements). In SFL, the relation between the paradigmatic and syntagmatic is hierarchic and described in terms of axial realization (dimension (4) in Table 2.1 and Figure 2.1; cf. “interstratal realization”, section 2.2.1.1.1), where “paradigmatic patterns are realized by syntagmatic ones” (Matthiessen, Teruya, and Lam 2010, 61).

Paradigmatic systems are organized metafunctionally (see section 2.2.1.1.3) and are typically represented by system networks that show the interrelation of options within a system (Halliday 2002 [1966], 2002 [1977], Fawcett 1988). Each of those options can be realized structurally/syntagmatically, and represented in the form of realization statements (Halliday 2002 [1966], 2002 [1977], Fawcett 1988). For example, the MOOD system for independent clauses in English is part of the interpersonal metafunction, since it is through this system that speech function (statements, questions, commands, and offers) and the roles of interlocutors are encoded (Matthiessen, Teruya, and Lam 2010, 146-147).<sup>6</sup> The system can be represented as a choice between the indicative or the imperative; an independent clause cannot be both mood-types simultaneously (see Figure 2.3). Moreover, each of these types is itself an entry point to further suboptions of increasing delicacy within the system. Choosing, for example, a yes-no (closed) interrogative involves a conceptual traversal of the MOOD system, along the pathway [indicative: interrogative: yes-no]. The selection is realized structurally/syntagmatically by a Finite followed by a Subject (see Figure 2.3), e.g. *Are (F) you (S) parking the spaceship?* Part of the meaning of the choice of a yes-no interrogative thus lies in its associative or paradigmatic relation with the other choices or options in the system, i.e. those that were not chosen but could have been, or those that were “chosen not to be chosen” (Halliday 2013, 25–26). Text, then, can be interpreted as “the process of continuous movement through the system, a process which both expresses the higher orders of meaning that constitute the ‘social semiotic’, the meaning systems of the culture, and at the same time changes and modifies the system itself” (Halliday 2002 [1977], 48).

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<sup>6</sup> In SFL, system names are written in small capitals, e.g. MOOD (see Matthiessen, Teruya, and Lam 2010, Martin 2013, Halliday and Matthiessen 2014, inter alia). Options or features within those systems are indicated by square brackets or single quotes, e.g. [indicative] or ‘indicative’, and colons are used to specify selection paths or feature relations, e.g. [indicative: interrogative: yes-no] (see Figure 2.3). Functional elements, e.g. Subject, are distinguished from structural elements such as nouns or nominal groups by initial capital letters. I follow this nomenclature throughout the thesis.

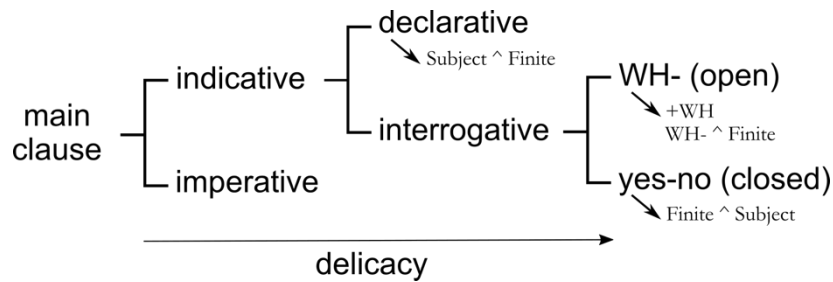


Figure 2.3. System network for MOOD.

According to Halliday (1991), choices in systems like the one represented in Figure 2.3 tend to be either “equiprobable” (0.5/0.5) or “skewed” (typically 0.9/0.1), rather than being distributed across the whole scale of probability values. For Halliday (1991, 45), this tendency is a property of language as system, which he describes as “inherently probabilistic”. Equiprobability across all choices in all systems cannot occur, because such systems would not allow for change, while a spread of “all possible [probability] values” would make “a semiotic system of this kind [...] virtually impossible to learn” (Halliday 1999, 69). In the case of MOOD (Figure 2.3), selection probabilities are typically skewed (0.9/0.1) for indicative/imperative and declarative/interrogative, and equiprobable for yes-no/WH- interrogatives.<sup>7</sup> However, the relative skewness of those choices may be affected, among other things, by co-textual conditioning and by contextual constraints. An interrogative, for example, generally “favours” a declarative response and “disfavours” another interrogative (Nesbitt and Plum 1988, in Halliday 1999), while the setting of an interview may place different constraints on the choice between indicative and imperative than, say, the instructions in a cookbook.

<sup>7</sup> Selection probabilities can be “local” or “global” (Matthiessen, Teruya, and Lam 2010, 164). Local selection probabilities characterize choices within a system, at the same level of delicacy; global selection probabilities characterize choices at the level of the overall system. In the case of MOOD, for example, the local selection probability for a yes-no interrogative may be 50%, but its global selection probability within the overall MOOD system is likely to be considerably lower, i.e. under 10%.

### 2.2.1.1.5 Rank

The semiotic dimension of rank describes the compositional aspect of language (Halliday and Matthiessen 2004, 20). Compositional layers or constituents are organized hierarchically in a rank scale, into what Matthiessen (2007a, 510) calls “a division of semiotic labour”, where the units of one rank are composed of units of the rank directly below. The rank scale for lexicogrammar (see dimension (5) in Table 2.1 and Figure 2.1) is clause – phrase/group – word – morpheme, in which a clause is said to be composed of one or more groups or phrases, a group or phrase of one or more words, and a word of one or more morphemes. Rank scales for other strata such as semantics and phonology include sequence – move/figure/message – element (Halliday and Webster 2009, 237, Matthiessen, Teruya, and Lam 2010, 206-207, see also Hasan 1996, 117-118) and tone group – foot – syllable – phoneme (Halliday and Matthiessen 2004, 11-20, Matthiessen, Teruya, and Lam 2010, 170), respectively.

Despite their hierarchic composition, rank scales allow for downward “rankshifting” (Halliday 2002 [1961]), whereby constituents higher up the rank scale, e.g. clauses and phrases, can serve as parts of constituents at a lower rank, e.g. groups and words. A clause can thus be downranked to serve as a Qualifier in a nominal group, e.g. *//The job [[I want]] was advertised//*, allowing more information to be packed into matrix clauses (O'Halloran 2005, 66-67).<sup>8</sup>

### 2.2.1.2 Trinocularly

One of the consequences of a stratified model of language in context is that strata, and the systems within them, can be examined from three interrelated perspectives. A lexicogrammatical system, for example, can be viewed “from below” in terms of its phonologic or graphologic expression or realization. It can also be viewed “from above” with regard to the kinds of semantic meanings it realizes, and “from round about”, i.e. “from the standpoint of lexicogrammar itself” (Halliday 2002 [1996], 408). The same perspective can be applied to semantics: we can look at a given semantic

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<sup>8</sup> In this example from O'Halloran (2005, 66), // marks the boundaries of the main or matrix clause and [[...]] indicates an embedded clause.

system “from below” in terms of its lexicogrammatical realizations, “from above” with regard to context and social practice, and “from round about” in terms of the relations of choices within the system and the relations of those choices to other semantic systems (Halliday 1973, 76). This trinocular principle implies a compromise according to Halliday (2002 [1996], 408–409), one that requires de-privileging a primarily (or exclusively) bottom-up or top-down approach to language and meaning.<sup>9</sup>

### 2.2.1.3 Grammatical Metaphor

The relation between wordings at the lexicogrammatical stratum and meanings at the semantic stratum (interstratal realization) can be described in terms of their typicality or congruence. A question, for example, is a semantic move (see rank scale in section 2.2.1.1.5), a speech function that is typically or most congruently realized lexicogrammatically in English by an interrogative clause (see MOOD network in Figure 2.3). Similarly, processes, participants, and circumstances—the semantic elements that comprise a figure (see rank scale in section 2.2.1.1.5)—are most congruently encoded by groups or phrases in a clause. Other, less congruent mappings are possible, however. A question might be realized by a declarative (e.g. *You’re sure about that?*), and the clausal realization of processes and their participants might be reconfigured as a single group (e.g. *Cells develop... → Cell development...*, or *We suggest... → Our suggestion...*). These less congruent or potentially less typical mappings between meanings and wordings are referred to as “grammatical metaphor” (see Simon-Vandenberg, Taverniers, and Ravelli 2003, Halliday and Matthiessen 2004, chapter 10), where

some aspect of the structural configuration of the clause [...] is in some way different from that which would be arrived at by the shortest route—it is not, or was not originally, the most straightforward coding of the meanings selected. This feature is not to be interpreted as something negative or deviant; it is partly in order to avoid any such connotations that we have used the term ‘metaphorical’ rather

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<sup>9</sup> Trinocularly is not only an interstratal perspective. According to Matthiessen, Teruya, and Lam (2010, 233–234), it can also be applied to the semiotic dimensions of instantiation, axis, and rank (see relevant sections above), as well as more globally to the relations between physical, biological, social, and semiotic systems (e.g. Matthiessen 2007a, 545–547, 2009, 14).

than ‘incongruent’. But it is something that needs to be accounted for in an adequate interpretation of a text.

(Halliday and Matthiessen 2004, 658) <sup>10</sup>

Grammatical metaphor is a common feature in all registers of English, but for Halliday (1994) it is characteristic of the “language of science” (see Banks 2003, 2005 for an historical perspective on the development of grammatical metaphor in scientific English). Grammatical metaphor is central to scientific reasoning, enabling “complex sequences of text to be ‘packaged’ so as to form a single element in a subsequent semantic configuration” (Halliday and Martin 1994a, 15). Nominalization, a form of grammatical metaphor in which a process is reconfigured as a participant or thing (see the *Cells develop* → *Cell development* example above), allows science to “[hold] reality still,” to observe it and experiment with it, as something persistent over time (Halliday and Martin 1994a, 15).<sup>11</sup> Halliday (1994) argues that semantic/lexicogrammatical reconfigurations like these may be difficult for learners of science to interpret and use, and can present a challenge for those involved in scientific or academic literacies.

#### 2.2.1.4 Semogenesis

Halliday and Matthiessen (1999, 17–18) argue that meaning is created over time. This process of meaning creation, or “semogenesis”, can be considered from three interrelated timeframes: “phylogenetically”, as a particular language evolves, over many generations; “ontogenetically”, as a particular individual develops, over the course of a lifetime; and “logogenetically”, as the act of meaning unfolds in a particular instance of language, in the timespan or space of a single text. It is with the logogenetic perspective that this thesis is primarily concerned.

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<sup>10</sup> Kress (1995, 126–127) questions the use of the term metaphor, arguing that those who regularly use such formulations are unlikely to view them as “metaphorical”. Rather, such forms will, if anything, be considered highly congruent for those individuals and groups who use them habitually across social practices.

<sup>11</sup> The term “nominalization” refers directly to the process of “making into a noun” (OED).



### 2.2.1.5 Context

In SFL, context is modelled as a higher-level stratum, above or superordinate to language (see section 2.2.1.1.1 and Figures 2.1 and 2.2). For Halliday (2007 [1991]), context extends along a cline of instantiation, with culture at one end (potential) and situation at the other (instance). Between those two poles lie social institutions and situation-types, where a particular institution, say a university, embodies a whole range of situation-types, such as lectures, tutorials, and student–staff meetings. In this model (see Figure 2.2), institutions provide the semiotic environment for registers, i.e. varieties of language, and situation-types provide the semiotic environment for text-types or genres (Matthiessen, Teruya, and Lam 2010, 126).

Martin (1985, 1992, 1993) offers an alternative model, in which context is treated as a “connotative semiotic which has language [and other denotative semiotic systems] as its expression plane” (Martin 1992, 493; cf. Hjelmslev’s 1961 [1943], 1947 content and expression planes for language; section 2.2.1.1.1). In this model, context is stratified into register, genre, and ideology, where ideology (the uppermost stratum) is realized by recurrent configurations of genre, genre by recurrent configurations of register, and register by recurrent configurations of language. This interstratal relationship is shown in Figure 2.4 as a set of nested concentric-like spheres or circles, where larger circles are said to recontextualize smaller ones and where the relative sizes of those circles are intended to reflect “the fact that the analysis tends to focus on larger units as one moves from phonology to ideology” (Martin 1992, 496).

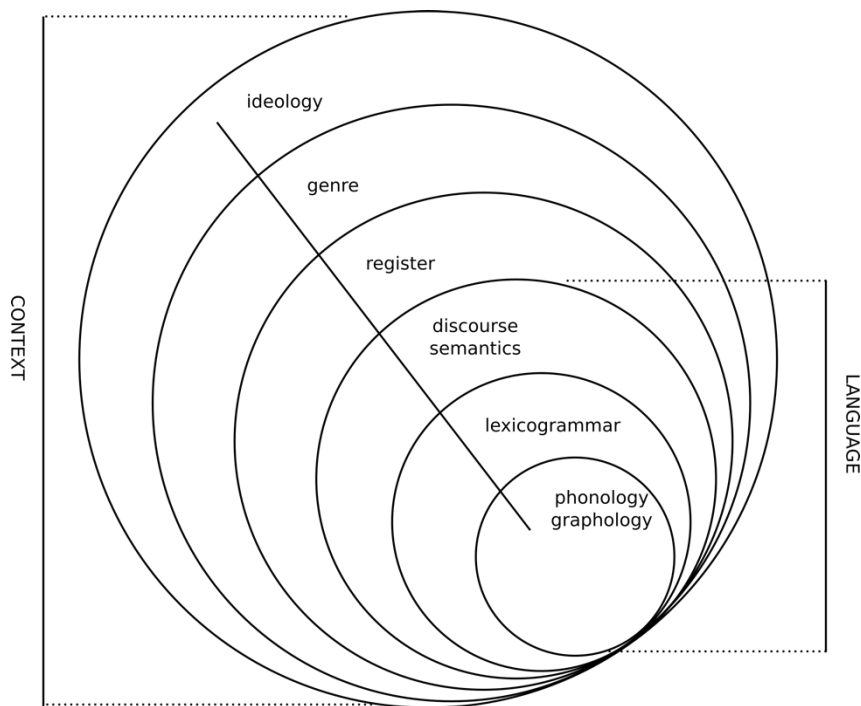


Figure 2.4. Martin's (1992) stratified model of language and context, adapted from Martin (1992, 496).

### 2.2.1.5.1 Register

While Halliday locates register, the functional variety of language, in the realm of semantics (e.g. Halliday and Hasan 1985, 38), Martin (1992) uses the term to refer to a separate stratum of context, one that is a metafunctionally organized connotative system in its own right, an interface between language and genre (see Figure 2.4). Martin conflates Halliday's notions of register and the discourse variables field, tenor, and mode (e.g. Halliday 1978, Halliday and Hasan 1985), where

[t]he field of discourse refers to what is happening, to the nature of the social action that is taking place [...] The tenor of discourse refers to who is taking part, to the nature of the participants, their statuses and roles [...] The mode of discourse refers to [...] the symbolic organization of the text, the status that it has, and its function in the context, including the channel [...] and also the rhetorical mode.

(Halliday and Hasan 1985, 12)

Those discourse variables are posited to “hook up” or connect with the ideational, interpersonal, and textual metafunctions (see section 2.2.1.1.3), so that field is generally expressed experientially, tenor

interpersonally, and mode textually (Halliday and Hasan 1985, 24–26, Martin 1992, 494).

### 2.2.1.5.2 Genre

Genre is a widely used term in literary and literacy studies, typically referring to groups of texts that share certain thematic, structural, and linguistic characteristics (see Kress 1993, Hyon 1996, Yunick 1997, Bazerman, Bonini, and Figueiredo 2009, among others). In social semiotics, genres are defined as “socially ascribed classifications of semiotic form”—they are an encoding of social practices, of the relations of participants, and of their expectations and purposes (Hodge and Kress 1988, 7).<sup>12</sup>

Martin (1992, 505) defines genre as “a staged, goal-oriented social process realised through register”.<sup>13</sup> That is:

*Staged*, because it usually takes us more than one step to reach our goals; *goal oriented*, because we feel frustrated if we don’t accomplish the final steps [...]; *social*, because writers shape their texts for readers of particular kinds.

(Martin and Rose 2008, 6, emphasis added)

Martin’s (1992) discussion of genre focuses on service encounters, narratives/stories, and factual texts. The latter, of particular relevance to this thesis, can be classified, according to Martin (1992), in terms of activity-structured and non-activity-structured texts that either generalize across experience, e.g. Recount, Procedure, Explanation, and Exploration, or refer to “a specific manifestation of a culture,” e.g. Description, Report, Exposition, and Discussion (Martin 1992, 562–563).

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<sup>12</sup> Similar definitions of genre can be found in related fields such as rhetoric and applied linguistics. For example, Miller (1984, 159) defines genres as “typified rhetorical actions based in recurrent events”, and Swales (1990, 58) defines them as “compris[ing] a class of communicative events, the members of which share some set of communicative purposes”.

<sup>13</sup> In Halliday’s model of language in context (Halliday 1978, Halliday and Hasan 1985, Halliday and Matthiessen 2004, 2014, inter alia), the term genre is rarely used, partly it seems to avoid possible confusion with its use in literary analysis (Matthiessen, Teruya, and Lam 2010, 106). Instead, social practices, relations of participants, and expectations and purposes are modelled in terms of register and text-type (see sections 2.2.1.1.2 and 2.2.1.5.1).

These genres are related axially, i.e. the meaning of one genre lies partly in its paradigmatic relation with the others (see section 2.2.1.1.4). Martin (1992, 563) also claims that the network they form “is comprised of ideational, interpersonal and textual features and thus cuts across register variables [field, tenor, and mode] to bring out the oppositions between the genres” (see section 2.2.1.1.3).

Texts in which two or more generic stages are combined, integrated, or co-deployed are referred to as “macro-genres” (Martin and Rose 2008, 216 ff., cf. Bakhtin 1986, 80, on complex speech-genres). Hood (2010) describes the academic research article as an example of a macro-genre, where one can, for example, distinguish “the procedural *recount* of a methodology segment from a *report* on findings” (Hood 2010, 6, emphasis added). In their work on genre relations, Martin and Rose (2008, 79) distinguish between the generic stages and phases of a text, where “stages of a genre are relatively stable components of its organization [... and] unfold in highly predictable sequences” and phases, which are the constituent elements of a stage, may be more variable, less predictable, and potentially unique to particular texts.

### **2.2.1.5.3 Ideology**

Martin models ideology as the uppermost stratum of context (see Figure 2.4), as a system of “coding orientations” (after Bernstein 1981). Coding orientations are sets of dynamic, culturally determined regulative principles that select and integrate relevant meanings, realizations, and specialized interactional practices (Bernstein 1981, 328 ff.). For a given social group, certain semiotic choices will be considered more appropriate or legitimate than others (Bernstein 1981, 329). Access to and control of the regulative principles that determine those choices can depend on a variety of possible factors, including social actors’ expertise, class, gender, ethnicity, generation, and/or capacity (Bernstein 1981, 336–337, Martin 1992, 576, 581, Martin and Rose 2008, 18).<sup>14</sup>

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<sup>14</sup> In a similar vein, Vološinov (1973 [1929], 10) writes: “Each field of ideological creativity has its own kind of orientation toward reality and each refracts reality in its own way”.

Kress and van Leeuwen (Kress and van Leeuwen 1996, 2006, van Leeuwen 1999) propose a number of distinct yet potentially overlapping coding orientations. Naturalistic coding orientations, for example, hold that semiotic choices should reflect or articulate as closely as possible some form of “natural reality”. In sensory coding orientations, on the other hand, the emotive or sensory is given precedence, favouring “more-than-real” representations to create potentially greater emotional impact. In contrast, technological or abstract coding orientations may value “effectiveness” over naturalistic or sensory representations, providing a blueprint for how to do something by reducing “the concrete to its essential qualities” (Kress and van Leeuwen 2006, 165). In scientific contexts, it is usually the latter, abstract/technological coding orientation that predominates (Kress and van Leeuwen 2006, 165).<sup>15</sup> As Hyland (2000, 18) notes, “the conventions of the research article are shaped by the ideological assumptions of the discipline and reinforced by both routine use and the customary procedures of academic quality control”.

### **2.2.2 Multisemiosis: Text as Multisemiotic Instantiation**

Vološinov (1973 [1929], 15) notes that language alone does not construe the ideological environment. It is not the only “ideological sign”, and, as Hasan (1996 [1986], 146) puts it:

a linguist who would aspire to throw light on the construction and maintenance of ideology, must be prepared, first, to place the verbal semiotic side by side with other semiotic systems, and secondly, to examine the ways in which the various semiotic systems of a culture are calibrated to produce recognizable semiotic styles.

Hodge and Kress (1988, vii), in their introduction to social semiotics, make a related point:

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<sup>15</sup> Although regulative principles determine to a large extent how social actors behave and respond in particular social settings, context need not precede action (see O'Donnell 1999). Social actors can and do behave in “contextually-inappropriate” ways for reasons that might include creativity, pretense, and/or the negotiation of new situational contexts (see O'Donnell 1999, 89). The relation between context and action (or text) can be seen as a partly reciprocal one. Moreover, coding orientations are not mutually exclusive. Certain discourses may be regulated by principles from different coding orientations. An example of this is the abstract/technological and sensory hybridity often seen in contemporary popular science (Fryer 2015).

no single code can be successfully studied or fully understood in isolation. So, a theory of verbal language has to be seen in the context of a theory of all sign systems as socially constituted, and treated as social practices.

With regard to instantiation (see section 2.2.1.1.2), text is more than an instance of language; it is an instantiation and integration of verbal and/or nonverbal semiotic resources. It is multisemiotic.<sup>16</sup> A scientific text, like a research article, is a hybrid of verbal, visual, and/or mathematical resources (Lynch and Woolgar 1990, Lemke 1998, Baldry and Thibault 2006), and it is only by examining the contributions made by those different semiotic systems in semiotic environments that we can understand how a text might mean, i.e. the meaning potential afforded by a particular text (Martin 2008a, 33–34).

The multisemiotic approach implies a number of challenges or questions for the analyst (see Matthiessen 2007b, 2009, Martin 2011). For example, what distinguishes one semiotic, or meaning-making system, from another? Do all semiotics have the same architecture as language? If not, how and why do they differ? And how are the resources of different semiotics deployed and integrated in instances of text?

Those questions—or responses to those questions—are a useful guide in presenting and discussing different nonverbal semiotic systems. In the following sections, I use them as the basis for an account of the semiotic resources of visual display (section 2.2.2.1) and mathematical symbolism (section 2.2.2.2), two systems of representation that, alongside language, are most typical of written scientific discourse (Lemke 1998). Section 2.2.2.3 then considers how—from a theoretical perspective—verbal, visual, and mathematical-symbolic resources might be deployed and integrated as text in context.

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<sup>16</sup> In this thesis, I follow O’Halloran (2005, 2009), Matthiessen (2009), Painter, Martin, and Unsworth (2013), and others, in distinguishing the terms multisemiotic/multisemiosis and multimodal/multimodality (e.g. Kress 2010). The reason for this is that, when we define language as a semiotic system (see section 2.2.1), a distinction may need to be made between language as system and the modes of materialization of that system, between written and spoken modes, between different rhetorical modes, and between different text functions (see Halliday and Hasan 1985 on mode of discourse (section 2.2.1.5.1), and Kress and van Leeuwen 2001 on mode as a channel of representation).

### 2.2.2.1 Visual Semiosis

Much of the work done on the social semiotics of visual meaning-making derives from O'Toole (1994) and Kress and van Leeuwen (1996, 2006).<sup>17</sup> Those authors contend that images, like language, are metafunctional: they can construe experience, they can enact social relations, and they can organize those meanings into coherent units (cf. section 2.2.1.1.3). Within each of those strands of meaning, O'Toole (1994) and Kress and van Leeuwen (1996, 2006) identify paradigmatic systems, from which selections (and meanings) can be made (cf. section 2.2.1.1.4 on axis).<sup>18</sup> Moreover, like language, the visual semiotic has an expression plane and a content plane (cf. section 2.2.1.1.1 on stratification), with the expression plane comprising a graphic stratum and the content plane being stratified into visual grammar and discourse semantics, at least in some social-semiotic frameworks (see, for example, Lim 2004, 2007). With regard to compositional layers or constituents, O'Toole (1994) proposes a rank scale, work – episode – figure – member, in which a piece of visual art, the overall work, may consist of one or more episodes, an episode of one or more figures, and a figure of one or more members or figure-parts (cf. section 2.2.1.1.5 on rank).<sup>19</sup>

Although not specifically discussed in O'Toole (1994) or Kress and van Leeuwen (1996, 2006), the cline of instantiation for images is assumed to be much the same as it is for language (see Kok 2004, Lim 2004, Matthiessen 2007b). At the potential pole is visual display as system, while at the instance pole is actualized image or text, with registers and text-/image-types on the cline between those two outer poles (Matthiessen 2007b, 55–56). A summary of the semiotic dimensions for images is

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<sup>17</sup> O'Toole (1994) and Kress and van Leeuwen (1996, 2006) for their part draw heavily on Halliday (1978). Kress and van Leeuwen (1996, 2006) also acknowledge the influence of Arnheim (e.g. Arnheim 1969) and Barthes (e.g. Barthes 1977), among others.

<sup>18</sup> According to Lim (2004, 223), these systems are less rigid than those of the lexicogrammar of language. For example, O'Toole's (1994) system of RHYTHM can be oriented toward interpersonal, experiential, and textual forms of meaning (Lim 2004, 223–224).

<sup>19</sup> Kress and Leeuwen's (1996, 2006) "grammar of visual design" does not operate with a rank scale. For discussion of the advantages and disadvantages of employing rank scales for semiotic systems other than language, see Zhao (2010).

provided in Table 2.2 (cf. the semiotic dimensions for language, summarized in Table 2.1, section 2.2.1.1).

Table 2.2. Semiotic dimensions of image in context, adapted from O'Toole (1994), Kress and van Leeuwen (1996, 2006), Lim (2004), O'Halloran (2005), Matthiessen (2007b).

Dimension	Type and relation	Orders
Stratification	Hierarchy of realization	context – content plane (discourse semantics – visual grammar) – expression plane (graphics)
Instantiation	Scale of generalization	potential – subpotential/instance type – instance
Metafunction	Simultaneous strands of meaning	representational / modal-interactive / compositional
Axis	Hierarchy of realization	paradigmatic – syntagmatic (system – structure)
Rank	Hierarchy of composition	work – episode – figure – member (for visual grammar)

### 2.2.2.2 Mathematical Symbolism

Mathematics can be identified by the kinds of meanings it makes: meanings about addition, subtraction, multiplication, and division; about numerical difference and equality; about geometrical relationships of parallelism, orthogonality, similarity, congruence, tangency, and many other endeavors in mathematical history. It is distinguished by these kinds of meanings, whether they are made by writing natural language, by drawing diagrams, or by formulating symbolic expressions.

(Lemke 2002, 4-5)

Lemke (2002) describes part of the history and development of mathematical discourse as a response to the need to construe topological meaning, or meaning-by-degree. Such meanings, Lemke (2002) argues, are not easily encoded in language, which tends to be more typologically oriented, i.e. meaning-by-kind or -category. Descriptions of motion or irregular shapes, for example, are more easily represented by gesture and visual-graphical elements than by language (Lemke 2002, 8–10). Over time, mathematics has gradually supplemented those gestural and visual-graphical representations with mathematical symbolism (see O'Halloran 2005, 55–57), a semiotic system that, according to Lemke (2002, 17–18),



combines the typological strategies of language with the topological potential of graphical representation.

Mathematical symbolism, however, is rarely deployed on its own; it usually requires a co-text of language and graphical representation “to contextualize the symbolic descriptions and procedures that take place” (O’Halloran 2005, 97). Moreover, this symbolism is not restricted to mathematical discourse *per se*; it pervades other scientific and non-scientific discourses (Lemke 2002, 4) and “underlies our day-to-day conception of reality” (O’Halloran 2005, 94).

O’Halloran’s (2005) social-semiotic, systemic-functional account of mathematical symbolism, alongside and in combination with an account of the verbal and visual resources of mathematics, proposes a similar kind of metafunctional diversity to that of language and images (see sections 2.2.1.1.3 and 2.2.2.1). O’Halloran (2005) notes, however, an expansion of experiential meaning and a contraction of interpersonal meaning compared with language, as mathematics (historically) began to extend its construal of “relations and patterns of variation” (O’Halloran 2005, 103) and reduce the “superficial” need to enact intersubjective positions (O’Halloran 2005, 114).<sup>20</sup> O’Halloran’s (2005, 97–98) model for mathematical symbolism is stratified in a similar way to language and images. The content plane comprises two strata—grammar and discourse semantics—and the expression plane (or “display plane”, to use O’Halloran’s terminology) comprises a graphology/typography stratum similar to that of language (graphology/phonology; see section 2.2.1.1.1). Within those strands of meaning and at different strata, O’Halloran (2005) identifies paradigmatic systems similar to those of language, e.g. SPEECH FUNCTION and MOOD (see section 2.2.1.1.4) as well as TRANSITIVITY and THEME (systems of experiential and textual meaning, respectively, at the stratum of (lexico)grammar). O’Halloran (2005, 98) also proposes a rank scale for the grammar of mathematical symbolism, i.e. statement – clause –

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<sup>20</sup> Doran (2016, 166–169) takes this a step further and argues that, from an axial perspective (see section 2.2.1.1.4), there is no evidence of distinct interpersonal paradigmatic systems in mathematical symbolism. Rather, “[w]hat is interpersonal in language [e.g. MODALITY] can be seen as quantified and ideationalised in mathematics” (Doran 2016, 168).

expression – component, in which a statement (or clause-complex) consists of one or more clauses, a clause of one or more expressions, and an expression of one or more components (i.e. functional elements such as  $x, y, f, p, =$ , etc.).

A summary of these semiotic dimensions for mathematical symbolism is provided in Table 2.3 (cf. Tables 2.1 and 2.2 above).<sup>21</sup>

Table 2.3. Semiotic dimensions of mathematical symbolism in context, adapted from O’Halloran (2005) and Lemke (2002).

Dimension	Type and relation	Orders
Stratification	Hierarchy of realization	context – content plane (discourse semantics – grammar) – display plane (graphology/typography)
Metafunction	Simultaneous strands of meaning	ideational (experiential + logical) / interpersonal / textual
Axis	Hierarchy of realization	paradigmatic – syntagmatic (system – structure)
Rank	Hierarchy of composition	For grammar: statement (clause-complex) – clause – expression – component

### 2.2.2.3 Intersemiosis: Integrating Multisemiotic Resources

Multisemiotic resources can be integrated in several ways. Using the example of a wedding invitation, Lim (2004) argues that integration is both material and socio-semiotic. Different visually and verbally construed meanings are bound together physically in the form of paper and print, as well as by wider contextual considerations such as the register and genre of the wedding invitation, and the systems of beliefs and values typically associated with weddings (Lim 2004, 222–223).

Matthiessen (2009) posits varying degrees of integration. Full or maximal integration is axial: “there is one semiotic system, and the

<sup>21</sup> Since mathematical symbolism requires the resources of other semiotic systems “to contextualize the symbolic descriptions and procedures that take place” (O’Halloran 2005, 97), it is difficult to conceive of a cline of instantiation equivalent to that for language and images. Indeed, no such cline is proposed by Lemke (2002), O’Halloran (2005), or Doran (2016).

different expressive systems involving different ‘modalities’ are integrated within one and the same content stratum” (Matthiessen 2009, 15). Matthiessen (2009, 15) cites the integration of language and intonation as an example (see also Halliday and Greaves 2008). Intermediate and minimal forms of integration depend on interstratal realization to create common systems at higher levels of abstraction, at the stratum of semantics (intermediate), or beyond the expression and content planes, at the level of context (minimal). As an example, Matthiessen (2009, 18–20) discusses visual-verbal intersemiosis in a World Health Organization report, noting that integration is primarily of the intermediate type, at the stratum of semantics. However, Matthiessen (2009, 19–20) also notes that “images [in the report] are integrated into the multimodal ‘text’ by means of clauses in language that relate references to displays (*Map 1, Table 1* and so on) to the linguistic text, as in [...] *Table 1 summarizes the scope of the SIAs and their impact on reported cases of neonatal tetanus.*”

Metafunction also plays a key role in integration. It creates synergy and co-contextualizing relations between different semiotic resources that share the same or similar broad meanings (Thibault 2000, Baldry and Thibault 2006, 23, Lim 2004, 2007, 199, O’Halloran 2005, 163).

O’Halloran (2005) draws on Thibault (2000), Lim (2004), and others to propose a series of mechanisms by which intersemiosis occurs:

1. **Semiotic Cohesion:** System choices function to make the text cohere across different semiotic resources.
2. **Semiotic Mixing:** Items consist of system choices from different semiotic resources.
3. **Semiotic Adoption:** System choices from one semiotic resource are incorporated as a system choice in another semiotic system.
4. **Juxtaposition:** Items and components within those Items are compositionally arranged to facilitate intersemiosis.
5. **Semiotic Transition:** System choices result in discourse moves in the form of macro-transitions which shift the discourse to another Item consisting primarily of another semiotic resource, or alternatively [micro-transitions] within Items occur.

(O’Halloran 2005, 169)<sup>22</sup>

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<sup>22</sup> O’Halloran’s (2005) use of the term “Item” is based on Kok (2004). In multisemiotic texts, an item is an instantiation of one or more semiotic resources that, alone or in combination, make a “methodologically justifiable whole” (Kok 2004, 134). Related terms in the literature include “cluster” (e.g. Baldry and Thibault 2006, 31) and “focus group” (e.g. Painter, Martin, and Unsworth 2013, 12–13).

With regard to semiotic transition (see point 5 above), O'Halloran (2003, 2005) suggests that macro-transitions can create metaphorical expansions of meaning—"semiotic metaphor" (cf. grammatical metaphor, section 2.2.1.3). In an example from a secondary-school mathematics lesson, O'Halloran (2005, 180 ff.) shows that shifts between language, images, and mathematical symbolism, and the semiotic metaphors those macro-transitional shifts imply, are fundamental to the construction of mathematical discourse. For example:

The process realized by the verb 'look' in 'and he looks down of course' becomes an entity in the form of a line segment AR [a line between two points A and R] in the visual diagram on the blackboard [...] This new entity is later introduced in the verbal discourse as 'the line of sight'.

(O'Halloran 2005, 182)

According to Martin and others (e.g. Martin 1999, 2008b, 2011, Zappavigna, Dwyer, and Martin 2008, Painter, Martin, and Unsworth 2013), meaning-making resources can be connected or integrated within and across strata, metafunctions, and semiotic systems. This "coupling" can be defined as "the binding of two [or more] meanings at any point along the cline of instantiation" (Zappavigna, Dwyer, and Martin 2008, 169) or as "the repeated co-patterning within a text of realisations from two or more systems" (Painter, Martin, and Unsworth 2013, 143). Couplings can be either convergent or divergent. For example, with regard to convergent couplings in a children's picture book, there "might be consistent co-patterning of particular ambience choices in the visual [...] with complementary choices of positive attitude in the verbal" or "consistent couplings of [...] interpersonal affect with a particular character" (Painter, Martin, and Unsworth 2013, 143). In the same children's picture book, divergent coupling might take the form of a verbalized first-person narrator and visualized third-person focalization, which "adds to the meaning potential by allowing us two points of view simultaneously" (Painter, Martin, and Unsworth 2013, 144).

The semiotic dimensions of stratification, instantiation, metafunction, and axis can all be used to varying degrees to account for how different semiotic resources are deployed and combined to make text. According to Lemke (1998) and Royce (2002, 2007), these resources

combine in synergistic, potentially multiplicative ways, producing overall meanings that are greater than the sum of individual contributions from each of the semiotic systems considered separately (see also O'Halloran 2005, 159, Baldry and Thibault 2006, 18–19).



### 3 Engagement as Discourse Semantic System

To read a text is to engage with that text (Kress 2010, 37–38);<sup>23</sup> anyone who encounters language, images, and/or mathematical symbols also engages with those resources in some way. The type and extent of engagement, however, will depend on a complex relation between the text and the reader—and the communicative context or ideological colloquy (Vološinov 1973 [1929], Martin and White 2005). Individual readings are based, among other things, on the meaning potential afforded by the text, and, crucially, on the repertoire of the reader in relation to the reservoir of meanings in a particular culture (see Bernstein 1996, Martin and Rose 2007, Martin 2008a). A central aim of this thesis is to identify the linguistic, visual, and mathematical “prompts” that allow for different possible readings and positionings (see Kress 2010, 32 ff.).

In this chapter, I present and discuss how, within a social semiotic framework, engagement can be conceptualized as a discourse semantic system, a system that can be explored, interstratally, from below, from round about, and from above (see section 2.2.1.2). All three of these views are crucial to the aims of the thesis (see section 1.2): to examine the means of engagement (from below), the types of engagement (from round about), and the sociocultural relevance of engagement with regard to the discipline of medical research (from above). Section 3.1 presents Martin and White’s (2005) ENGAGEMENT system for language. Subsequent sections, sections 3.2 and 3.3, discuss how this and related models have been or can be adapted for visuals and mathematical symbolism, respectively.

#### 3.1 Verbal Engagement

One of the most explicit connections between the work of the Bakhtin Circle and social semiotics is provided by Martin and White (2005, see also White 1998, White 2003, 2012, Hood 2004, 2010, Martin 2008a, Martin and Rose 2003, 2007). Martin and White’s (2005) system of ENGAGEMENT is

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<sup>23</sup> In this thesis, I use the term “read” in its most general sense, as a process of interpretation. The term “reader”, i.e. one who interprets, is intended to cover a wide range of related positions, including the hearer, viewer, and addressee.

part of a wider framework for modelling evaluative language, known as APPRAISAL. APPRAISAL comprises three simultaneously available subsystems: ATTITUDE, ENGAGEMENT, and GRADUATION (see Figure 3.1). ATTITUDE models “our feelings, including emotional reactions, judgements of behaviour and evaluation of things” (Martin and White 2005, 35), while GRADUATION deals with the ways in which evaluative meanings can be scaled or graded, by adjusting the force or amplitude of those meanings, or by sharpening or softening the focus on them (Martin and Rose 2003, 42–48, 2007, 37–43, Martin and White 2005, 135–153). ENGAGEMENT attempts to account for the ways in which a verbal text—or the voice represented by that text—refers to, responds to, and is influenced by prior and anticipated utterances. The ENGAGEMENT system also models how the textual voice attempts to align or disalign itself and the reader with regard to the other voices and positions “construed as being in play in the current communicative context” (Martin and White 2005, 94). White (2003) and Martin and White (2005) refer to this (dis)alignment as intersubjective stance or dialogistic positioning.<sup>24, 25</sup>

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<sup>24</sup> Lemke (1998, 105–106) and Baldry and Thibault (2006, 89–90) identify three types of stance or positioning: 1) the stance a text adopts towards its own presentational content (e.g. importance, warrantability, usuality/typicality); 2) the stance a text adopts towards its prospective readers (e.g. solidarity, antagonism, deference, condescension); and 3) the stance a text adopts towards the other texts that it invokes (e.g. opposition, alliance, complementarity). Although this chapter focuses primarily on the work of Martin and White (2005), Lemke’s (1988, 1995, 1998, 2002) discussions of heteroglossia, heteroglossic relations, and intertextual thematic formations provide a useful supplementary and complementary perspective.

<sup>25</sup> Note the potential similarities here between alignment/disalignment and compliant/resistant readings (see Martin and Rose 2007 and section 2.2.1.1.2).



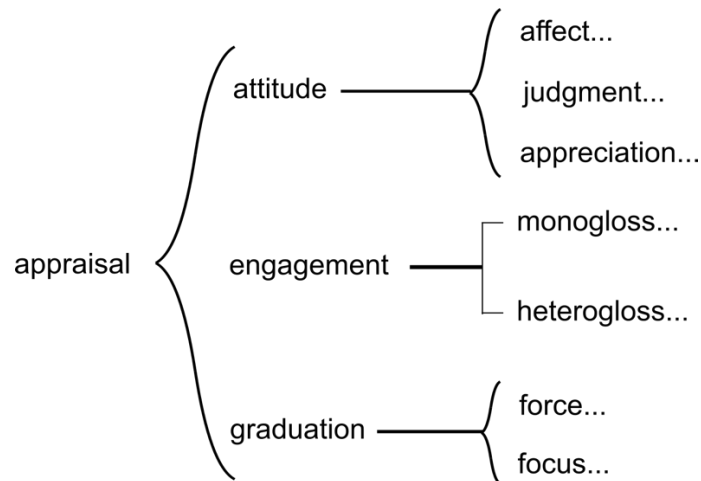


Figure 3.1. Discourse semantic system of APPRAISAL, adapted from Martin and Rose (2003, 55, 2007, 59). Curly brackets indicate potentially simultaneous options or subsystems at the same level of delicacy; square brackets indicate alternatives from which only a single option or subsystem can be selected; ellipses indicate that the option leads to further suboptions/subsystems of increasing delicacy, but they have been elided for the sake of simplicity.

Within the theoretical architecture of SFL, ENGAGEMENT is an interpersonal system of meaning in the stratum of discourse semantics (see section 2.2.1.1). A system network for ENGAGEMENT is shown in Figure 3.2. The basic choice in the ENGAGEMENT system is whether an utterance is considered ‘monoglossic’ (single-voiced), in which no overt reference is made to other voices or viewpoints in the discourse, or ‘heteroglossic’ (other-voiced), i.e. whether the textual voice invokes, allows for, or in some way challenges other voices or viewpoints in the communicative context (cf. Bakhtin 1981 [1935], 281, in section 2.1).

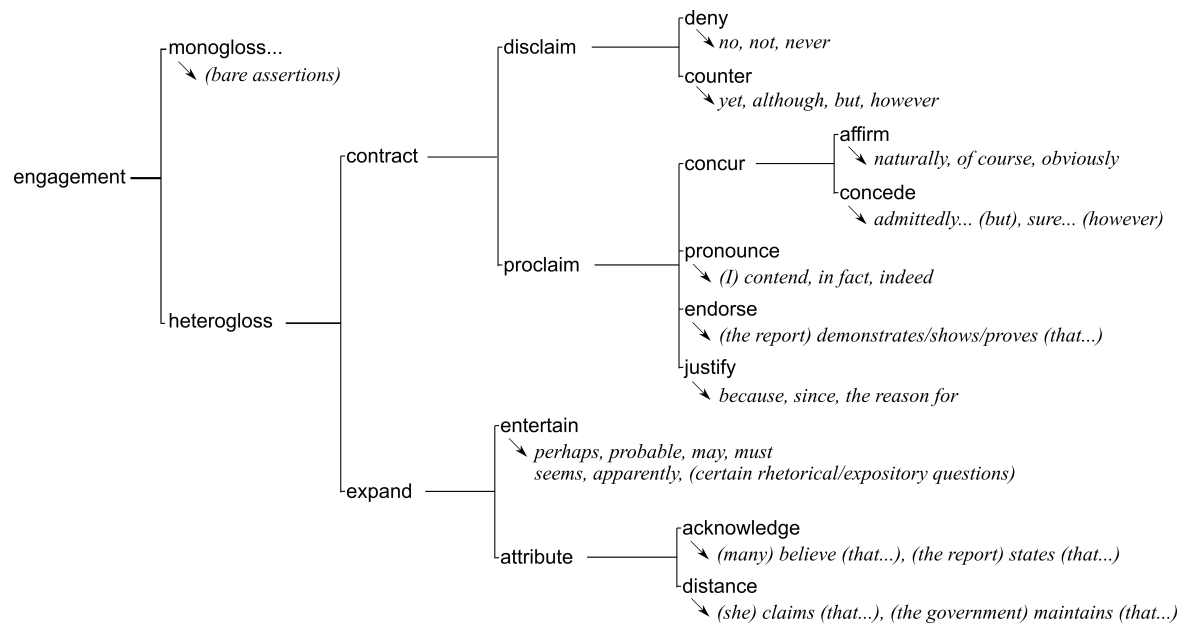


Figure 3.2. Discourse semantic system of ENGAGEMENT, adapted from Martin and White (2005, 134), White (2003, 2012, 65), Martin (2008a), and the Appraisal website (White and Don 2012). The figure shows typological relations between features/options in the system, as well as examples of their realization (in italics), i.e. “from below” in the lexicogrammar (Halliday 2003 [1997], 250).

### 3.1.1 Monoglossic Engagement

In ‘monoglossic’ or single-voiced utterances, the textual voice chooses not to recognize or invoke other voices or viewpoints. Such choices, according to White (2003, 263), represent “the textual voice’s single, autonomous and isolated subjecthood”, at least for “the brief textual moment taken up by the utterance” (Martin and White 2005, 99). As Martin and White (2005, 100) note, a number of co-textual and contextual factors affect this choice, including “the communicative objectives being pursued by the text as a whole (for example, whether it argues, explains, narrates, recounts, records, etc.), the proposition’s role with respect to these communicative objectives, and the nature of the proposition itself”.<sup>26</sup>

<sup>26</sup> In SFL, a proposition is a statement or question, a semantic move typically realized by a declarative or interrogative clause (collectively referred to as indicative). According to Halliday and Matthiessen (2014, 138), a proposition “can be argued about – something that can be affirmed or denied, and also doubted, contradicted, insisted on, accepted with reservation, qualified, tempered, regretted, and so on”. Propositions are usually contrasted with proposals, i.e. commands and offers.

Bare assertions, such as *The banks have been greedy* (example from Martin and White 2005, 100), may, on the one hand, be assumed to be ‘taken for granted’ (Martin and White 2005, 98–102), that is, as given, generally accepted, or “consensual ‘knowledge’” (White 2003, 263)—what Bakhtin (1981 [1935], 342) calls “authoritative discourse”. In such cases, the assertion construes for the text an addressee who shares (or is expected to share) a particular position with the writer or speaker, a position of alignment or alliance (Lemke 1988) that may not need further clarification or justification. On the other hand, the same proposition may be ‘at issue’ or ‘open for discussion’, perhaps as part of a controversial claim or polemic. In those cases, the utterance might construe for the text a disalignment or antagonism (Lemke 1988) between the position of the audience and that of the textual voice, one that may require further support or clarification as the text unfolds (Martin and White 2005, 101–102).

### 3.1.2 Heteroglossic Engagement

‘Heteroglossic’ or other-voiced utterances can ‘contract’ or ‘expand’ the space for dialogic alternatives (see Figure 3.2). That is, they can act “to challenge, fend off or restrict the scope” of alternative voices in the discourse (Martin and White 2005, 102), or they can serve to make allowances for those voices. For example, in (3.1), from White (2003, 270) and Martin and White (2005, 102), the author’s use of the reporting verb *shows* signals a particular stance towards the attributed or projected proposition. The textual voice aligns itself with the attributed voice (*he, Follain*), holding the projected proposition to be valid or true. Such endorsements, according to Martin and White (2005, 103), “fend off” actual or potential contrary positions, ‘contracting’ the “dialogic space” (White 2003, 273, Martin and White 2005, 103) for alternative viewpoints or propositions—in this case, the allegedly romanticized and discredited view of the mafia as Robin Hood-style outlaws—and aligning (or attempting to align) the reader to the same position.

- (3.1) Follain punctures the romantic myth that the mafia started as Robin Hood-style groups of men protecting the poor. He shows that the mafia began in the

nineteenth century as armed bands protecting the interests of the absentee landlords who owned most of Sicily.

- (3.2) I firmly believe that air traffic control and the safety of both passengers and those who live near and work in Britain's airports are far too important to be trusted to the vagaries of market forces or indeed shareholders interest.

In (3.2), on the other hand, from White (2003, 262), the projecting clause *I firmly believe* construes a different type of relation between the projected proposition (*air traffic control and the safety of both passengers and those who live near and work in Britain's airports are far too important to be trusted to the vagaries of market forces or indeed shareholders interest*) and the dialogic background. Here, the projecting clause, and its explicit subjectivity (Halliday and Matthiessen 2004, 149–150), construes for the text a proposition and position that is but one among a set of possible alternatives. The dialogic space is thus opened up, or 'expanded', in order to acknowledge and allow for those alternatives, modelling a readership that might be in disagreement with or opposition to the textual voice (White 2003, 277).

Seen across the space of a text, i.e. logogenetically (see section 2.2.1.4), appraisal resources create different prosodic patterns that "swell" and "diminish", creating "the 'stance' or 'voice' of the appraiser, and [...] defin[ing] the kind of community that is being set up around shared values" (Martin and Rose 2007, 59). The different generic stages and phases of a text (see section 2.2.1.5.2) do this in different ways, variously 'expanding' and 'contracting' the dialogic space, shifting stance and forming different kinds of relations with the reader as the text unfolds (Martin and Rose 2007, 61–63).

### **3.1.2.1 Dialogic Contraction**

The resources for dialogic 'contraction' can be considered in terms of two basic options: [disclaim] and [proclaim] (see Figure 3.2). Both of these features, which are also system entry points to options of increasing delicacy, act to 'contract' or limit the dialogic space for alternative propositions and positions.

### 3.1.2.1.1 Contract: Disclaim

In selecting the [contract: disclaim] feature, the textual voice positions itself as being at odds with some prior or alternative contrary proposition, one that is explicitly “rejected, replaced or held to be unsustainable” (Martin and White 2005, 118). As indicated in Figure 3.2, the DISCLAIM system comprises two suboptions: [deny] and [counter].

The [disclaim: deny] feature directly rejects (or ‘denies’) a dialogically contrary position. The feature is typically encoded by the lexicogrammatical resources of negation, e.g. *not*, *no*, *none*, *nothing*, and similar wordings. Propositions of this kind invoke or acknowledge a positive-polarity alternative, so as to reject it. For example, *There’s nothing wrong with meat, bread and potatoes* (from Martin and White 2005, 118) invokes and acknowledges, on the one hand, the belief or claim that there *is* something wrong with *meat, bread and potatoes*; at the same time, the negation explicitly rejects or dismisses such a position. A number of other studies or treatments of negation also emphasize this particular function, generally as a form of presupposition (see, for example, Kress and Hodge 1979, 137–151, Leech 1991, 101, 165, Fairclough 1992, 121–122, Givón 2001a, 370–372).

Martin and White (2005, 118–120) note that [deny] plays varying roles in terms of alignment and intersubjective positioning. In the case of the “meat, bread, and potatoes” example above, the textual voice rejects and corrects a particular alternative. The correction of a misunderstanding or misconception may enhance solidarity if addressees are “not resistant to having this particular lack of knowledge projected onto them” (Martin and White 2005, 120) or if they happen to share the same position as the textual voice. However, if the correction is intended or assumed to challenge the ignorance of the putative addressee, the explicit ‘denial’ is likely to be met with resistance, disaligning (intentionally or otherwise) the textual voice from that of the addressee.

Rather than rejecting a particular proposition, the [disclaim: counter] feature acts to replace or supplant an otherwise expected or actual proposition (White 2003, 271–272, Martin and White 2005, 120–121, Hood 2010, 183–185). The feature can be signalled by a variety of lexicogrammatical resources, typically concessive conjunctions and

connectives such as *although*, *however*, *but*, and *yet*, as well as adjuncts such as *even*, *only*, *just*, and *still* (Martin and White 2005, 120–121).<sup>27</sup> For example, in (3.3) (from White 2003, 271), the conjunction *but* signals an overturning of the assumption that new legislation is needed. The textual voice rules this possible assumption or interpretation to be unfounded (White 2003, 271), stating that such laws already exist.

- (3.3) In the wake of last week's revelations about the Ku Klux Klan's presence in the state, the Premier has stated that tougher anti-racial hatred laws are on the 'drawing board'. But we already possess laws against threatening behaviour and incitement to violence.

Dialogic alignment construed by selection of the [counter] feature varies, but Martin and White (2005, 121) claim that 'counters' are generally aligning rather than disaligning. In the example above, such alignment depends on whether the intended addressee believes that new laws are necessary and continues to do so after this assumption is overturned. More subtly, it may be *the Premier*, the protagonist in this particular story, whose knowledge or integrity is being brought into question, in which case the textual voice and the addressee may be aligned in their disalignment with or opposition to the projected voice of the protagonist (see White 2003, 272, and example (3.4)).<sup>28</sup>

### 3.1.2.1.2 Contract: Proclaim

The [contract: proclaim] option (see Figure 3.2 above) allows the textual voice to emphasize its own position or other positions it considers maximally warrantable, thus excluding alternatives from the ongoing colloquy. According to Martin and White (2005, 121), there are three main

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<sup>27</sup> See also Givón (2001b, 336), Hood (2010, 183–185), and Kress and Hodge (1979, 148–151).

<sup>28</sup> The addressee may of course agree with *the Premier's* implied solution, in which case, the textual voice disaligns itself with regard to both the addressee and the projected voice of *the Premier*.

options in the PROCLAIM system: [concur], [pronounce], and [endorse]. I also include here a fourth option, [justify], based on White (2003, 2012).<sup>29</sup>

The choice of [proclaim: concur] announces the textual voice as being in agreement with or sharing the same knowledge as some projected dialogic partner (Martin and White 2005, 122). In ‘concurring’, the textual voice seeks to [affirm] or [concede] a particular point or position (see Figure 3.2). Such dialogic functionality is typically signalled by comment Adjuncts such as *of course*, *naturally*, *certainly*, and *admittedly*. For example, in (3.4)—an excerpt from the same text as (3.3)—the textual voice emphasizes and ‘affirms’ a particular position attributed to *The Premier*. Moreover, by choosing the comment Adjunct *of course*, “the textual voice actively and explicitly presents itself as aligned with the construed reader, as having the same belief or attitude or ‘knowledge’” (White 2003, 269). In (3.4), the textual voice and the addressee are construed as being united in their opposition to *The Premier*.

(3.4) The Premier, of course, wants us to think what a fine anti-racist fellow he is.

(3.5) Sure, he broke the rules. Yes, he ducked and dived. Admittedly he was badly behaved. But look at what he achieved.

In (3.5), from Martin and White (2005, 124), the textual voice ‘concur[s]’ with a projected dialogic partner, by ‘conceding’ a number of points regarding the behaviour of a particular third person, the protagonist in this excerpt, signalled by the underlined comment Adjuncts and an affirmative marker/interjection. The textual voice presents itself as being in agreement, although perhaps reluctantly so, with the construed addressee, thus reducing the dialogic space for alternative positions that might, for example, claim that “rules were not broken”. These concessions, however, are followed by a [counter] proposal, one that attempts to overturn the potentially negative view projected by the previous clauses. So-called [concede] + [counter] pairings of this kind (Martin and White 2005, 125–126) construe for the text an addressee who is likely resistant to the textual voice’s primary argumentative position, in this case a

<sup>29</sup> In Martin (2008a), [proclaim] comprises two suboptions: [confirm] and [commit], where [commit] is further subdivided into [pronounce] and [endorse].

positive view of the protagonist. The [concede] option helps to align the textual voice and the addressee. In dialogic terms, this is an important gesture of solidarity in a context in which the writer/speaker may anticipate disagreement or disalignment with the addressee.

The [proclaim: pronounce] feature allows the textual voice to add explicit, subjective emphasis to propositions that are “directed against some assumed or directly referenced counter position” (Martin and White 2005, 129). The resources available for such ‘pronouncements’ are diverse, and include the formulations *I contend...*, *The facts of the matter are... The truth is...*, *You must agree that...*, as well as certain comment Adjuncts such as *really*, *indeed*, and *in fact*. In (3.6), from Martin and White (2005, 129), two formulations serve to add authorial emphasis to the proposition that “Bush and King Fahd have a policy that entails the destruction of the Kurds and the Shiites”: *I contend that...* and *indeed*. These interpolations reduce the space for dialogic diversity, by emphasizing the warrantability or validity of the counter-proposition, thereby narrowing the scope for alternatives.<sup>30</sup> They also increase the interpersonal risk involved, by expressing a high level of personal commitment. If the ‘pronouncement’ challenges or confronts the addressee, there is a threat to solidarity, one that may need to be negotiated through the use of other dialogic resources; but if the ‘pronouncement’ confronts a third party “on behalf of the putative addressee”, the situation may be reversed, construing the textual voice and addressee as standing united against some dialogic adversary (Martin and White 2005, 130).

- (3.6) There was a lot of talk during Daniel Schorr’s spot on “Weekend Edition” about George Bush’s not having a coherent postwar policy for Iraq. I contend that Bush and King Fahd do, indeed, have a policy that entails the destruction of the Kurds and the Shiites.

The [proclaim: endorse] option allows the textual voice to construe an externally sourced proposition as being “correct, valid, undeniable or

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<sup>30</sup> The [counter] position here is signalled by the emphatic: “they DO have a policy”. Note that, like the [concur: concede] feature, ‘pronouncements’ tend to occur as part of [pronounce] + [counter] pairings (see Martin and White 2005, 129).



otherwise maximally warrantable” (Martin and White 2005, 126). These ‘endorsements’ are generally signalled by a limited set of reporting or projecting verbs that typically construe, experientially, relational processes of identification or mental processes of cognition (Halliday and Matthiessen 2004, 197–248), e.g. *show*, *prove*, *demonstrate*, *find*, and *point out*. In the second sentence of (3.7), from Martin and White (2005, 126), the textual voice ‘endorses’ the projected proposition attributed to “five studies”, i.e. *dependence is associated with greater inequality*. This ‘endorsement’ construes the projected proposition as maximally warrantable, and hence restricts the dialogic space for alternative positions, aligning (or attempting to align) the addressee to the value position advanced by the textual voice (Martin and White 2005, 127).

- (3.7) Five of the studies examine the effects of economic dependence on economic inequality. All five show that dependence is associated with greater inequality.

The [proclaim: justify] option presents the textual voice as arguing for or substantiating a particular position, one that may be contentious or in need of additional support (White 2003, 274–275).<sup>31</sup> ‘Justifications’ are typically signalled by connectives and conjunctions such as *therefore*, *thus*, *accordingly*, *because*, and *for this reason*. In (3.8), from White (2012, 65), the textual voice deems it necessary to provide ‘justification’ for the assertion that *The government has betrayed the people*.<sup>32</sup> The textual voice gives an explicit reason or motivation for the proposition, signalled by the conjunction *because*, and in doing so ‘contracts’ the dialogic space for alternative explanations. Intersubjectively, the [justify] feature acknowledges or anticipates an addressee who may hold an alternative viewpoint and is in need of persuasion. The [justify] feature is therefore crucial in negotiating alignment, serving (at least potentially) to “win over

<sup>31</sup> Note that White (2012) places [justify] at a different level of delicacy from that in the system network on the Appraisal website and the typology used in this thesis (see Figure 3.2). In White (2012, 65), [pronounce] and [justify] are grouped as part of a REINFORCE subsystem, at the same level of delicacy as [concur] and [endorse]. Taken together, ‘pronouncements’ and ‘justifications’ act to strengthen or ‘reinforce’ propositions against possible alternatives.

<sup>32</sup> This is a ‘monoglossic’ bare assertion that appears to be ‘at issue’ or ‘open for discussion’ (see section 3.1.1).

those who might be dubious or resistant” to certain claims (White 2012, 64, see also Martin 2008a, 50–51 for further discussion).<sup>33</sup>

- (3.8) The government has betrayed the people because it didn’t maintain full employment.

### 3.1.2.2 Dialogic Expansion

The resources for dialogic ‘expansion’ can be considered in terms of two main categories: [entertain] and [attribute] (see Figure 3.2). Both features serve to ‘expand’ or open up the dialogic space for alternative propositions and positions.

#### 3.1.2.2.1 Expand: Entertain

By selecting the [expand: entertain] feature, the textual voice signals that its position, being an overtly subjective one, is but one among a number of possible alternative positions. The [entertain] feature is encoded by a wide range of lexicogrammatical resources that are variably dealt with elsewhere in the literature under the headings of modality, hedging, and evidentiality (e.g. Chafe 1986, Hyland 1996, 1998b, Halliday and Matthiessen 2004, see also White 2003). These include modal resources such as *could*, *may*, *possible*, and *probably*, and modalized projections of the kind *I believe* and *I think* (interpersonal grammatical metaphor; see Halliday and Matthiessen 2004, 613–625, and section 2.2.1.3), as well as “evidentials” such as *suggest*, *appear*, *apparent*, and so on (Martin and White 2005, 109). White (2003, 277) and Martin and White (2005, 110) also note that certain “rhetorical” or “expository” questions ‘entertain’ a similarly diverse dialogic background of alternative viewpoints and propositions, as do conditionals such as *if*-clauses (White 2003, 272–274).

In (3.9), from Martin and White (2005, 110), the proposition *he feels ashamed and guilty...* is construed, via projection, as being subjective,

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<sup>33</sup> White (2003, 274–275) notes that ‘justifications’ are often not explicitly signalled, e.g. *These [moral] panics are invariably based on questionable grounds. Either a few nasty statements or incidents are blown out of all proportion, or the definition of racism is expanded to cover a range of new sins.*

based on the deductions or surmise of the textual voice. That the speaker in (3.9) chooses the verb *suggests* rather than, say, *shows* presents the proposition as being one among a number of potential alternatives, opening up or ‘expanding’ the dialogic space. A similar example of [entertain] can be seen in (3.10), from Hood (2010, 183), where, again, the position of the textual voice is construed, in this case by the modal Finite *may*, as being one among a number of potential alternatives.

(3.9) His defensive behaviour suggests he feels ashamed and guilty that you’ve discovered his habit.

(3.10) [T]his may be due to the potentiality that writing offers over speaking in that it is more concrete and durable

The [entertain] feature plays an important role in modelling intersubjective stance, since it recognizes and legitimizes positions or propositions that may differ from those of the textual voice. In doing so, [entertain] provides the possibility of solidarity even with those who may hold contrary views. Of course, the extent to which [entertain] functions in this way will depend on the co-text/context of the utterance and how ideologically oriented it is (Martin and White 2005, 109). In (3.11), for example, from Martin and White (2005, 109), the textual voice does not appear to be anticipating potential dissent or disagreement. Rather, it ‘entertains’ the possibility that the number given (*several hundred*) might be slightly higher or slightly lower, and that it should not be taken as a precise figure. According to Martin and White (2005, 109), the position is “more ‘private’ than ‘public’” and is one that “is not so obviously ideologically connected”. Nevertheless, *possibly* does seem to play an important role in establishing the speaker’s credibility and authority, in the way it modifies, by seemingly downscaling and thus modestly downplaying, the quantification and emphasis of the speaker’s level of experience and expertise (see Hood 2010, 185–188 on the relation between GRADUATION and ENGAGEMENT, and section 5.4).

(3.11) As a nurse with more than 50 years’ experience including 10 years caring for the terminally ill I feel it appropriate to respond. [paragraph break] It has been my privilege to have cared for possibly several hundred terminally ill patients.

### 3.1.2.2.2 Expand: Attribute

The [expand: attribute] feature serves to “disassociate the proposition from the text’s internal authorial voice by attributing it to some external source” (Martin and White 2005, 111). The feature comprises two main suboptions: [acknowledge] and [distance] (see Figure 3.2 above).

The [attribute: acknowledge] option makes no overt reference, “via the choice of the framer” (Martin and White 2005, 112), as to the stance of the framer with regard to the proposition. This feature, and the apparent lack of explicit stance by the textual voice towards an external source, is generally encoded by a set of reporting verbs that, experientially, construe certain verbal and mental cognitive processes (Halliday and Matthiessen 2004, 197–210, 252–256). These include *say*, *state*, *announce*, *believe*, and *think*.

In (3.12), for example, from Martin and White (2005, 112), the direct quote is explicitly attributed to an external source, *The Rt Rev Colin Buchanan, Bishop of Woolwich*. The choice of the verb *says* gives no indication (at least for the brief textual moment) as to the textual voice’s stance with regard to the quote.<sup>34</sup> It merely ‘acknowledges’ who is responsible, leaving it instead to the co-text to make clear how the textual voice might align or disalign itself with the position advanced in the quote. ‘Acknowledgements’ such as this are dialogically ‘expansive’ in that they associate a particular position or proposition with an external source, one with which the textual voice is engaged. The viewpoint ‘acknowledged’ is construed as being explicitly subjective (the external voice’s subjectivity, in this case) and therefore one among a number of possible alternatives (cf. [entertain] above). Martin and White (2005) describe the [acknowledge] feature as potentially construing, however briefly, a certain intersubjective neutrality (cf. Thompson 1996), “remain[ing] aloof from any relationships of either alignment or disalignment” (Martin and White 2005, 115). Such formulations represent the textual voice as “an informational fair trader” (Martin and White 2005, 115) and may

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<sup>34</sup> In Thompson’s (1996) terms, the source of this particular attribution is a “specified other”, the message is a “quote”, the reporting signal is “separate dominant”, i.e. a reporting clause, and the attitude to the reported message is “neutral” (for a summary of these dimensions, see Thompson 1996, 524).

therefore be highly valued in certain domains such as media commentaries, political speeches, and scientific discourse. However, this does not necessarily make them alignment-neutral. Attitudinal assessment and external voices of varying status or credibility also influence the degree to which the textual voice appears to align itself with a particular viewpoint, and thus the degree to which the addressee might be construed as sharing that viewpoint. The textual voice's alignment with the value position construed by the quote in (3.13), for example—also from Martin and White (2005, 115)—is made clear through both attitudinal assessment (*rightly*) and the potential credibility of the external voice (*The Archbishop of Canterbury*).

(3.12) The Rt Rev Colin Buchanan, Bishop of Woolwich, says: 'In this, as in so many other things, the Church of England prefers to live by fantasy rather than look coolly at the facts.'

(3.13) The Archbishop of Canterbury rightly describes the mass killing of children as 'the most evil kind of action we can imagine.'

Another important resource for 'acknowledging' other voices in the discourse, and a common characteristic of academic and scientific texts, is the use of references or citations. These include integral references (Swales 1990, 148) of the kind "Martin and White (2005, 53) report that..." (cf. examples (3.12) and (3.13) above) as well as non-integral references like those in examples (3.14) and (3.15), from Sheldon (2013, 98) and Coffin (2009, 174), respectively, where some or all of the associated proposition is 'acknowledged' as being attributable to an external source.<sup>35</sup>

(3.14) ... researchers in this tradition have since given the notion a psychological interpretation, seeing the frequent co-occurrence of words as evidencing the existence of "semi-preconstructed phrases that constitute single choices" for the speaker (Sinclair, 1987, p. 320).

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<sup>35</sup> Coffin (2009, 174) argues that, in the case of non-integral numerical-endnote citations like that in (3.15), "the referenced proposition merges so seamlessly into the writer's argument that it resembles text which is entirely in the writer's voice [and...] is more likely to be perceived as an established fact, thus creating dialogic contraction" (cf. [contract: pronounce/endorse]).

- (3.15) The apparent success of the economic system during the 1920s, especially in the consumer industries had confirmed the psychology of Frontier dynamics that linked expansion with a sound economy.<sup>3</sup>

White (2012) extends the ATTRIBUTE system to account not only for dialogic positioning by the projecting or primary voice, but also by the projected or secondary voice, what White (2012, 66) calls a “double dialogistic function”. Verbs such as *insist* or *contend* are seen as “firstly presenting the primary authorial voice as grounding a proposition in the contingent subjectivity of a secondary voice (a quoted source), and as secondly presenting that secondary source as having ‘pronounced’ that proposition by way of challenge or refutation of some prior utterance” (White 2012, 66). In example (3.16), from White (2012, 66), White argues that the proposition *insisted* by the secondary voice is disfavoured by the primary or textual voice.

- (3.16) All the charities’ spokespeople insist that the celebrities who support them do not need the publicity; they’re famous enough already and only help out of the goodness of their hearts. But then again, as John Rendall of HELLO! magazine points out, they would say that, wouldn’t they. ‘It certainly keeps the celebrities in the public eye,’ he says.

Selection of the [attribute: distance] feature indicates disassociation and ‘distancing’ from a particular external voice. Like the [acknowledge] feature, this is typically signalled in the text by a framing device, a reporting verb, but one that makes explicit the framer’s stance. The [distance] feature is generally signalled by a relatively limited set of reporting verbs that construe experiential verbal processes (Halliday and Matthiessen 2004, 252–256) with speaker-oriented modality of doubt or disbelief (Matthiessen 1995, 293–294), e.g. *claim*, *maintain*, and *insinuate*.<sup>36</sup> Such verbs are semantically complex, and, unlike those

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<sup>36</sup> Note how, in linking propositions to external voices, the lexicogrammatical resources associated with [acknowledge] and [distance], on the one hand, and [endorse], on the other, differ. The former tend to be encoded by verbs that construe mental/verbal processes; the latter by verbs that construe relational processes. A similar point is made by Martin and White (2005, 133–135), who note that projection is diversified across the

associated with [acknowledge], they are, according to Halliday and Matthiessen (2004, 456), “seldom used to quote; there is too much experiential distance between them and the actual speech event”.

In (3.17), from Martin and White (2005, 113), the textual voice appears to detach and distance itself from a particular external voice. The dialogic effect of such a formulation, framed or encoded here by the reporting verb *claim*, is to ground the proposition in the subjectivity of an external source, as one among a number of possible alternatives. Moreover, in distancing itself from the external source, the textual voice itself represents a potentially alternative viewpoint in the ongoing colloquy, thus “maximis[ing] the space for dialogistic alternatives” (Martin and White 2005, 114). Intersubjectively, the textual voice disaligns itself from the projected external voice. The effect this ‘distancing’ has on the addressee, however, will depend on what positions are at risk in the framed proposition and the extent to which those positions are shared or held by the addressee.

(3.17) His attack came as the Aboriginal women involved in the case demanded [...] a female minister examine the religious beliefs they claim [...] are inherent in their fight against a bridge to the island near Goolwa in South Australia.

(3.18) They claim that the report uses extrapolations and projections based on Bangui and other unreliable registrations. It does no such thing.

Martin and White (2005, 103–104) acknowledge that a verb like *claim* does not always function dialogically to construe [distance] between the textual voice and the attributed position of an external voice. It will vary depending on certain “co-textual conditions, and across registers, genres and discourse domains” (Martin and White 2005, 103), potentially signalling [entertain] ( $\approx$  *suggest*) or [acknowledge] ( $\approx$  *state*), at least for the brief textual moment (Fryer 2013, 202). In (3.18), for example, *claim* as [distance] becomes more apparent as the text unfolds, with the explicit ‘denial’ (*no such thing*) in the second sentence essentially confirming the potential ‘distancing’ effect of *claim* in the first. Example (3.18) is from a

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system, and can be used to construe dialogically ‘contractive’ and dialogically ‘expansive’ propositions (see also section 3.1.3).

Letters to the Editor section of a scholarly journal (see Fryer 2013). The authors of such letters tend to be critical of other researchers' work, and the choice of 'distancing' (rather than 'entertaining' or 'acknowledging') may be more appropriate for the textual voice's explicit disalignment from the external voice.<sup>37</sup>

'Distance' can also be construed through the use of "scare quotes" (Martin and Rose 2003, 47, 2007, 52, Hood 2010, 181, 2011, 110). In example (3.19), from Hood (2010, 181, 2011, 110), the textual voice highlights and potentially dissociates itself from a particular source or position.

- (3.19) The many stories and 'radical' fragments within this work can be envisaged as a series of sites to which the reader is exposed.

### 3.1.3 The Lexicogrammar of Engagement: Projection, Modality, Concession

In their analyses of evaluative language, Martin and Rose (2003, 2007) and Hood (2010) organize the seemingly disparate lexicogrammatical resources described in sections 3.1.1 and 3.1.2 into three basic categories: projection, modality, and concession. A system network representing those choices is shown in Figure 3.3.

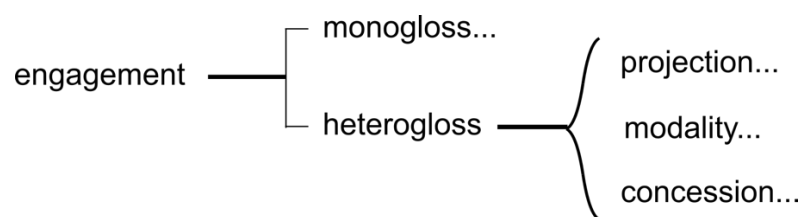


Figure 3.3. ENGAGEMENT system, including projection, modality, and concession, adapted from Martin and Rose (2003, 55, 2007, 59) and Hood (2010, 172).

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<sup>37</sup> This differing rhetorical and dialogic potential of *claim* in relation to [distance], [acknowledge], and [entertain] might justifiably be extended to dialogistic resources as a whole (Martin and White 2005, 104, Fryer 2013, 192–193), a point emphasized by Vološinov (1973 [1929], 23) in terms of "multiaccentuality", in which signs are never fixed but "are always inflected in different ways to carry different values and attitudes" (Dentith 1995, 23).



As discussed above, projection allows us to quote or report what we or others have said or thought, as in examples (3.7), (3.9), (3.12), and (3.13). Less congruently, those projections can take the form of integral and nonintegral references and scare quotes (see examples (3.14), (3.15), and (3.19)) as well as nominalized processes like that in (3.20). In (3.20), from Hood (2010, 182), “the nominalised verbal process *suggestions* labels the subsequent phase of text as projected wording”.

(3.20) Anderson (2004) offers a number of suggestions. First, ... . Secondly, ... . Finally, ... .

In addition to modal auxiliaries and other modalizing or modulating resources, Martin and Rose (2003, 2007) and Hood (2010) include the resources of polarity (negation, bare assertions) under the more general category of modality, where polarity represents the outer limits or poles of the modal space. From a dialogic perspective, modality allows us to introduce additional voices into a text (Martin and Rose 2007, 53) by acknowledging or rejecting alternative propositions and positions in the discourse (see examples (3.9)–(3.11)). In the case of bare assertions, potential alternatives are ignored.

Under the heading of concession, Martin and Rose (2003, 2007) and Hood (2010) group together resources that express counterexpectancy. These include certain conjunctions, conjuncts, and adjuncts (e.g. *but, however*) as well as continuatives (e.g. *still, only, just*). Examples of concession can be seen in (3.3) above and (3.21) and (3.22) below (from Martin and White 2007, 58 and Hood 2010, 184, respectively).

(3.21) In fact, virtually all the important applications to the Commission have been considered in public in the full glare of television lights.

(3.22) Yet in all those years, I only met two Indigenous women who went on to graduate research in science.

The dialogic functionality of projection, modality, and concession varies, as do their effects on writer–reader alignment. However, organizing verbal [engagement] resources in this way allows for a more systematic comparison with the literature regarding previous studies that may, for

example, have examined modality, projection, or concession in medical research discourse, but may not have done so from an explicitly dialogic perspective (see chapter 4).

### 3.2 Visual Engagement

Several studies adapt the work of White (2003), Martin and Rose (2003, 2007), and/or Martin and White (2005) to account for the visual construal of [engagement] (e.g. Chen 2008, 2009, 2010, Economou 2009, Tan 2010, Feng and Wignell 2011). Most of those studies also draw upon the work of O'Toole (1994) and/or Kress and van Leeuwen (1996, 2006) (see section 2.2.2.1).<sup>38</sup>

Economou (2009), for example, proposes a system of ENGAGEMENT based on the meaning potential of newspaper photographs. The system recognizes as 'monoglossic' those news photographs that are unmarked "naturalistic congruent visual representations of material reality", in which the subjectivity of the textual voice (the image-producer) or any external voices is backgrounded and the image is presented as more or less "objective and true" (Economou 2009, 203). With regard to other-voicedness, newspaper photography does not generally construe the [heterogloss: contract] feature/subsystem of verbal [engagement] (see Economou 2009, 202, 215) (cf. Figure 3.2). It can, however, express [heterogloss: expand]. Images can [attribute] certain meanings to other sources in two basic ways according to Economou (2009, 204-209): 1) by 'incorporating' the visual attitude of represented participants (e.g. clapping as a realization of approval) or the visual quote of an embedded visual/verbal text (e.g. a placard held by a demonstrator), or 2) by 'substituting' the entire news photograph for another external image. (A naturalistic photograph of a painting might be a typical example of this.)

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<sup>38</sup> In O'Toole's (1994) study of the language of visual art (see section 2.2.2.1), *all* interpersonal meaning is essentially a mode of engagement: a painting, for example, *engages* our attention, thoughts, and emotions, "drawing us into the world of the painting, and colouring our view of that world" (O'Toole 1994, 5). A number of interpersonal systems are potentially in operation when an artist or a work "engage[s] the attention and emotional involvement of the viewer" (O'Toole 1994, 12). For O'Toole (1994), these include the RHYTHM, GAZE, FRAME, LIGHT, PERSPECTIVE, COLOUR, and MODALITY of the painting or parts thereof.

News photographs can also construe [entertain], by foregrounding the subjectivity of the textual voice. This can be done, according to Economou (2009, 214), through “marked ideation”, where depictions of people, objects, or places are represented in “atypical or unrepresentative” ways, or through “marked expression”, where certain textural or spatial choices give a sense of the unreal or surreal—basically anything that diverges from a naturalistic or typical-for-news representation (see section 2.2.1.5.2 on coding orientation). Economou (2009) also extends the ENGAGEMENT system to include photographs that, in some way, [suggest] another type of text or image, e.g. those suggestive of art photography or frames from popular cinema or television drama (Economou 2009, 236).<sup>39</sup>

Other studies, e.g. Lemke (1998), O’Halloran (2005), Chen (2008, 2009, 2010), Tan (2010), Feng and Wignell (2011), and Painter, Martin, and Unsworth (2013), provide additional examples of visual dialogic resources, from a variety of fields and text-types (mathematics, school textbooks, advertising, and children’s picture books). They include speech/thought bubbles that [expand: attribute], interactive hypertext objects and graph error-bars that [expand: entertain], various colour/font highlights, verbal labels, and “positive” facial expressions that [contract: proclaim: pronounce/endorse], and depiction styles that construe varying degrees of emotional distance.<sup>40, 41</sup> Some images, or parts thereof, can also construe [contract: disclaim], by depicting and then rejecting or countering certain inappropriate or undesired behaviour, e.g. the widely recognized no-smoking sign with its red line across a smoking cigarette.

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<sup>39</sup> O’Toole (1994, 105) suggests a similar function, “intertextuality” (cf. Kristeva 1984), in which “the design knowingly refers to, mimics or contrasts with other ‘texts’ of its genre”.

<sup>40</sup> In Halloran’s (2005) study of mathematics, colours and other graphic highlights are said to give prominence, indicating which episodes or figures a reader ought to pay most attention to (treated as approximately equivalent to [contract: proclaim] in this thesis). In Chen’s (2009) study of EFL school textbooks, however, the use of colour or bold in verbal texts is dialogically ‘expansive’ rather than ‘contractive’, indicating possible options for answers (i.e. [entertain]) or the presence of the editor’s voice (i.e. [attribute]) (Chen 2009, 117–118).

<sup>41</sup> Painter, Martin, and Unsworth’s (2013, 30–35) account of depiction styles in children’s picture books is part of a system they refer to as *PATHOS*. Depiction styles vary from minimalistic to hyper-real and help to construe different types of emotional engagement or alignment with the reader.

All these options are presented in the form of a system network, in Figure 3.4.

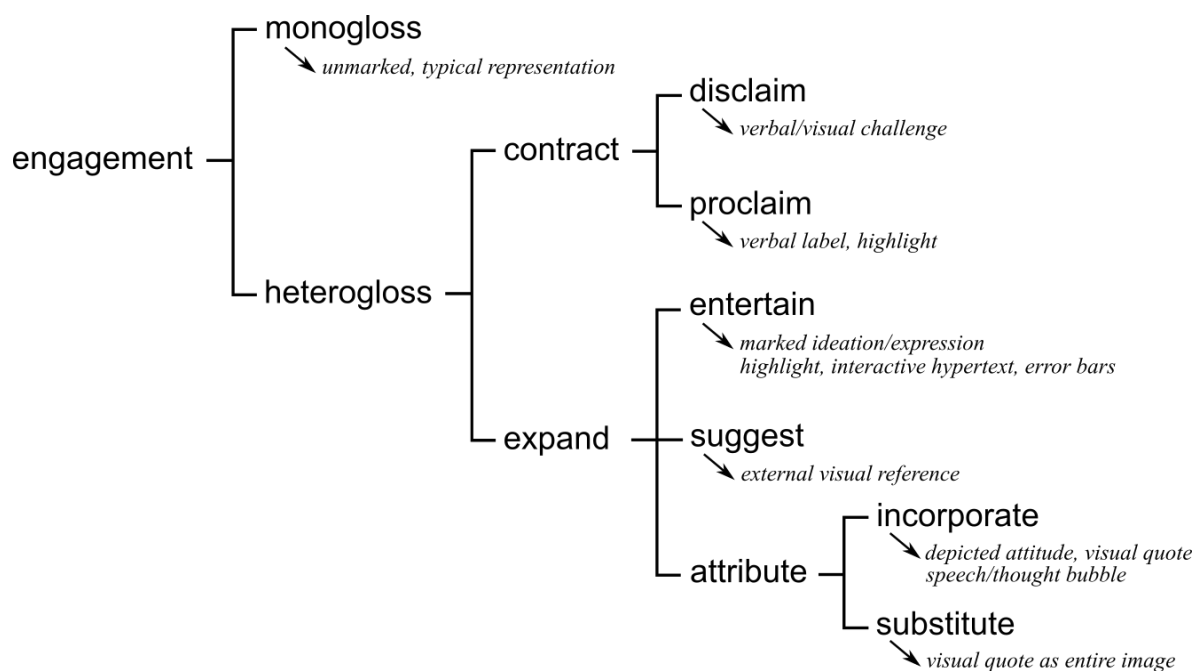


Figure 3.4. Discourse semantic system of ENGAGEMENT for visual display, adapted from Economou (2009), Lemke (1998), O'Halloran (2005), Chen (2008, 2009, 2010), Tan (2010), and Feng and Wignell (2011). Like Figure 3.2, the system network shows typological relations between features/options in the system, as well as examples of their realization (in italics), i.e. "from below" in the visual grammar or expression plane.

### 3.3 Mathematical-Symbolic Engagement

O'Halloran's (2005) systemic-functional analysis of mathematical discourse does not include an account of the potential [engagement] resources of mathematical symbolism.<sup>42</sup> As noted in section 2.2.2.2, mathematical symbolism seems to have developed a relatively narrow range of interpersonal meanings compared with language and images. For example, with regard to SPEECH FUNCTION, mathematical symbolism "is concerned largely with descriptive statements and a more restricted sense of commands" (O'Halloran 2005, 114), and modal meanings referring to

<sup>42</sup> O'Halloran (2005) only discusses ENGAGEMENT with regard to mathematical visuals (see section 3.2).

probability, usuality, obligation, etc. “are typically excluded in mathematical symbolic statements” (O'Halloran 2005, 115). However:

choices for MODALITY in the form of probability may be realized through symbolic statements for measures of probability; for example, levels of significance:  $p < 0.5$  (where the notion of uncertainty is quantified) and different forms of approximations.

(O'Halloran 2005, 115)

In this thesis, such expressions of modality are treated as encoding the [expand: entertain] feature, albeit in a potentially narrower sense than that construed by language and images (see sections 3.1.2 and 3.2). Likewise, the negative polarity expressed by a slash through a process symbol, e.g.  $\neq$ , is taken to construe [contract: disclaim], and logical relations such as *because/since* ( $\therefore$ ) and *therefore/hence* ( $\therefore$ ) can construe [contract: proclaim]. Mathematical statements or clauses without those resources—i.e. binary relations or bare assertions typically marked with process symbols such as  $=$  and  $\in$ —are considered ‘monoglossic’. A system network for mathematical-symbolic [engagement] is proposed in Figure 3.5.<sup>43</sup>

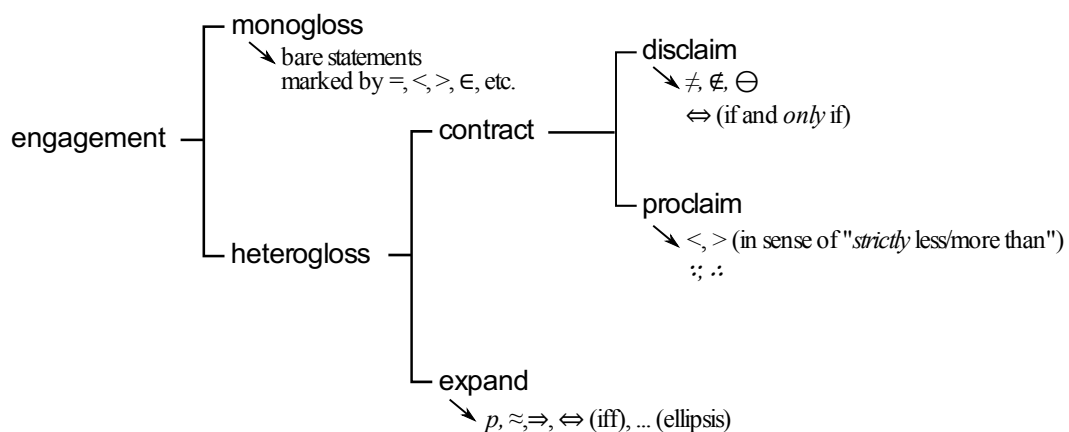


Figure 3.5. Discourse semantic system of ENGAGEMENT for mathematical symbolism.

<sup>43</sup> In Figure 3.5, the symbol  $\ominus$  describes a relation between sets that includes the objects that belong to those sets but not their intersections, usually referred to as symmetric difference. The symbols  $\therefore$  and  $\because$  generally represent the logical relations *therefore* and *because*. The symbols  $\in$  and  $\notin$  indicate membership or non-membership of a group, i.e. the relation *is (not) an element of*. The symbols  $\Rightarrow$  and  $\Leftrightarrow$  represent *implies* (or *if... then*) and *iff* (or *if and only if*), respectively.



## **4 Medical Research Discourse: An Extended Review and Discussion**

In this chapter, I provide an extended literature review and discussion of previous applied linguistic, social semiotic, and social/anthropological studies of medical research discourse in light of the previous chapters and sections on engagement, multisemiosis, and context. Section 4.1 reviews and discusses previous analyses of the medical research article as genre; section 4.2 reviews and discusses linguistic features of the genre; section 4.3 reviews and discusses previous studies of medical research discourse from a multisemiotic and/or nonverbal perspective; and section 4.4 looks at various sociological, epistemological, and ideological issues concerned with modern medical research. Several studies transcend these sectional boundaries and are discussed at various points throughout the chapter.

### **4.1 The Medical Research Article as (Macro)Genre**

According to MacDonald (2002), the paradigmatic text for the primary contextualization of knowledge in modern medicine is the medical research article. It is this text-type or (macro)genre that “creates the ‘intellectual field’ of medical epistemology” (MacDonald 2002, 451).

#### **4.1.1 IMRaD: Introduction, Methods, Results, and Discussion**

Different parts of the medical research article perform different functions (MacDonald 2002, 453), and contemporary medical research articles tend to follow a standard format, usually referred to as IMRaD: Introduction, Methods, Results, and Discussion (see Sollaci and Pereira 2004).<sup>44</sup> This particular format is recommended by the International Committee of Medical Journal Editors (ICMJE 2008, 2010, 2013), commonly known as the Vancouver Group, a committee whose guidelines are endorsed by the

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<sup>44</sup> The IMRaD structure developed in part, it seems, from the need for seventeenth-century empiricists to distinguish “empirical fact” from “human speculation” in reports of experiments and observations (Atkinson 1992, 339, see also Bazerman 1988, 63, 75–77).

editorial boards of more than 2000 medical research journals (ICMJE 2018).<sup>45</sup>

The 2008 *Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Writing and Editing for Biomedical Publication* (ICMJE 2008) recommends inclusion of the following stages and phases in the medical research article.<sup>46</sup>

[Introduction]

Provide a context or background for the study (that is, the nature of the problem and its significance). State the specific purpose or research objective of, or hypothesis tested by, the study or observation; the research objective is often more sharply focused when stated as a question. Both the main and secondary objectives should be clear, and any prespecified subgroup analyses should be described. Provide only directly pertinent references, and do not include data or conclusions from the work being reported.

[Methods]

Describe your selection of the observational or experimental participants (patients or laboratory animals, including controls) clearly, including eligibility and exclusion criteria and a description of the source population. [...] Identify the methods, apparatus (give the manufacturer's name and address in parentheses), and procedures in sufficient detail to allow others to reproduce the results. Give references to established methods, including statistical methods [...]; provide references and brief descriptions for methods that have been published but are not well-known; describe new or substantially modified methods, give the reasons for using them, and evaluate their limitations. Identify precisely all drugs and chemicals used, including generic name(s), dose(s), and route(s) of administration. [...] Describe statistical methods with enough detail to enable a knowledgeable reader with access to the original data to verify the reported results. When possible, quantify findings and present them with appropriate indicators of measurement error or uncertainty (such as confidence intervals). Avoid relying solely on statistical hypothesis testing, such as *P* values, which fail to convey important information about effect size. [...] Define statistical terms, abbreviations, and most symbols. Specify the computer software used.

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<sup>45</sup> Only 14 of those 2000-plus journals are official members of the ICMJE: *Annals of Internal Medicine*, *British Medical Journal*, *Canadian Medical Association Journal*, *Chinese Medical Journal*, *Ethiopian Journal of Health Sciences*, *JAMA (Journal of the American Medical Association)*, *Nederlands Tijdschrift voor Geneeskunde*, *New England Journal of Medicine*, *New Zealand Medical Journal*, *Revista Medica de Chile*, *The Lancet*, *PLOS (Public Library of Science)*, *Tidsskrift for Den norske Lægeforening*, and *Ugeskrift for Læger*.

<sup>46</sup> In 2013, the ICMJE *Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Writing and Editing for Biomedical Publication* was renamed *Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals*.



[Results]

Present your results in logical sequence in the text, tables, and illustrations, giving the main or most important findings first. Do not repeat all the data in the tables or illustrations in the text; emphasize or summarize only the most important observations. Extra or supplementary materials and technical detail can be placed in an appendix where they will be accessible but will not interrupt the flow of the text, or they can be published solely in the electronic version of the journal. [...] When data are summarized in the Results section, give numeric results not only as derivatives (for example, percentages) but also as the absolute numbers from which the derivatives were calculated, and specify the statistical methods used to analyze them. Restrict tables and figures to those needed to explain the argument of the paper and to assess supporting data. Use graphs as an alternative to tables with many entries; do not duplicate data in graphs and tables. Avoid nontechnical uses of technical terms in statistics, such as “random” (which implies a randomizing device), “normal,” “significant,” “correlations,” and “sample.”

[Discussion]

Emphasize the new and important aspects of the study and the conclusions that follow from them. [...] For experimental studies, it is useful to begin the discussion by summarizing briefly the main findings, then explore possible mechanisms or explanations for these findings, compare and contrast the results with other relevant studies, state the limitations of the study, and explore the implications of the findings for future research and for clinical practice. [...] Link the conclusions with the goals of the study but avoid unqualified statements and conclusions not adequately supported by the data. [...] Avoid claiming priority or alluding to work that has not been completed. State new hypotheses when warranted, but label them clearly as such.

Genre analyses of medical research articles (e.g. Skelton 1994, Nwogu 1997, Fryer 2012, Davis 2015) reveal similar stages and phases to those recommended by the ICMJE. Some of those stages/phases are considered obligatory; others are optional.

Introduction sections orient the reader to the object of study: they describe the field of study, identify a gap or niche in the field, and state the main research purpose(s). Despite the recommendations of the ICMJE (see above), some Introductions describe or highlight specific methods or results (see Nwogu 1997, 128, Fryer 2012, 14, Davis 2015, 86); some also explain the rationale or importance of the study (Skelton 1994, 456–457, Fryer 2012, 12–13).

Methods sections describe the material and explain how (and why) it was selected. They also recount the experimental and data-analysis procedures. Some, more recent articles include a conflict-of-interest

statement (Fryer 2012, 20, Davis 2015, 90–92) in which authors declare any financial or personal relationships that may “inappropriately influence (bias) his or her actions” (ICMJE 2008, 4). Not all conflict-of-interest statements are part of the Methods section, however; some are dealt with under separate sections at the end of articles (Fryer 2012, 20).

Results sections report the main findings and their (in)consistencies with the aims or hypotheses of the study. The section includes references to and presentation of nonverbal or multisemiotic resources, usually in the form of graphs and/or tables. It may also include a description of any adjustments made to the data or data analysis (Skelton 1994, 457, Fryer 2012, 22) as well as an explanation or evaluation of selected findings (Skelton 1994, 457–458).

Discussion sections compare the study’s findings with those of previous studies, they offer explanations and discussions as to possible/probable mechanisms and causes, and they discuss the study’s strengths and weaknesses. They also make recommendations for future research and/or practice-based activities or interventions. Some articles conclude with an overall summary of the study (see Nwogu 1997, 133–134).

A summary of the main stages and phases identified in Skelton (1994), Nwogu (1997), Fryer (2012), and Davis (2015), and their equivalent recommendations in the ICMJE (2008) guidelines, is provided in Table 4.1. As this summary shows, the generic structure of medical research articles is not fixed. Research articles exhibit individual variation, and the genre itself evolves over time, in response it seems to the changing needs of the discourse community (see Li and Ge 2009).

Table 4.1. Summary of generic stages and phases in English-language medical research articles.

Generic stage/phase	Skelton (1994)	Nwogu (1997)	Fryer (2012)	Davis (2015)	ICMJE (2008)
<b>Introduction (Orientation, Evaluation, Description)</b>					
Introducing background/object of study	x	x	x	x	x
Explaining rationale, importance	x	–	x	–	x
Identifying gap/need in field	x	x	x	x	x
Stating research purpose	x	x	x	opt.	x

Describing main methods/results	–	opt.	opt.	opt.	–
<b>Methods (Recount, Description, Explanation)</b>					
Describing conflict of interest	–	–	opt.	opt.	x
Describing material	x	x	x	x	x
Explaining inclusion/exclusion criteria	opt.	x	x	x	x
Recounting experimental procedure	x	x	x	x	x
Recounting data-analysis procedure	x	x	x	x	x
<b>Results (Report, Evaluation)</b>					
Reporting main findings	x	x	x	x	x
Reporting consistent observations	–	x	x	–	–
Reporting non-consistent observations	–	x	x	–	–
Presenting non-verbal material	x	x	x	x	x
Describing/recounting adjustments	x	–	x	–	x
Explaining/evaluating the data	x	–	opt.	opt.	–
<b>Discussion (Exposition, Explanation, Discussion, Exploration, Recommendation)</b>					
Reporting main findings	x	x	x	x	x
Explaining specific outcomes	x	x	x	x	x
Exploring connections with literature	x	x	x	x	x
Explaining/discussing (possible) mechanisms/causes, implications, importance	–	x	x	x	x
Explaining/discussing limitations	x	x	x	opt.	x
Recommending (applicability, future research)	x	x	x	x	x
Concluding, summarizing	–	x	x	–	x

“x” indicates that stage/phase is mandatory; “opt.” indicates that stage/phase is optional; “–” no stage/phase identified.

#### 4.1.2 Other Stages of the Medical Research Article

Although most genre studies of the medical research article focus on the stages described above, some also examine titles (Gledhill 1995b, León and Divasson 2006, Soler 2007, Wang and Bai 2007), abstracts (Salager-Meyer 1992, Gledhill 1995a, b, León and Divasson 2006), and acknowledgments (Salager-Meyer et al. 2006).

Titles summarize the main content of a research article; they play a key role in the organizing and retrieving of data; and they are an important factor in persuading readers to continue reading (Soler 2007, 91, Wang and Bai 2007, 389). Medical research article titles are typically nominal

groups with relatively long or complex pre- and/or postmodification, e.g. *Acute liver failure caused by diffuse hepatic melanoma infiltration* (Soler 2007, 94). Nominal groups in titles are often longer and more complex than those in the Introduction, Methods, Results, and Discussion sections, a consequence it seems of the high conceptual density required of this short, obligatory generic stage (León and Divasson 2006). Less commonly, titles are “compounded” using a colon, and tend to follow what Swales and Feak (2004) call a general–specific structure, where “authors make a general presentation of the object of study and simultaneously indicate a specificity of such study” (Soler 2007, 99). Titles may also be formulated as declarative or interrogative clauses, or as a combination of ‘compounded’ and clausal types, e.g. *Viral infection, inflammation, and the risk of idiopathic dilated cardiomyopathy: can the fire be extinguished?* (Soler 2007, 100). Clausal or full-sentence titles appear to be becoming more common, perhaps because of the “increasing independence of the title and abstract as ‘stand-alone’ text types” (Jaime-Sis 1993, in Gledhill 1995b, 33). This phenomenon is more typical of medical and biological research articles than it is of other disciplines such as linguistics, psychology, and anthropology; medical research article titles also tend to be longer (Soler 2007).

Abstracts can be considered “a ‘péritexte’, a disembodied and self-standing reference tool” (Lane 1992, in Gledhill 1995a) that seems to perform two basic functions: to summarize and to promote research (León and Divasson 2006, 302–303). It does so through a sequence of generic phases that closely resemble the four main stages of the article. Salager-Meyer (1992, 96) identifies four obligatory phases—purpose, methods, results, and conclusions—as well as two non-obligatory phases—statement of the problem and recommendation. Compared with the main body of the research article, abstracts are characterized by a relatively high number of “semantically dense nominal units” (León and Divasson 2006, 302; cf. titles above) and fewer instances of modality and author comment (Adams Smith 1984; see also section 4.2.3).

Acknowledgments are a common feature of medical research articles. They usually appear towards the end of articles, but they may not always be explicitly labelled as acknowledgments (Salager-Meyer et al.

2006, 413). Acknowledgments function, in a sense, as academic “thank-you notes” (Salager-Meyer, Ariza, and Berbesí 2009, Salager-Meyer et al. 2011). They give credit for moral, technical, financial, academic, administrative, and/or editorial support (Salager-Meyer et al. 2006, 414–415). They are also an important part of the democratization and transparency of science, since they list and specify the roles and relations of different participants in the research. This is especially important in medical science, in which the numbers of authors and funding bodies have increased dramatically in recent years (Salager-Meyer et al. 2006). For Salager-Meyer et al. (2006, 425), acknowledgements are also “the only place where science is portrayed as a dialogic process that reveals the complex web of interpersonal debts implicit in the construction of knowledge”.

## **4.2 Linguistic Features of the English-Language Medical Research Article**

Relatively few studies, with the exception of Pérez-Llantada (2011) and Fryer (2013), explicitly examine the instantiation and realization of verbal [engagement] in medical research articles. There is, however, an extensive literature on the analysis of a diverse set of linguistic resources in medical research articles that, in various ways and to varying degrees of explicitness, can be considered dialogic. I review, here, those previous studies, indicating their relevance with regard to the ENGAGEMENT system and highlighting, where relevant, researchers’ comments on and discussions of potential dialogic functionality. I begin with a review of Pérez-Llantada (2011) and Fryer (2013). Subsequent sections are organized according to Martin and Rose’s (2003, 2007) taxonomy of the lexicogrammatical resources of ENGAGEMENT, namely projection, modality, and concession (see section 3.1.3).

### **4.2.1 Engagement**

Drawing on the work of White (2003), Pérez-Llantada (2011) examines how medical research writers “construct subtle social relationships with their audiences for reasons of acceptance and recognition within a given

disciplinary community” (Pérez-Llantada Auría 2011, 26). Pérez-Llantada (2011) investigates the occurrence and distribution of certain dialogically ‘contractive’ and dialogically ‘expansive’ resources in medical research articles written by North American and Spanish researchers, comparing the choices made by native and non-native speakers writing in English (ENG and SPENG, respectively) and those made by native speakers writing in Spanish (SP). Based on a limited set of grammatical constructions—*we*-subjects and anticipatory-*it* patterns (described by Pérez-Llantada as dialogically ‘contractive’ resources), and inanimate subjects and passive constructions (defined as dialogically ‘expansive’ resources)—Pérez-Llantada (2011) notes a number of genre-related and intercultural characteristics.

In Introduction sections, authors tend to choose “dialogically expansive passive constructions to indicate a research gap, raise a question or set the grounds for occupying the research space” and “dialogically contractive *we*-pronouns to express commitment when they refer to the rationale of the study at the end of the section” (Pérez-Llantada Auría 2011, 30). Methods sections “[show] an all-encompassing use of passive constructions” (Pérez-Llantada Auría 2011, 32), which, according to Pérez-Llantada (2011, 33), allows for an objective recount of research procedures and facilitates replication and (possible) verification of the study. Results sections also use passive constructions, to summarize the main results, to state limitations, and to evaluate findings. Together with inanimate subjects, dialogically ‘expansive’ resources in this section “convey detachability and restrict the scope of the writers’ claims” (Pérez-Llantada Auría 2011, 33). In contrast, in Discussion sections, ENG authors tend to opt for dialogically ‘contractive’ resources to convey “assertiveness” and “[to invite] readers to accept the writers’ points of view” (Pérez-Llantada Auría 2011, 35), construing for the text a readership that shares similar positions to the textual voice (Pérez-Llantada Auría 2011, 36). SP writers, on the other hand, prefer dialogically ‘expansive’ resources such as the passive, construing for the text a readership with “potentially dissenting views” (Pérez-Llantada Auría 2011, 38). According to Pérez-Llantada (2011, 37), SPENG writers represent a hybrid mode of expression that “fluctuates between

disengaged and engaged positionings,” between aligned and disaligned readerships, particularly at the end of Discussion sections (see also Pérez-Llantada 2012). Pérez-Llantada (2011, 43) concludes by emphasizing the importance of engagement in “facilitat[ing] the transmission of disciplinary knowledge as well as the construction of preferred dialogic spaces for writer-reader interaction across cultural contexts and languages.”

In Fryer (2013), I report findings, based mainly on the framework of Martin and White (2005), that variously converge and diverge with those of Pérez-Llantada (2011).<sup>47</sup> In general, the English-language medical research articles in the study (Fryer 2013) are considered dialogically ‘expansive’, at least in terms of the frequencies of instantiation of [engagement] features—the [entertain] option accounts for over half of all instances of [engagement], and is most commonly expressed by the modal Finite *may* (Fryer 2013, 195). With regard to generic staging, I note that [heterogloss] is more frequently construed in Introduction and Discussion sections, while the Methods and Results have a higher relative frequency of [monogloss] (Fryer 2013, 198–199). In attempting to explain this difference, I quote MacDonald (2002, 435), who describes the Introduction and Discussion sections of medical research articles as “the zones in which the writer(s) negotiate with their peers for ‘research space’ [...] for their findings.” In Methods and Results sections, on the other hand, “argumentation is [generally] elided and the writer appears to assume that he/she can take understanding of a range of shared meanings for granted” (MacDonald 2002, 435).<sup>48</sup>

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<sup>47</sup> Fryer (2013) is a pilot study for this thesis, based on a selection of articles from the material described in chapter 5.

<sup>48</sup> While this distinction is widely acknowledged in the literature, Hyland (2005, 190) argues that “the division of research papers into rhetorically simple and detached Methods and Results, and complex, subjective and author-centred Introductions and Discussions might be unwise. Even the most rhetorically innocent sections reveal writers’ efforts to persuade their audience of their claims, so that stance and engagement are likely to figure, in different ways, across the research paper”.

## 4.2.2 Projection

With regard to projection, several studies investigate the types and functions of reporting verbs in English-language medical research articles. Others examine citation practices and the use of pronominal reference as a means of projecting different voices in those texts.

### 4.2.2.1 Reporting Verbs

Thomas and Hawes's (1994) and Davis's (2015) studies of reporting verbs are based on the typologies of Thompson and Ye (1991). Thomas and Hawes (1994) identify three main types of reporting verbs in medical research articles. Their "discourse", "cognition", and "real-world" categories are more or less comparable with Thompson and Ye's (1991) textual, mental, and research-act verbs. Discourse or textual verbs refer to "activities that are linguistic in nature and involve interaction through speech or writing" (Thomas and Hawes 1994, 137); they include *hypothesize*, *suggest*, *state*, and *conclude*. Cognition or mental verbs "refer to the mental activities that the researcher goes through" (Thomas and Hawes 1994, 144); these include *believe*, *consider*, and *think*. Real-world or research-act verbs make reference to some aspect of the recounting of methods or the reporting of results (Thomas and Hawes 1994, 133–134) and include *find*, *demonstrate*, and *show*.

As Thomas and Hawes (1994) and Davis (2015) note, and as the examples above may suggest, reporting verbs play an important interpersonal function, indicating varying degrees of (dis)association or (dis)agreement between the textual voice and the reported (or projected) proposition. Based on Thompson and Ye (1991), Davis (2015) categorizes reporting verbs as "factive", "counter-factive", and "non-factive", depending on whether projected propositions are presented as true or correct, as false or incorrect, or with no clear indication as to the attitude of the textual voice, respectively (cf. [endorse], [distance], and [acknowledge]).

The majority of Thomas and Hawes's (1994) reporting verbs are of the "real-world" type, most commonly the neutral or non-factive reporting



verb *find* (as in *More recently, Mohamad et al. [9] found...*).<sup>49</sup> Evaluative real-world reporting verbs tend to be of the factive type, including *demonstrate*, *show*, and *establish*, e.g. *Drage and Berendes [111] showed that...* Such verbs, according to Thomas and Hawes (1994, 135), explicitly indicate that the citing author “accepts the factual validity of the reported claim” (cf. [endorse]).

Discourse verbs and cognition verbs are less common than real-world verbs in medical research articles (Thomas and Hawes 1994). Non-factive discourse verbs include *state*, *document*, and *report*; factive and counter-factive discourse verbs include *conclude*, *provide [evidence]*, and *maintain*. A second, less common subtype of discourse verbs, expressing “tentativity”, includes the reporting verbs *suggest*, *propose*, *postulate*, *hypothesize*, and *indicate*, e.g. *Some data suggests that...* Cognition verbs include the reporting verbs *believe*, *consider*, *regard*, and *think*, typically used in the passive form, e.g. *It is believed that...* They often occur in the opening sentences of articles, “almost invariably recounting views or ideas generally held by the practitioners in the field, or at least by a large number of researchers” (Thomas and Hawes 1994, 145).

With regard to distribution, Davis (2015) observes a greater “prosody of non-factiveness” (Davis 2015, 178) in Introduction sections and “more verbs that exhibited factiveness” (Davis 2015, 179) in Results sections. Davis (2015) also shows which reporting verbs are typically used to describe the field, and which are used to refer to the study itself. Those used in Introduction sections, e.g. *claim*, *report*, *think*, *find*, *suggest*, mainly focus on field, “generally describing what others have done” (Davis 2015, 178), while those in Methods sections, e.g. *think*, *suggest*, *find*, *indicate*, have a greater focus on the actual study, with writers “usually outlining what they did” (Davis 2015, 178). Similarly, reporting verbs in Results sections, e.g. *discover*, *observe*, *argue*, *claim*, *find*, *think*, *indicate*, *suggest*, are almost exclusively study-focused, while Discussions have a more

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<sup>49</sup> Davis (2015, 177) notes that “[f]ound has a prosody of non-factiveness in the Introduction, Methods, and Discussion sections of MRAs [medical research articles] [...], but switches its prosody to factiveness for the Results section.”

balanced combination of field- and study-focused reporting verbs (Davis 2015, 178–179).

The metadiscourse studies of Dahl (2003, 2004) and Pérez-Llantada (2010b) overlap with Thomas and Hawes (1994) and Davis (2015) in a number of ways. Dahl's (2003, 2004) rhetorical metadiscourse—metatextual elements that “assist the reader in the processing of the text by making explicit the rhetorical acts performed by the writer in the argumentation process” (Dahl 2004, 1812)—includes reporting verbs such as *argue*, *believe*, *claim*, *conclude*, *maintain*, *report*, *stress*, and *think*. Pérez-Llantada's (2010b) text-oriented and participant-oriented metadiscourse categories, based on Ädel (2006, 2008), include similar verbs, such as *report*, *demonstrate*, *indicate*, *propose*, *speculate*, and *note*.

Dahl's (2003, 2004) studies of academic research articles show that, regardless of language (English, French, and Norwegian), medical research articles contain far fewer rhetorical metadiscourse markers than linguistics and economics research articles. According to Dahl (2003, 135, 2004, 1822), medical research articles (RAs) tend to have a more experimental rather than argumentative focus compared with linguistics and economics RAs, “making the interpretation of research data [in medical research articles] less dependent on subjective evaluation [or rhetorical metadiscourse] than what is the case in the humanities and social sciences” (Dahl 2004, 1822).

Pérez-Llantada (2010b) examines metadiscoursal features in the Introduction and Discussion sections of English-language and Spanish-language medical research articles, emphasizing the “dialogic and interactive” character of written academic discourse in general (Pérez-Llantada 2010b, 59). With regard to English-language medical research articles, Pérez-Llantada shows that there are more ‘arguing’ metadiscoursal features—realized by constructions that include reporting verbs such as *demonstrate*, *indicate*, *confirm*, and *propose*—in Discussions compared with Introductions. One reason for this difference, according to Pérez-Llantada (2010b, 60), might be the increased persuasive effort needed to convince readers of new knowledge claims made in Discussion sections.

Characteristic words and phrases in medical research article titles include nominalized research-activity mental or material processes such as *study*, *evaluation*, and *treatment* as well as “nouns synonymous with the illness or the patient” (Gledhill 1995b, 130), e.g. *cancer*, *human*, *breast*, *patients*, *tumor*, and *prostate*.

#### 4.2.2.2 Referencing

Dubois’s (1988) study of citation practices in biomedical research articles examines four citation types. “Direct quotations” are characterized as segments of three or more non-technical words from another article; “paraphrases” are restatements of ideas “in different words but the same length”; “summaries” are “abbreviated statement[s] of a result or fact from a single source article”; and “generalizations” are broad statements of “similarity from the work of two or more source articles” (Dubois 1988, 183). The examples Dubois (1988) provides for direct quotations and paraphrases include the projections *Duncker (1972) also reported that* and *We have previously shown that*, respectively (cf. [acknowledge] and [endorse]). These types of citation, however, are rarely used in Dubois’s (1988) study material. Instead, the majority of citations are of the summary or generalization type. Dubois’s (1988) examples for summaries and generalizations include author-date references and numerical endnote references—what Swales (1990, 148–149) calls “non-integral citations”—but no clausal projection involving the source of the idea or locution. Such citations are “outside of the grammatical structuring of the clause”, according to Hood (2010, 55), but the ideas or locutions they refer to can be seen as “projected by the writer and as ‘authorised’ by another source” (Hood 2010, 56), what Hood (2010, 134) calls “implied projection.” This is a particular form of attribution common to and characteristic of academic discourse, one that not only acknowledges sources but also “give[s] weight to or impl[ies] greater validity of the proposition or claim they are included to support” (Hood 2010, 95) (cf. [acknowledge] and [endorse]). In such cases, the textual voice takes greater responsibility for claims than is usually the case with integral citations (Hood 2010, 56), in which the source is commonly construed as the framer of the proposition (see section 2.3.1.2). By paraphrasing or

summarizing (cf. Dubois 1988, 183), the textual voice “seamlessly” merges the referenced proposition(s) into its own arguments, especially in the case of numerical-endnote references, which elide the names of source authors (Coffin 2009, 173–174). Coffin (2009, 174) argues that such resources are essentially dialogically ‘contractive’, since “the referenced proposition is more likely to be perceived as an established fact.”

Dubois’s (1988) study focuses on ethical issues connected to the reference and use of others’ work, i.e. plagiarism, rather than the epistemological and/or rhetorical reasons for citations and referencing. Hu and Wang (2014), however, explicitly examine the dialogic functionality of referencing, and they use their findings to comment on epistemological differences between the disciplines of medicine and applied linguistics. Drawing on work by Martin and White (2005) and Coffin (2009), among others, Hu and Wang (2014) distinguish between dialogically ‘contractive’ and dialogically ‘expansive’ resources as a means of categorizing “writer stance”. Using Coffin’s (2009) model of “textual integration”, they also describe “the extent to which a cited proposition is integrated into the citing sentence” (Hu and Wang 2014, 17). The majority of references in their medical research article subcorpus are non-integral (after Swales 1990, 148–149); that is, the cited author or study is referred to only parenthetically or via a superscript number referring to a bibliography. Rather than inserting a direct quotation, medical researchers assimilate cited propositions into the text by paraphrasing or summarizing (cf. Dubois 1988, 183). The most frequently used reporting verbs for those references/citations are *report*, *show*, *find*, *indicate*, and *demonstrate* (cf. [endorse] and [acknowledge]). Such verb choices and the use of non-integral references function, according to Hu and Wang (2014, 24), to construe a relatively ‘contracted’ dialogic space in which the scope for alternative voices and propositions in the discourse is restricted (see section 3.1.2.1). Moreover, Hu and Wang (2014, 25) argue that those choices may reflect the dominant positivist epistemology of medical science and other hard-science disciplines—an epistemology that “assumes the existence of a single objective reality independent of human subjectivity and governed by universal laws of causality” (Hu and Wang 2014, 25)—“[b]y framing propositions as more or less factual information

[and] downplaying the role of human agency in knowledge construction” (Hu and Wang 2014, 25). This contrasts with the comparatively more dialogically ‘expansive’ citation resources used in applied linguistics (integral references and reporting verbs such as *argue*, *claim*, *note*, *point out*, *propose*, *state*, and *suggest*; cf. [entertain], [acknowledge], and [distance]), which, the authors argue, reflect “an academic discourse that foregrounds human agency at the core of knowledge construction, recognizes the multiplicity of interpretations, and opens up the space for dialog” (Hu and Wang 2014, 25).

Like Hu and Wang (2014), Fløttum et al. (Fløttum 2003a, 2004b, 2006, Fløttum, Dahl, and Kinn 2006) also focus on the dialogic (or “polyphonic”; Fløttum, Dahl, and Kinn, 2006, 35–39) functionality of references and citations. In a cross-linguistic and cross-disciplinary project (English, French, and Norwegian; medicine, linguistics, and economics), Fløttum et al. (Fløttum 2003a, 102–105, 2004b, 153, Fløttum, Dahl, and Kinn 2006, 227) propose an extension of Swales’s (1990) classification of references as integral or non-integral, to include four main types of reference categories: “non-integral”, in which citations are referred to by superscript numbers only; “part-integral”, in which author names and publication dates are given in parentheses; “semi-integral”, in which author names are an integrated element of the citing sentence; and “fully integral”, as in the case of quotations.

Fløttum et al. (Fløttum 2003b, 106, 2004b, 154, 2006, 261, Fløttum, Dahl, and Kinn 2006, 219–220) find that medicine has the highest overall relative frequency of references (almost exclusively of the non-integral type), although linguistics has the highest number overall. This seems to contrast with Hyland’s (2000, 24) finding that “softer disciplines tend to employ more citations”, assuming, as Fløttum (2003a, 106) notes, that “one considers medicine as a hard science”, and that the linguistics research articles studied can be considered “soft” (cf. Biglan 1973, Kolb 1981, Becher 1994, Becher and Trowler 2001). The majority of those references, in the case of medicine, are found in the Introduction and Discussion sections, emphasizing their association with and relevance for argumentation and discussion (Fløttum 2003a, 107, see also MacDonald 2002, 435). Moreover, the relatively high frequency of references in

medical research articles may, as Fløttum, Dahl, and Kinn (2006, 263) suggest, reflect “the more cumulative nature of medicine”—“in the sense that new research contributions are added to the collective knowledge capital” (Fløttum, Dahl, and Kinn 2006, 261)—“and the stronger integration of medical research in an established and global research community [compared with linguistics and economics].”

Fløttum (2003a) suggests three categories of verbs used with references: research process verbs, rhetorical verbs, and opinion verbs (cf. Thomas and Hawes’s (1994) real-world verbs, discourse verbs, and cognition verbs). No explication or exemplification of these categories is provided, but another publication (Fløttum 2003b) does give examples based on a study of first-person and indefinite pronouns (see review in section 4.2.2.3): research process verbs include *adopt, analyse, choose, do, explore, find, follow, limit, study, and use*; rhetorical verbs include *close, conclude, discuss, highlight, illustrate, move on, offer, outline, present, repeat, and turn to*; and opinion verbs include *argue, believe, claim, reject, and think* (Fløttum 2003b, 40–41). Fløttum, Dahl, and Kinn (2006) describe a similar set of categories: reporting verbs such as *report, say, and write*; research and discourse verbs such as *find* and *show*; and position verbs such as *argue* and *claim*. The first two types are frequently used in medical research articles (e.g. *report, find, show, demonstrate, suggest*), while the latter is more typical of linguistics and economics articles (Fløttum, Dahl, and Kinn 2006, 233–234). Fløttum, Dahl, and Kinn (2006, 230) conclude that the general lack of integral references in medical research articles suggests that “medical authors rarely give the floor to others” compared with linguistics and economics researchers. Moreover, verb choice in medical research articles may reflect “the nature of research undertaken in [medicine]” (Fløttum, Dahl, and Kinn 2006, 240), with a greater focus on “observable and quantifiable findings”, as expressed by verbs such as *find, report, and show*, than on discussion and argumentation (e.g. *argue, suggest, claim*) as is more typically seen in linguistics research articles (Fløttum, Dahl, and Kinn 2006, 240).

Salager-Meyer (1998, 1999b) provides a diachronic perspective on the use and development of referencing practices in medical research discourse, emphasizing the important intertextual role that references

play in allowing scientists to “refer to previously published texts in order to present their claims and discuss scientific knowledge” (Salager-Meyer 1999b, 281). Based on a variety of English-language medical texts, including case reports, review articles, and original research articles, published between 1810 and 1995, Salager-Meyer (1999b, 281) notes a general increase in the overall number of references used over time (from 1.8 references per 1000 words in the period 1810-1949, to 10.7 per 1000 words in 1950-1995). There is also a distinct change in the types of references used, with certain reference patterns typifying different periods of medical research. For example, papers from the 19th century prefer “verbatim quotes”, “generalized references” in which “cited researchers’ names are provided in the body of the article but without any specific reference to their works”, and “specific references” in which “cited researchers’ names are indicated in the body of the article along with a specific reference [...] to the work cited” (Salager-Meyer 1999b, 284). Papers from the early 20th century, on the other hand, are typified by “footnote references”, and those from the late 20th century by “endnote references”, particularly of the numerical-endnote subtype (cf. Fløttum et al. above). The findings from this study, Salager-Meyer (1999b) suggests, reflect sociocultural changes in the field of medicine, from “an individually-, privately-based and non-specialized medicine and [...] a small, non-professionalized and ‘visible’ scientific community” (Salager-Meyer 1999b, 290) to a more “highly professionalized, structured and conventional character” (Salager-Meyer 1999b, 295) in which scholars themselves gradually, from the late 1950s onward, become “invisible” (Salager-Meyer 1999b, 300).

#### **4.2.2.3 Pronominal References**

One way in which researchers can be explicitly written into the text, in addition to referring to individual scholars by name (see Salager-Meyer 1999b, above), is through pronominal reference. Carciu (2009) examines the use of the “exclusive” *we* pronoun, and its related oblique and possessive forms (*us* and *our*), in English-language medical research articles written by North American and Spanish scholars. Overall, Carciu (2009, 77) finds that first-person plural references are most common in

Discussion and Introduction sections, followed by Results and Methods. Carciu (2009) also notes that “exclusive” *we* is used for a number of discursive/rhetorical purposes, usually in combination with different reporting verbs. For example, Methods and Results sections typically “recount” what the writers/researchers did or observed. In cases where the Agent is made explicit, we find *we divided* and *we measured*.<sup>50</sup> In the Introduction and Discussion sections, however, “exclusive” *we* tends to foreground the writers’ role as “architect”, “indicating that [they] are attending to the ongoing discourse and its text-internal realities” (Carciu 2009, 84), e.g. *we report here*. “Exclusive” *we* may also be used to “guide” or align the reader towards potentially shared values or viewpoints, e.g. *we show* and *we demonstrate* (a form of text-internal [endorse]). Writers’ opinions and attitudes are also typically expressed here, particularly in Discussion sections, by the use of *we think* and *we believe* (cf. [entertain]), as well as by possessive forms such as *our results suggest*, which help writers to “mitigate propositional meanings and distance themselves from their claims when stating new hypotheses” (Carciu 2009, 83). This, Carciu (2009, 88) adds, shows awareness that potential readers might reject their claims. Carciu (2009, 89–90) concludes that, from a pedagogic perspective, researchers need to be aware of the varying rhetorical effects of first-person plural references, as a means of presenting writers as accepted members of the discourse community and as a means of “persuading audiences of the validity of new knowledge”.

Breivega, Dahl, and Fløttum (2002) also examine the use of first-person pronouns and their possessive forms in English, French, and Norwegian medical, linguistics, and economics research articles. Although Breivega, Dahl, and Fløttum (2002) is a pilot study for a more comprehensive project (see Fløttum, Dahl, and Kinn 2006), the authors note that “[t]he typical medical article [...] seems to be a description of actions rather than a discussion presenting different views or attitudes”,

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<sup>50</sup> In a related example, Hood (2010, 181) argues that referenced sources as Actors in material processes can also be considered reporters or Sayers in verbal processes. According to Hood (2010, 181), a material clause like *Van de Kooi and Knorr (1973) measured...* implies a projecting verbal clause, i.e. *Van de Kooi and Knorr (1973) (report that they) measured...*



and choices of *we* represent the authors as “acting subjects”, e.g. *we used*, *we treated*, and *we performed* (Breivega, Dahl, and Fløttum 2002, 226), rather than as explicitly attitudinal or argumentative participants. Indeed, the results of the pilot study, which also include preliminary findings on metatextual comments, references, and negation, prompt Breivega, Dahl, and Fløttum (2002, 232) to hypothesize that, in comparison with linguists and economists, “[m]edical researchers are non-expressive writers who do not let other researchers be heard in their texts”. This hypothesis is in part confirmed by Fløttum (2003b, 40, 2006) and Fløttum, Dahl, and Kinn (2006, 261 ff.), all of which report relatively low frequencies of personal and indefinite pronouns in medical research articles compared with linguistics and economics. While these differences might be attributed to the “objectivist ideal of science in medical research” (Fløttum, Dahl, and Kinn 2006, 261), Fløttum, Dahl, and Kinn (2006) extend their possible explanations to a number of other, interrelated factors. One of these is the “the relation between research group and author group in medicine”, groups that do not necessarily fully overlap (Fløttum, Dahl, and Kinn 2006, 262). In cases where research may have been performed by only some of the authors, and where the importance of who did what is not necessarily at stake, “the choice of some impersonal mode of expression may simply be more appropriate than using ‘we’” (Fløttum, Dahl, and Kinn 2006, 262).

Lafuente Millán (2010) examines the use of selected “exclusive first-person markers” (*we*, *us*, *our*, *I*, *my*) across four disciplines, including medicine/urology, which Lafuente Millán (2010, 40) describes as a hard science. Like Fløttum (2006) and Carciu (2009), Lafuente Millán (2010) finds no instances of first-person singular markers (*I*, *my*) in the multi-authored urology texts. Despite this, they do contain a “surprisingly high relative number of [plural] self-mention resources”, which prompts Lafuente Millán (2010, 41–42) to suggest that urology research articles do “not conform to the conventional description of hard science academic texts that often appear in writing manuals, where writers are advised to adopt an impersonal and objective writing style”.<sup>51</sup>

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<sup>51</sup> Historically, first-person pronouns have played an important role in situating the writer’s experience as central to the narrative of experiment and observation (Atkinson 1992, 339–

*Our* is the most frequent first-person marker in Lafuente Millán's (2010) urology subcorpus, and is used in nominal groups like *our results* and *our findings*. Those groups tend to function as "inanimate subjects of epistemic lexical verbs such as 'suggest', 'indicate', 'imply', and also more emphatic verbs such as 'show' or 'demonstrate'" (Lafuente Millán 2010, 45, cf. [entertain] and [endorse], respectively). According to Lafuente Millán (2010, 45), those resources "help writers to present data as the originators of the findings, thus concealing the part played by subjective interpretation in the conception of that claim." This may reduce "the potential negative consequences of having [...] claims refuted" (Lafuente Millán 2010, 46); it also highlights the specificity of the findings (e.g. *our findings*), suggesting that they "are not assumed to have a general validity for other studies" (Lafuente Millán 2010, 45).

With regard to the use of exclusive *we*, Lafuente Millán (2010, 48) proposes a taxonomy of discourse functions: 1) structuring information, 2) stating a goal, 3) explaining procedures, 4) stating expectations/hypotheses, 5) expressing strengths or limitations, 6) stating results, and 7) making claims. The first three "involve a less manifest authorial presence than other of the pragmatic functions for which self-mention markers are used" (Lafuente Millán 2010, 48), and by far the majority of uses in the urology research articles are for explaining procedures, e.g. *we started by dissecting preprostatic fatty tissue...* (Lafuente Millán 2010, 49, 50).

Lafuente Millán (2010, 53) concludes by highlighting the importance of creating "an appropriate authorial identity by means of self-mention resources", in order for researchers "to present themselves as competent and reliable members of the discipline, and to persuade readers about the relevance of their contributions". The variety of uses of exclusive first-person pronominal references "reflect[s] the epistemological and social practices of particular discourse communities" (Lafuente Millán 2010, 53), and, for Lafuente Millán (2010, 54), it is important that learners are made aware of their different functions.

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340). According to Atkinson (1992), they are a key feature of early experimental reports published by the Royal Society in the seventeenth century.

Herrando-Rodrigo (2010) uses Hyland's (2005) framework to examine stance (self-mentions) and engagement in medical research articles and their online popularizations, in the field of urology (cf. Lafuente Millán 2010).<sup>52</sup> Herrando-Rodrigo (2010) studies the use of "exclusive first-person pronouns and possessive adjectives (*I, me, mine, we, our, ours*)" as markers of stance, and "the pronoun *you* (when addressing the potential readership), the inclusive *we*, imperatives, asides and questions" as markers of engagement (Herrando-Rodrigo 2010, 260). The study also includes "potential non-verbal metadiscourse signals, such as italics, font, size, etc." (Herrando-Rodrigo 2010, 260) (see also section 4.3).

Herrando-Rodrigo (2010) finds approximately equal frequencies of self-mention/stance and engagement markers in her corpus of urology research articles (4.9/1000 words and 4.2/1000 words, respectively). With regard to self-mention, there are no instances of *I*. Rather, "authors [make] themselves visible" and "project their authority and presence" (Herrando-Rodrigo 2010, 261, 262) by means of first-person plural *we, us, and our*. With regard to engagement, very few research articles include *you, your*, inclusive *we*, and direct questions, but imperatives and parenthetical asides are more common. In comparison, online popularizations tend to use relatively few self-mentions (1.7/1000 words), but considerably more engagement markers (13.5/1000 words) than the original research articles. Herrando-Rodrigo (2010, 271) argues that the projection of authority and author visibility in urology research articles "adds to the well-established belief that academic writing is less objective than we tend to think, and [is] in contrast to false assumptions which claim that RA writers are not visible in their articles in their quest for objectivity". Moreover, writes Herrando-Rodrigo (2010, 272), the

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<sup>52</sup> According to Hyland (2005, 176), stance refers to "the ways writers present themselves and convey their judgements, opinions, and commitments". Engagement accounts for how writers "acknowledge and connect to others, recognizing the presence of their readers, pulling them along with their argument, focusing their attention, acknowledging their uncertainties, including them as discourse participants, and guiding them to interpretations" (Hyland 2005, 176).

similar relative frequencies of self-mention and engagement markers in urology research articles suggest that “the formality and the tight disciplinary conventions of the academic arena requires an equilibrium between the projection of identity and the involvement of the readers”.

Li and Gi (2009) also comment on the use of pronouns in medical research articles. They note an increase in the relative numbers of first-person plural pronouns over time, a consequence, Li and Ge (2009, 101–102) argue, of the ubiquity of multiauthored articles in the field and of current movements in medical science to be explicit about who does what in the research process.<sup>53</sup>

### 4.2.3 Modality

Modality is a widely studied topic in the field of applied linguistics, and there are several studies dealing with the phenomenon in medical research articles. This section takes a broad approach to modality, including studies of hedging and negative polarity (cf. Martin and Rose 2003, 2007, Hood 2010).

#### 4.2.3.1 Modalization and Modulation

Salager-Meyer (1992) investigates the distribution of modal auxiliaries (and tense, aspect, and voice) across abstracts of English-language medical research articles, review articles, and case reports.<sup>54</sup> *May* is the most frequently used modal auxiliary in the abstracts of all three text-types. In terms of their generic distribution, modal auxiliaries are most frequently found in phases of the abstract that present recommendations (typically *should*), conclusions (*may*), and syntheses of findings (*can* and *may*), with little modalization/modulation in methods and results phases. According

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<sup>53</sup> The *British Medical Journal*, for example, expressly asks potential contributors to “[w]rite in the active and use the first person where necessary” (BMJ 2018b).

<sup>54</sup> With regard to tense, aspect, and voice, Salager-Meyer (1992, 104) emphasizes the potential dialogic functionality of the present perfect, “mostly in the passive voice,” which “was not only used to refer to past experiments related to the present study [...] but also and mainly to imply authors’ disagreement with and questioning of previous research findings” (cf. realization of [distance] in section 3.1.2.2.2). Examples include *It has previously been reported/established/thought that...* and *Diacylglycerol has been proposed to be...* (Salager-Meyer 1992, 104). (See also section 4.2.2 on projection.)

to Salager-Meyer (1992, 105), the use of these modal auxiliaries (*may, can, should*) signals the “tentative, suggestive [...], and author-marked” nature of certain phases of the abstract. These phases are “indicative rather than definitive: Scientists do not want to commit themselves to absolute statements because they know that their interpretation may not be the only one” (Salager-Meyer 1992, 105) (cf. [entertain]).

Vihla (1999) extends the study of modality in medical research discourse to include other modal expressions, e.g. *maybe, perhaps, possibly, seem, apparent(ly), believe, and think*, as well as modal auxiliaries. Like Salager-Meyer (1992), Vihla (1999, 47) finds that *may* is by far the most frequently used modal expression in medical research articles.<sup>55</sup> With regard to distribution, the majority of modal auxiliaries are found in Discussion sections, especially “when hypotheses are stated near the end of the article” (Vihla 1999, 69–70).<sup>56, 57</sup> In Introduction sections, which have the second highest relative frequencies of modal auxiliaries, epistemic modals like *may* and *might* tend to be used to “present the reasons for studying the topic in question” (Vihla 1999, 70). In contrast, Methods and Results contain few modal auxiliaries. Vihla (1999, 70) sees the four main sections of the medical research article as being in “intratextual ‘dialogue’” with each other—a dialogue construed in part through the use of epistemic modals. Methods and Results, with their relative lack of modal expressions, are primarily descriptive, while “the discussion sections and, to a lesser degree, the introductory sections show the writer’s role as the construer of knowledge through the use of epistemic modals” (Vihla 1999, 71). I make a similar point in Fryer (2012, 29) with regard to the use of “modality and interpersonal Epithets” and the interrelations of phases across medical research article sections.

Vihla’s (1999, 60–61) study also includes a category of “experimental expressions”: *data, evidence, find (finding), observe (observation), and significant(ly)*. According to Vihla (1999, 61), these terms complement epistemic expressions of certainty and likelihood (e.g.

<sup>55</sup> Biber et al. (1999, 487) make a similar observation for academic writing in general.

<sup>56</sup> Only modal auxiliaries are included in Vihla’s (1999) distributional analysis.

<sup>57</sup> In Gledhill’s (1995a) phraseology study of cancer research articles, *may* is most salient in the Discussion section.

*appear, seem, must*), “have connotations related to the empirical mode of knowing”, and provide support and justification for arguments in medical research articles (cf. [endorse]). In addition to “experimental” and “epistemic” (or “interpretative”) strategies for supporting and justifying arguments, Vihla (1999, 112) mentions “quotative strategies”, i.e. references and citations, that emphasize “the role authorities have in constructing knowledge” (see section 4.2.2.2).

Vihla (1999) connects certain aspects of modality to the discipline and practice of medicine. For example, the use of epistemic possibility in Discussion sections and statistical terminology in Results sections reflect what Vihla (1999, 122) calls a “probabilistic attitude toward knowledge”. However, medical research articles do not only reflect the “language of the laboratory” (Vihla 1999, 122); they also reflect the language of the clinic, in the form of deontic recommendations, typically encoded by modal auxiliaries like *should*. Vihla (1999, 122) considers this “an expression of ‘heteroglossia’ (see Bakhtin, 1981)”, in which different discourses of medicine—i.e. medicine as science and medicine as practice—meet, overlap, and combine (cf. section 1.1).

Adams Smith’s (1984) study of “author comment” in medical research texts analyses the use and distribution of modal auxiliaries and other modal resources. The study also includes “attitudinal markers” such as evaluative adverbs (e.g. *frankly, fortunately*), reporting verbs (e.g. *establish, claim*), “reporting nouns” (e.g. *speculation*), and evaluative adjectives (e.g. *important*) (Adams Smith 1984, 26–27). In comparing medical research articles, case reports, and editorials, Adams Smith (1984) finds that, in general, research articles contain more instances of author comment than case reports, but fewer than editorials. Moreover, with regard to medical research articles, Introduction and Discussion sections contain more author comment than do the Abstract, Methods, and Results. Modal auxiliaries account for 54% of all instances of author comment in research articles, most frequently *may* and *should*. Overall, according to Adams Smith (1984, 34–35), author comment is used primarily to assess probability/possibility (70% of instances), to make recommendations, to emphasize importance and relevance, to evaluate the work of others, and to dispute, argue, or concede.

Yang, Zheng, and Ge (2015) take a systemic-functional approach in their study of epistemic modality in English-language medical research articles. They include a wide range of linguistic realizations of epistemic modality—such as modal auxiliaries (e.g. *may*), modal adverbs (e.g. *perhaps*), modal adjectives (e.g. *possible*), modal nouns/nominalizations (e.g. *possibility*), and modalized mental and relational projecting clauses (e.g. *believe*, *imply*)—and they examine the relative “values” and “orientations” of those resources across the four main sections of the medical research article.<sup>58</sup> Yang, Zheng, and Ge (2015, 4–5) find that the majority of epistemic meanings are instantiated in the Discussion and Introduction sections (cf. Salager-Meyer 1992, Vihla 1999). Epistemic modality is generally of low value, with implicit subjective orientation, e.g. *The increased expression of PCSK9 may attenuate the LDL-lowering effect of statins*. Explicit objective orientation is also common in Discussion sections and, to a lesser extent, in Results sections, e.g. *This result suggests that* and *It is probable that*.

According to Yang, Zheng, and Ge (2015, 6), the choice of low and median values of modality reflects the need to delimit and define the extent of claims and their relative truth-values, highlighting a possible lack of precision and reliability of data in medical research compared with the “hard sciences” (cf. Fløttum 2003a, Hu and Wang 2014).<sup>59</sup> Low and median values of epistemic modality may help medical researchers “gain readers’ acceptance of their claims” (Yang, Zheng, and Ge 2015, 6), reflecting, on the one hand, researchers’ “meticulousness and rigor in their judgments of propositions,” and, on the other, “reduc[ing] the risk of opposition from the readers” (Yang, Zheng, and Ge 2015, 6). Similarly, implicit subjective and explicit objective orientations de-emphasize the roles of authors, “blur[ring] the relation between themselves and the claims” and “shift[ing]

<sup>58</sup> The system of VALUE specifies differing degrees of modality: [low], [median], or [high]. ORIENTATION specifies, on the one hand, whether the source of the modality is made known or not ([subjective] or [objective]) and, on the other, whether the modality is expressed in the same clause as the main proposition or not ([implicit] or [explicit]). See Halliday and Matthiessen (2004, 148–150).

<sup>59</sup> Hiltunen’s (2010, 196–197) study of existential-*there* constructions in academic research articles suggests that the use of modal auxiliaries in those constructions is far lower in a hard-science discipline like medicine compared with soft disciplines such as law and literary criticism.

the readers' focus to the procedures and findings of the research by distancing themselves from the text" (Yang, Zheng, and Ge 2015, 7). Yang, Zheng, and Ge (2015) also relate their findings to politeness (see Varttala 1999, Vold 2006, below), arguing that low-value modal expressions show "writers' reservedness in making claims and their deference to [...] readers" (Yang, Zheng, and Ge 2015, 8). High-value modal expressions such as *show*, which express "categorical or definite judgment" (Yang, Zheng, and Ge 2015, 9) and positive politeness, are used sparingly. As Yang, Zheng, and Ge (2015, 9) note: "[i]f the writers' viewpoints are not endorsed by the readers, the writers' politeness strategy will most probably end in failure and the interaction between the writers and the readers will not succeed".

#### 4.2.3.2 Hedging

Hedging is closely related to modality. An early account by Lakoff (1973, 471) describes "hedges" as "words whose job it is to make things fuzzier or less fuzzy". Such wordings are characteristic of academic writing, according to Hyland (1996, 1998b, 2000), and "represent explicit qualification of the writer's commitment", variously allowing the author to express uncertainty, to distinguish fact from opinion, and "to convey deference, modesty or respect for colleagues' views" (Hyland 2000, 88).<sup>60</sup>

Salager-Meyer (1994) investigates the phenomenon in medical research articles and case reports, and defines hedges in terms of three interrelated properties: their "purposive fuzziness and vagueness", as part of a threat-minimizing strategy; a reflection of author modesty of achievements and avoidance of personal involvement; and an expression of the impossibility or unwillingness "of reaching absolute accuracy and of quantifying all the phenomena under observation" (Salager-Meyer 1994, 153). Based on this definition, Salager-Meyer (1994) categorizes hedges according to whether they are "shields" expressing probability or possibility, e.g. modal auxiliaries and modal expressions such as *probably*, *likely*, and *suggest*; "approximators" of quantity, degree, frequency, and

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<sup>60</sup> Hedging is not only characteristic of contemporary academic or scientific writing. According to Atkinson (1992, 339), it was also strongly advocated by seventeenth-century empiricists as an index of modesty and caution in interpreting empirical evidence.



time, e.g. *approximately*, *somewhat*, and *often*; expressions of “doubt and direct involvement”, e.g. *I believe* and *it is our view that*; “emotionally charged intensifiers”, such as *of particular importance* and *surprisingly*; and “compound hedges” comprising strings of hedging devices, e.g. *It would seem likely that*.

Salager-Meyer (1994) finds that the Discussion section in the research article and the more-or-less-equivalent Comment section in the case report are the most heavily hedged sections, with the Methods sections in each text-type displaying the lowest frequency of hedges. The most frequently used hedging devices are “shields”, followed by “compound hedges” and “approximators”; the other two hedge types are seldom used. In Introductions, “shields” are the most common hedging device, usually taking the form of “epistemic verbs” such as *speculate*, *suggest*, and *indicate*, and, less frequently, modal auxiliaries. In Discussions, this distinction is reversed; “shields” are predominantly modal auxiliaries, with epistemic verbs playing a lesser role.

These findings, according to Salager-Meyer (1994, 163), highlight and support, among others, Adams Smith’s (1984, see above) comments on the apparently objective, detached reporting of the Methods and Results, on the one hand, and the more subjective author involvement of the Introduction and Discussion, on the other. As Salager-Meyer (1994, 163) also notes, hedging devices, and particularly “shields” (as the name suggests), allow researchers to avoid absolutes and to indicate how strongly they want to align themselves with their claims, thus allowing “[r]oom for disagreement” or “alternative explanation[s] somebody else might come up with” (cf. [entertain]).

The importance of “approximators” of quantity, degree, frequency, and time as a hedging device (see Salager-Meyer 1994 above) is also picked up by Vihla (1999) and Jones (2013). Vihla (1999, 96) notes that the hedging of numerical expressions

is an important means of showing non-commitment in research articles. Quantifiable data may be hedged by words such as *about* and *approximately*. Moreover, the statistical terminology used in research articles can be regarded as a form of hedging, as P-values, standard deviations, and confidence intervals show that the statements only have a certain amount of statistical support [...] On the

other hand, rather than referring to the uncertainty of knowledge, these statistical terms may be used to increase the argumentative force of the text.

Similarly, Jones (2013, 40) notes how figures and their approximations can be powerful rhetorical devices. They have a special “epistemological authority”, deriving from “the belief that numbers are ‘ideologically neutral’ and immune from human bias” (Jones 2013, 40), and their approximation can be used “to make values seem smaller or larger, or to present contrasts as either extreme or negligible” (Jones 2013, 41).

Varttala (1999) investigates the occurrence and distribution of selected hedging devices in medical research articles and in their corresponding popularizations in science magazines. Those hedging devices include “epistemic modal auxiliaries” (e.g. *may*), “epistemic main verbs” (e.g. *suggest*), “epistemic adverbs” (e.g. *perhaps*), “epistemic adjectives” (e.g. *potential*), and “epistemic nouns” (e.g. *probability*).

Varttala (1999) finds that, in general, hedges are not only characteristic of academic communication (cf. Hyland 1996, 1998c, 2000, above). Although the Discussion sections of the research articles display the highest relative frequencies of all the above-mentioned hedging devices, the popularizations generally use these devices more frequently than the Introductions, Methods, Results, and abstracts of the research articles. As Varttala (1999, 190) notes, “[w]ith regard to medical discourse, arguing that hedges are not used or needed in the rhetoric of scientific popularization is a crude oversimplification based on a narrow view of the notion of hedging”. Instead, Varttala (1999) interprets the potential differences and similarities between the two text-types in terms of the textual and interpersonal functions of hedges—that is, with regard to conceptual fuzziness and precision, and with regard to their use as a politeness strategy, in leaving room for other opinions and fending off potential criticism.

The textual function of hedging in research articles expresses the need for “conceptual precision conditioned by the specialist needs of the audience” (Varttala 1999, 191), while in the popularizations, it accounts for a lack of references or non-exact numerical expressions for a non-specialist audience, “to make sure that the readership draws the desired conclusions from the information presented” (Varttala 1999, 192).

Popular-science writers are likely to follow some of the conventions of specialist discourse, but the organization of popular-science texts differs from that of research articles, with generally less emphasis on the methodological and technical aspects of the research. Therefore, “the tone of popularizations may be seen as quite similar to the Discussion sections [of research articles]” (Varttala 1999, 192). However, the putative audiences of those two texts differ, and the politeness strategies performed by hedges are therefore likely to differ, too. Varttala (1999, 192–193) concludes that, while negative politeness (aimed at non-imposition and the achievement of distance) may predominate in the research articles, positive politeness (constructing a sense of closeness and common ground) is more salient in the popularizations.

Vold (2006) studies the use of “epistemic modality markers” (EMM) in English, French, and Norwegian medical and linguistics research articles. Vold (2006, 64) considers EMMs a “dominant and basic type of hedge”, defining them as “*linguistic expressions that qualify the truth value of a propositional content (for example perhaps, probably)*” (Vold 2006, 65, emphasis in original). Based on an exploratory study, Vold (2006) produces lists of the most frequent EMMs in each language. For English, these are *may, assume, suggest, appear, might, seem, perhaps, and indicate*, as well as three “prototypes of epistemic modality markers” (Vold 2006, 68): *possible, probably, and could*.

*May* is the most common EMM in the medical English subcorpus (cf. Adams Smith 1984, Salager-Meyer 1992, Vihla 1999, Fryer 2013), followed by *suggest, might, could, and possible*. *Could* is rarely used by linguists, but relatively often by medical researchers, while *seem, assume, and appear* are almost exclusive to linguistics. *May, might, and could*, however, are more common in the medical subcorpus than in linguistics. (Across the three languages studied, English has the greatest relative occurrence of the EMMs examined by Vold.)

Vold (2006) notes that, due to the polysemy of modal resources, categorization of EMMs is not always clear-cut. In the case of *indicate*, for example, Vold (2006, 70–71) observes that “two meanings [‘suggest’ and ‘show’] may co-occur in one single form and are not necessarily mutually exclusive”, and that dominant meanings, if they exist, might vary from

reader to reader. Vold (2006, 81) also notes a difference between “real hedges” and “strategic hedges”. The former is similar to Varttala’s (1999; see above) description of the textual function of hedges, expressing “real uncertainty”, and the latter is similar to the interpersonal function, which can be used to express “possible opinions or interpretations, and thus [...] anticipate potential criticism” (Vold 2006, 81). Vold (2006, 82) also notes that EMMs may be used as a politeness strategy “in order to cautiously criticize fellow researchers” (cf. Salager-Meyer et al. on “academic conflict”, section 4.2.5)

In a study of British and Sudanese medical researchers writing English-language medical research articles, ElMalik and Nesi (2008) discuss similarities and differences in the choice and function of hedging. Based on Salager-Meyer’s (1994) hedging typology (see above), ElMalik and Nesi (2008, 92) note that the overwhelming majority of hedges are “shields”, e.g. *might have limited*, with “very few examples” of “approximators”, “authors’ comments”, “emotionally charged intensifiers”, and “compound hedges”.<sup>61</sup> The majority of hedges occur in Discussion sections (ElMalik and Nesi 2008, 93), as also noted by other researchers (see above), but are used “somewhat more frequently [in] the British articles”, a finding that apparently accords with those of Skelton (1988) and Salager-Meyer (1994), that non-native speakers of English tend to use hedges more sparingly than native speakers.

Pérez-Llantada (2010a) explores the manifestation or effect of globalization on academic writing, by examining the frequencies and discourse functions of epistemic lexical verbs (ELVs) in medical research articles written by North American and Spanish authors (ENG, SPENG, and SP; see Pérez-Llantada 2011 in section 4.2.1). Pérez-Llantada (2010a) uses

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<sup>61</sup> Salager-Meyer (1994) and ElMalik and Nesi (2008) find few, if any, instances of “emotionally charged intensifiers” in their material. Investigating this category more broadly, however, Pahta (2006) notes that pre-adjectival amplifiers or intensifiers such as *very* and *highly* have important functions in medical discourse. While those intensifiers are most often used in popularized medical texts, they also play an important role in medical research articles in justifying the choice of research topics and methods, highlighting specific features of experiments, and assessing and commenting on the relevance of particular findings (e.g. *extremely valuable...*, *particularly susceptible...*, *very low...*, *highly specific...*) (Pahta 2006, 370–371). In the hedging literature, such resources are commonly referred to as “boosters” (e.g. Hyland 1998a, 2000).

Hyland's (1998c) taxonomy of "judgmental" ("speculative" or "deductive") and "evidential" ELVs. Speculative ELVs "express opinions and mark the mode of knowing through confidence or degree of commitment" (Pérez-Llantada 2010a, 26), e.g. *assume, believe, consider, know, predict, propose, speculate, think, suggest, and suspect*. Deductive ELVs "convey writers' degree of commitment based on inference from known facts" (Pérez-Llantada 2010a, 26), e.g. *calculate, conclude, demonstrate, estimate, imply, indicate, and infer*. Evidential ELVs "indicate writers' commitment on the basis of evidence or perception of unproven facts" (Pérez-Llantada 2010a, 26), e.g. *note, quote, report, appear, exhibit, notice, seem, show, argue, attempt, claim, seek, admit, and observe*.

According to Pérez-Llantada (2010a), the use of these ELVs varies across cultural contexts and languages, and across different stages of the research article. Overall, the highest frequency of ELVs is found in SPENG/ENG Discussions, followed by Results (highest in SPENG/ENG), Introductions (highest in SPENG), and Methods (low across all three subcorpora). There are also varying preferences of ELV types. For example, in Introductions, SPENG authors prefer evidence ELVs to judgment ELVs, ENG authors generally strike a balance between the two, and SP authors show a preference for judgment ELVs (Pérez-Llantada 2010a, 29). Similar patterns occur in the Results and Discussion, with SPENG more closely resembling ENG than SP, while in the Methods there is a general preference for judgment ELVs across all three subcorpora. Variations are also noted for the textual patterning of these ELVs, particularly the way in which projected clauses are modalized (SP/SPENG) or not (ENG), e.g. *suggest that X might Y* or *suggest that X*.<sup>62</sup>

According to Pérez-Llantada (2010a, 38), the "Spanish writers' hedged discourse expresses provisionality of findings and [...] brings to the fore writers' perception of the audience as potentially dissenting". In contrast, the ENG authors seem to be more assertive and "appear to perceive their audiences as potentially consenting towards writers' opinions" (Pérez-Llantada 2010a, 38). That the strategies of SPENG authors more closely resemble those of ENG than SP is, according to Pérez-

<sup>62</sup> Note that the SP/SPENG example is an instance of what Salager-Meyer (1994, 154–155) calls a "compound hedge", i.e. a string or cluster of hedging devices.

Llantada (2010a, 38), suggestive of a possible effect of globalization affecting the writing practices of the two cultural contexts, as well as a result of differences in audience construal (SP, national; SPENG/ENG, international). On the other hand, the apparent hybridity of the SPENG texts, using features characteristic of both ENG and SP, does not appear to have been an obstacle for the publication of the texts, suggesting that academic medical English is “subject to [a certain degree of] culture-specific variability” (Pérez-Llantada 2010a, 39, see also, more generally, Pérez-Llantada 2012).

Szarvas et al. (2008) discuss the annotation of hedging (and negation) in a corpus of biomedical reports, research papers, and abstracts. They define hedging as uncertainty or speculation, and they find that almost one-quarter of all sentences (22.29%) in their research-paper subcorpus contain some form of hedging. The Conclusion sections of those papers “tend to contain significantly more uncertain or negative findings than the description of *Experimental settings and methods*” (Szarvas et al. 2008, 43, emphasis in original).

With regard to annotation, Szarvas et al. (2008) highlight the importance of scope. “The scope of a key word [i.e. a hedging or negation device] can be determined on the basis of syntax” (Szarvas et al. 2008, 41). According to Szarvas et al. (2008, 41), the scope of auxiliaries and verbs in written English extends rightwards over the rest of the clause, the scope of attributive adjectives generally extends rightwards to the end of the noun phrase, and the scope of predicative adjectives and sentential adverbs extends leftwards and rightwards over the entire clause/sentence, to name a few examples. For instance, *These findings (<might> be chronic) and (<may> represent reactive airways disease) and (The chimaeric oncoprotein <probably> affects cell survival rather than cell growth)* show how the scope (marked by parentheses) of the modal auxiliaries *might* and *may* extends rightwards over their respective clauses and how the scope of the adverb *probably* extends both leftwards and rightwards over an entire clause (Szarvas et al. 2008, 41).

Szarvas et al. (2008, 44) note the potential difficulty of identifying and annotating hedges, because of the large number of “possible cue

words” and annotators’ disagreement as to what may or may not be considered a hedge. A similar point is made by Vold (2006, 82).

Although “[q]uestions inherently suggest uncertainty – which is why they are asked” (Szarvas et al. 2008, 40), they are not generally annotated as hedges in Szarvas et al.’s (2008) corpus, “unless they contain speculative language” (Szarvas et al. 2008, 40).<sup>63</sup> Webber (1994), however, explicitly investigates the function of questions in a number of medical research text-types, noting that questions “are used to arouse interest, as discourse organisers, as attitudinal markers, particularly as distancing and hedging techniques or to express doubt or caution, as reader guidance devices and to point to the future, as well as to criticise or attack opponents” (Webber 1994, 258). Medical research articles contain relatively few questions compared with related text-types such as editorials and letters, and the few that are used are “confined mainly to the more subjective discussion section” (Webber 1994, 260). Webber (1994) does not discuss the function of these questions, and none of the examples in the section entitled “Distancing and Hedging Techniques” (Webber 1994, 263-264) are taken from research articles. Webber (1994, 266) does, however, conclude in general that “[t]he most important objective of using interrogatives in the corpus studied is that of reader involvement”, bringing the reader “into a kind of dialogue with the writer” (cf. Hyland 2002, 2005). By using questions, authors avoid imposing their opinions and interpretations, allowing readers to draw their own conclusions and “thus leaving open the possibility of alternatives” (Webber 1994, 267) (cf. rhetorical/expository questions as construing [entertain]; see section 3.1.2.2.1 and White 2003).

Carter-Thomas and Rowley-Jolivet (2014) examine the role of *if*-conditionals in medical editorials and research articles, in which they include a section on questions in the main clauses of *if*-complexes. Although those questions are not explicitly described as hedges, Carter-

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<sup>63</sup> According to Hyland (2002, 547), questions can function to hedge alternative claims, e.g. *Is emotion simply discourse, in which case the study of emotions would be just a part of discourse analysis, or is there something more distinctive about the study of emotion?* Moreover, they are a dialogic resource, “inviting engagement and bringing the interlocutor into an arena where they can be led to the writer’s viewpoint” (Hyland 2002, 530, 2005, 185–186).

Thomas and Rowley-Jolivet (2014, 74) emphasize the dialogic function of questions in “involving the reader in the text and in the author’s argument”. They also emphasize that questions may “exert a considerable degree of discourse control, since the questions asked are the ones chosen by the author and to which he or she has the answers, and are often used in fact to lead the reader in a particular direction” (Carter-Thomas and Rowley-Jolivet 2014, 74). There are generally few questions in medical research articles compared with editorials. This is because, according to Carter-Thomas and Rowley-Jolivet (2014, 74), “questions [in medical research articles] would be felt to be condescending by many readers, as an egalitarian stance is expected”. In contrast, writer–reader relations are often relatively “unequal” in editorials, allowing authors to “exert editorial control” and adopt “a clear didactic stance towards [the] reader”, as in the following example: *If “fit elderly” patients can tolerate aggressive multimodality therapy, does this mean that all older patients should be treated this way? The answer is no* (Carter-Thomas and Rowley-Jolivet 2014, 75).

Carter-Thomas (2007) and Carter-Thomas and Rowley-Jolivet (2014) describe the function of *if*-conditionals in terms of a number of argumentative strategies, including their use for “hypothesizing and hedging” and for “envisaging alternatives and conceding competing points of view” (Carter-Thomas and Rowley-Jolivet 2014, 63). According to Carter-Thomas (2007, 150), their use in medical research discourse may be important with regard to the inductive, observation-based reasoning of clinical investigations and the subsequent need to weight evidence carefully in order to make space for claims. The majority of *if*-conditionals in English-language medical research articles appear in Methods and Discussion sections (Carter-Thomas 2007, 156, Carter-Thomas and Rowley-Jolivet 2014, 69). In Methods, they specify eligibility criteria for patients involved in trials, e.g. *Patients were defined as “downstaged” if the final pathologic stage was less than the preoperative ultrasound stage, “leaving space for possible discussion of the criteria adopted”* (Carter-Thomas 2007, 172). In Discussions, they help to refocus claims “by expanding the argumentative space through various predictions, hypotheses or recommendations or alternatively by contracting the space



through different types of restrictive, contrastive and concessive conditionals” (Carter-Thomas 2007, 160), e.g. *Also, if preoperative therapy is administered at the time of diagnosis it might be more effective because the metastatic burden may be the smallest at this point* (Carter-Thomas 2007, 165) (cf. [entertain]). However, with regard to text-type, the conjunction *if* is seldom used in medical research articles compared with other medical texts such as professional handbooks and popularizations (Vihla 1999, 86–87).<sup>64</sup>

The passive voice is generally considered to be characteristic of academic writing, with Biber et al. (1999, 476–479) reporting that almost 25% of all finite verb phrases in their academic subcorpus are passive, compared with approximately 2% in conversation.<sup>65</sup> Hyland (1996, 443–444) argues that passive constructions can function as hedges in academic research articles, reducing author responsibility by distancing the author-as-agent from a claim, and thus “shield[ing] the writer from the consequences of opposition by limiting personal commitment” (cf. Perez-Llantada 2011, 28, on the passive as a dialogically ‘contractive’ resource; section 4.2.1). del Olmo (2006) briefly examines this claim in a collection of English and Spanish medical research articles and case reports. For English-language medical research articles, del Olmo (2006) finds that a native English-speaking reader interprets passive constructions differently from a non-native speaker. The former considers passives to have a primarily textual, thematic function, while the latter considers passives to be a type of writer-oriented hedge. Although no examples are provided, del Olmo (2006, 215) speculates that these differences in

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<sup>64</sup> Vihla (1999) also examines the use of the conjunction *because*, as well as *if* and *but* (see section 4.2.4), arguing that conjunctions “may be used to justify hypotheses or recommendations, and thus their use might resemble the distribution of epistemic and deontic expressions” (Vihla 1999, 84) (cf. [justify]). Vihla’s (1999, 87) comparison of different medical text-types shows that research articles use *because* more often than professional handbooks, but less frequently than editorials and scientific textbooks.

<sup>65</sup> Despite this observation, early scientific writing, such as that published by the Royal Society in the seventeenth and eighteenth centuries, is characterized by the use of the active voice (Atkinson 1992, 339). This, together with the marked use (by contemporary standards) of first-person pronouns, is part of a “rhetoric of immediate experience” that allowed the reader to vicariously experience the experimental process (Atkinson 1992, 339).

interpretation could be due to readers' different cultural and academic backgrounds, highlighting the importance of ethnographic investigation in understanding the polysemy of lexicogrammatical resources in academic discourse.

#### 4.2.3.3 Negative Polarity

For negative polarity (or negation), previous studies focus primarily on the morphologic/affixal and syntactic types—and usually on a limited set of cardinal negative markers such as *not*, *no*, *none*, and *un-*—with relatively little discussion of inherent-lexical or semantic negation.<sup>66</sup> According to Szarvas et al. (2008, 44), approximately 14% of sentences in medical research articles are “negation sentences” containing some form of morphologic or syntactic negative marker. Syntactic negation, and particularly the negative operator *not*, appears to be the most frequently used form in biomedical research articles, followed, in terms of relative frequency, by the negative determiner *no* and affixal *un-* (Carciu 2011, Laso, Comelles, and Verdaguer 2013, 106).<sup>67</sup>

Negative markers are often found in clauses of cause, consequence, and contrast in biomedical English (Laso, Comelles, and Verdaguer 2013), e.g. *Thus, it seems unlikely that...* (example from Laso, Comelles, and Verdaguer 2013, 115). They are also a more common feature of existential-*there* constructions in medical research articles, compared with research articles from other fields such as physics, law, and literary criticism (Hiltunen 2010), e.g. *There was no association between obesity and the SF-36 mental summary measures* (example from Hiltunen 2010, 198).<sup>68</sup>

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<sup>66</sup> Exceptions are Nwogu (1997, 127), who mentions the example of *fail* as negative evaluation, and Hiltunen (2010, 189), who, based on Quirk et al. (1985, 780–782), gives *seldom* as an example of non-formal negation (cf. semantic negation in Fairclough 1992, and inherent-lexical negation in Givón 2001, among others).

<sup>67</sup> *Not*-negation is generally the “default choice” for syntactic negation in English (Biber et al. 1999, 170). Likewise, *un-* is the most productive negative affix in English (Quirk et al. 1985, 1540) and perhaps unsurprisingly the most frequently occurring form of morphologic negation in biomedical English (Carciu 2011, Laso, Comelles, and Verdaguer 2013, 106).

<sup>68</sup> According to Gledhill (1995a), existential *there* (and the negation of existential-*there* constructions) is a highly salient feature of abstracts compared with other sections of the research article.

Fløttum (2003a, 111) describes negation as one of a number of resources of polyphony, i.e. the “manifestation of several voices or points of view [...] in one and the same utterance.”<sup>69</sup> Fløttum, Dahl, and Kinn (2006, 251) examine *not*-negation, which “indicates two points of view, where the locutor is responsible for the negated one.” They note that this type of negation tends to be less frequent in medical research articles than in linguistics research articles (Fløttum, Dahl, and Kinn 2006, 222, see also Fløttum 2006, 259), and less explicitly polyphonic or polemic (Fløttum, Dahl, and Kinn 2006, 254–255).

With regard to generic structure, negation plays an important role in the Introduction sections of medical research articles, in identifying limitations of previous studies (e.g. *Some studies have failed to find such associations or have found small differences that are not significant*; Nwogu, 1997, 127) and establishing a gap in the literature in order for authors to situate their own research (see Carciu 2011, 144, Nwogu 1997, 127–128; and section 5.1.1). Moreover, negation is more commonly used in the Results and Discussion sections of medical research articles, compared with the Introduction and Methods sections (Laso, Comelles, and Verdaguer 2013, Fryer 2013). In particular, negation plays a key role in the reporting of non-consistent observations (Nwogu 1997, 131–132) and the “non-existence” of certain hypothesized associations (see example above from Hiltunen 2010, 198), as well as in the discussion of study limitations, as the following example from Nwogu (1997, 133) demonstrates: *Our data was clearly unable to define conclusively the role of HPV-16 in genital neoplastic disease.*

#### **4.2.4 Concession**

The study of concession in medical research articles, like the study of negative polarity, tends to be restricted to a limited set of markers,

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<sup>69</sup> Nølke (1993, 241–242), Fløttum (2004a, 30–32), and Fløttum, Dahl, and Kinn (2006, 243–247) argue that all forms of negation are essentially “polyphonic”, since a positive point of view always underlies the negative form. In cases where this positive point of view is not immediately obvious, there is a “descriptive derivation” (Nølke 1993, 241, my translation), in which the underlying positive viewpoint appears to be absent or “erased” (Fløttum 2004a, 31, Nølke 1993, 241, my translation). Similarly, although less explicitly, White (2003, 271) gives a general definition of [deny] as “negation in the broadest sense”.

primarily concessive conjunctions and conjuncts such as *but*, *however*, and *although* (see, for example, Vihla 1999, Breivega, Dahl, and Fløttum 2002, Fløttum, Dahl, and Kinn 2006, Carciu 2011). *But* appears to be the most frequently used concessive or contrastive device in medical research articles, followed by *however* and *although* (Vihla 1999, 87, Fløttum, Dahl, and Kinn 2006, 224).

Breivega, Dahl, and Fløttum (2002) and Fløttum, Dahl, and Kinn (2006) argue that, like negation, contrastive or concessive connectives are polyphonic, in that they construe different points of view. For example, in *p but q*, “p and q constitute two propositions in contrast [...], where p represents the concession and q an argument that the locutor identifies with, here and now” (Fløttum, Dahl, and Kinn 2006, 247–248)—“concessive ‘but’ always points to a source whose point of view is accepted, but not judged valid in the here and now of the text” (Fløttum, Dahl, and Kinn 2006, 270). Fløttum, Dahl, and Kinn’s (2006) study of English-language medical research articles reveals that, like *not*-negation (see 4.2.3.3 above), the concessive and contractive connective *but* is less frequently used by medical research writers than those in linguistics and economics (Fløttum, Dahl, and Kinn 2006, 224, see also Fløttum 2006, 260–261), which may suggest a less polemic or argumentative approach in medical research articles (Fløttum, Dahl, and Kinn 2006, 225). Vihla (1999, 87) also notes that medical research-article writers seem to use *but* less frequently than writers of other medical text-types such as popular-science articles, professional handbooks, and textbooks, and less frequently than is used in “general English”, as suggested by figures from the Brown corpus.

In research articles, concessive devices play an important role in establishing a research niche or warrant (see Swales 1990, 154 ff., Hood 2010, 161 ff., and section 4.1.1), and several studies of medical research articles emphasize the role of concessive devices with regard to signalling a gap or shortcoming in the literature (e.g. Skelton 1994, 457, Nwogu 1997, 127, Fryer 2012, 13, Davis 2015, 82). The following example from Nwogu (1997, 127) demonstrates this: *However, the possible prevention of PIH and pre-eclamsia [sic.] in primigravidae by suppression of platelet TXA2 production with low dose aspirin has not been investigated.* Concessive or

countering devices such as *but* and *however* occur most commonly in the Introduction and Discussion sections of medical research articles, with relatively few instances in the Methods and Results sections (Fryer 2013, 194).<sup>70</sup> Moreover, those concessive resources commonly co-occur with negative markers (Breivega, Dahl, and Fløttum 2002, 230), particularly in Introduction sections (Nwogu 1997, 127–128, Carciu 2011, 147–148, Fryer 2013, 199), as the above example from Nwogu (1997, 127) demonstrates.<sup>71</sup>

#### 4.2.5 Projection, Modality, and Concession

Salager-Meyer et al.'s (Salager-Meyer 1999a, Salager-Meyer, Ariza, and Zambrano 2003) diachronic investigations of direct and indirect academic conflict in written medical research discourse emphasize the integral role played by projection, modality, and concession in presenting and discussing potentially conflicting knowledge claims. Indeed, all the examples of direct and indirect conflict provided by Salager-Meyer et al. (Salager-Meyer 1999a, Salager-Meyer, Ariza, and Zambrano 2003) include some form of projection, modality, and/or concession.

Direct conflict is defined as a “straightforward, overt ‘attack’” in which there is “a strong, unmodulated assertion to which the writer fully commits him/herself” (Salager-Meyer 1999a, 376), e.g. *The statements of Dr. Johnson rest upon pure assumption and are not trustworthy* (example from Salager-Meyer 1999a, 382). In contrast, indirect conflict is “a covert, subdued or ‘polite’ conflict” in which “the writer’s commitment to the truth of the proposition is mitigated [...] through the use of hedging devices [and/or] by shifting the responsibility for the academic conflict away from the writer to some inanimate facts” (Salager-Meyer 1999a, 377), e.g. *It has been claimed that vaginal breech delivery is associated with an increased mortality from intracranial hemorrhage [...]. Our study somewhat*

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<sup>70</sup> Gledhill (1995a) notes that *but* is most salient in the abstract section compared with its use in other sections of the research article, “suggest[ing] that the reporting of negative results is a fundamental characteristic of abstracts” (see earlier footnote on use of existential *there*).

<sup>71</sup> Swales (1990, 154–156) makes a similar observation for research article introductions in general.

*contradicts this claim* (example from Salager-Meyer 1999a, 388) (cf. [distance]).

Diachronically, there is a general reduction in the number of academic conflicts in medical research discourse from the early nineteenth century to the late twentieth century (Salager-Meyer 1999a). This reduction is especially marked with regard to direct conflict (see example above), which has all but disappeared from contemporary medical research writing; when conflict does occur, it is usually of a more indirect nature (see above). Moreover, the distribution of those conflicts appears to have changed over time. Instances in earlier medical papers are spread throughout the texts, while in the late twentieth century they are restricted “to the most argumentative parts of research articles, i.e., the introduction and discussion sections” (Salager-Meyer 1999a, 391).

Salager-Meyer et al. (Salager-Meyer 1999a, Salager-Meyer, Ariza, and Zambrano 2003) attribute changes in the written construal of academic conflict to changes in the epistemology of medical science itself. According to Salager-Meyer (1999a, 390–391, cf. Salager-Meyer 1999b),

[t]he changes observed over time mirror the evolution from a privately and individually based and author-centered medicine towards the work of a tight, object/fact-centered and highly professional scientific community in which a group of expert-specialists (almost totally ‘invisible’ colleagues) in a narrowly defined field write for a target readership composed of peer expert specialists in that field.

Skelton’s (1997) study of the representation of truth in medical research articles also emphasizes the importance of projection and modality. Skelton (1997) identifies three different types of truth in medical research articles: contextualized, evidential, and interpreted. “Contextualized truth”, writes Skelton (1997, 126), is essential to creating and delineating “the context of debate to which the author wishes to contribute”. It creates “the backdrop against which the research to be displayed is interpreted, and the set of generalizations which constrain the enquiry” (Skelton 1997, 126, cf. Bakhtin 1981 [1935], 281). This kind of contextualization takes place primarily in the Introduction and Discussion sections of the medical research article (Skelton 1997, 126). Here, authors deploy reporting verbs to express “the extent to which they are personally committed to the truth of what they say” (Skelton 1997, 126), ranging “from the apparently

neutral (*is thought to be, reported*), to apparently accepting (*have pointed out, have shown*), to the implicit criticism of *failed to examine*" (Skelton 1997, 127, emphasis in original) (cf. Thompson and Ye 1991, Thomas and Hawes 1994, Davis 2015).

"Evidential truth sets forward things declared to be true as the result of the study in question. Contextual truth, that is, defines the given; evidential truth defines the new" (Skelton 1997, 128). These "new", study-based truths are primarily confined to Results sections and are typically signalled by "a very small set of technical terms" (Skelton 1997, 128), including *significant* and *association* (or *is associated with*), as well as mathematical expressions such as *p-value* and *confidence interval* (cf. Vihla 1999, 96). Claims for evidential truth may also be found in Discussion sections, usually expressed by the reporting verbs *show, demonstrate, and find*, e.g. *our study shows that...*

Skelton's (1997) third type of truth is "interpreted truth", a form of speculation that, according to Skelton (1997, 132), "creates a new truth, a tentative and provisional truth of interpretations and possibilities, and it is a major function of the Discussion section to sketch out those possibilities". Skelton's (1997) account here is mainly concerned with the resources of modality and hedging, and the expression of degrees of certainty and/or possibility, e.g. *Both conditions may result from oestrogen deficiency...*

### **4.3 Multisemiotic and Nonverbal Approaches to Medical Research Discourse**

As noted by Vihla (1999) and Jones (2013), mathematical expressions and mathematical symbolism play an important role in construing the uncertainty and provisionality of scientific medical knowledge (see section 4.2.3.2). They may also serve as potentially powerful rhetorical devices that imbue research with a certain "epistemological authority" that appears to be ideologically neutral and free from human bias (Jones 2013, 40).

In a pilot study (Fryer 2013), I argue that the deployment of mathematical symbols and expressions such as *p(-value)*, *confidence*

*interval*, and *risk* (in the sense of statistical likelihood) has the potential to encode [heterogloss: expand: entertain], i.e. that a given (mathematical-statistical) proposition can be considered one among a number of possible alternatives (see section 3.1.2.2.1). For example, *p* values refer to the chance or probability of achieving a particular observed result if no real effect exists. “[I]t is this function that ‘entertains,’ mathematically, the possibility of the effect being one of chance” (Fryer 2013, 199). *P* values can also be used to modulate otherwise ‘monoglossic’ propositions, e.g. *The effect of pravastatin was greater among women than among men (P = 0.05 for the interaction between the patient’s sex and treatment)* (Fryer 2013, 199). *Confidence interval*, *risk*, and similar mathematical expressions also encode the notion of chance or probability—albeit it in different ways—and therefore have the semiotic potential to construe a background of alternative propositions (see Fryer 2013, 196, 199). However, as Vihla (1999, 96) notes, the use of mathematical symbols and expressions like *p* and *confidence interval* might also “increase the argumentative force of the text”, by reducing doubt and uncertainty (or at least quantifying the level of doubt or uncertainty), and thus potentially narrowing the dialogic space for alternatives. The majority of dialogically ‘expansive’ or dialogically ‘contractive’ mathematical resources seem to be deployed in the Results sections of medical research articles (Fryer 2013).

Mathematical-numerical relations can also be represented visually (see Lemke 2002, O’Halloran 2005) (section 2.2.2). In the case of medicine, Jones (2013) comments on the resemiotization (Iedema 2003), i.e. the semiotic translation, of language and numerical data into graphs and other forms of visual representation. Graphs, according to Jones (2013, 54), allow readers to see differences or changes in data at a glance, in a way that is not possible (or far more difficult) verbally and/or numerically. We see, for example, a slope of increase or decrease, and its varying rates of change, “in a way that language can only portray with less exact words like ‘steep’ and ‘gradual’” (Jones 2013, 54). Graphs like the one reproduced in Jones (2013, 54), representing the annual number of reported cases of measles in Britain since the 1950s, allow for more topological meaning-making than that offered by language or numbers alone (cf. Lemke 2002) (section 2.2.2.2), even if the points in those graphs represent discrete data



sets. A line connecting different data points clearly shows increases or decreases from year to year; but the same line may also suggest relations between the data that are not there and that “can sometimes be deceptive depending on the way the data points are spread out and what was actually happening between them” (Jones 2013, 54). Jones (2013, 55) also discusses a pain management scale in which patients are presented with a combination of typological and topological resources, including a numerical scale from 1 to 10, a series of smiling and frowning faces, and an open, horizontal bar, in order to express the kinds and degrees of pain they experience. Jones (2013, 55) sees the scale as facilitating a translation of patients’ “subjective, topological experience of pain into the more abstract, typological language of doctors”. More generally, Jones (2013, 55) uses both examples—the graph and the visual analogue scale—to demonstrate how verbal, visual, and numerical resources are co-deployed and integrated as text (cf. section 2.2.2.3).

Drawing on the work of Kress and van Leeuwen (1996) (see section 2.2.2.1), Rowley-Jolivet (2002, 2004) also discusses the use of visual resources in medical research discourse (as well as in physics and geology).<sup>72</sup> Although both studies (Rowley-Jolivet 2002, 2004) examine conference papers and not research articles, Rowley-Jolivet (2002, 20) argues that the conference paper is, “in most cases, written up and included as an article in the conference proceedings, or forms the basis of an article published elsewhere, and can, broadly speaking, be considered as the spoken counterpart of the RA [research article]”.<sup>73</sup>

Rowley-Jolivet (2002, 2004) develops a typology of visual elements, which includes “graphical” images such as graphs, diagrams, and maps; “numerical” images such as mathematical formulae and tables; “figurative” images such as photographs and X-rays; and “scriptural” images that account for the visual dimension of verbal text. Cross-category hybrids are also possible, e.g. flowcharts, which Rowley-Jolivet (2002, 28) describes as

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<sup>72</sup> According to Rowley-Jolivet (2002, 24, 2004, 148), physics and geology are classed as “hard sciences”, while medicine is referred to as a “life science”.

<sup>73</sup> Historically, the presentation of papers at the meetings of scholarly societies, e.g. the Royal Society, was a precursor for scientific reports and the written documentation of what scholars observed and what they presented to and discussed with peers.

a scriptural-graphical image.<sup>74</sup> Relations between consecutive images, what Rowley-Jolivet (2002, 32, emphasis in original) calls “*visual clause relations*”, tend to display a left-to-right, Given-New information structure (cf. Kress and van Leeuwen 1996, 2006) that variably encodes general-specific, high-low iconic, temporal, and compare-contrast relations (Rowley-Jolivet 2002, 31–35).

According to Rowley-Jolivet (2002, 2004), medical conference papers contain more images than geology and physics papers. Graphical images in medical papers are typified by graphs, bar charts, and anatomical diagrams; numerical images are typically tables, with relatively few mathematical formulae; figurative images include intra- and postoperative photographs, X-rays, and magnetic resonance images (MRIs); and scriptural images include summaries of case reports, eligibility criteria, and the like. There is a more-or-less even split with regard to the frequency of use of the four main image-types across medical conference papers, although medical papers tend to use fewer graphical images than physics and geology, possibly reflecting the “less theoretical nature of the field” (Rowley-Jolivet 2004, 155).

While 65% of images used in conference papers are presented in colour (Rowley-Jolivet 2002, 26), in medicine that figure is as high as 82%, with only X-rays and ultrasound images being reproduced in black-and-white or monochrome (Rowley-Jolivet 2004, 153). Rowley-Jolivet (2004, 153) notes that colour in science is typically reserved for the coding of graphs or computer-modelled images, and that its use may otherwise be “felt to be merely ornamental” and more typical of scientific popularizations (cf. Kress and van Leeuwen 1996, 2006 on colour and the abstract coding orientation of science). According to Rowley-Jolivet (2002, 2004), the relatively high number of full-colour images in medicine compared with physics and geology suggests that “greater attention is paid to the visual comfort of the audience and to creating an attractive display” (Rowley-Jolivet 2004, 153), emphasizing (at least partly) the

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<sup>74</sup> One could argue that most images in medicine, physics, and geology conference papers are in fact hybrids of two or more of Rowley-Jolivet’s (2002, 2004) four basic image-types. Graphs and tables, for example, invariably contain numerical and scriptural elements, as may certain figurative images such as photographs and X-rays.

interactional reasons for using colour in medicine (Rowley-Jolivet 2002, 26) rather than, or in addition to, the “more scientific reasons” that motivate geology and physics researchers (Rowley-Jolivet 2004, 153). Dubois (1980, 50) makes a similar point, in a study of slides in biomedical presentations, concluding that, “[i]n addition to providing visual interest and reinforcement of key points, they [the slides] carry the crucial information of the body of the speech, information which is often not imparted orally by the speaker”.

Another text-type related to the research article and the conference paper is the academic poster. Dubois (1985) sees the poster, like the conference paper, as being one of the first steps in communicating research. Dubois’s (1985) study, written primarily with students and teachers in mind, provides insights into how researchers present and discuss their work. For example, effective biomedical posters, according to Dubois (1985), organize visual elements into rows and columns, insert clear dividing lines and spaces, and make extensive use of headings. Colour and depth (added by mounting elements on thicker board) also help to organize, emphasize, and differentiate components, and may be “compelling” or enticing to prospective readers (Dubois 1985, 42).

Smith et al. (2000) examine the use of graphs in research articles from several disciplines, including medicine. By looking at the number of graphs and the amount of space those graphs occupy, Smith et al. (2000) find a correlation between what they call “graph use” and “scientific hardness”. That is, disciplines that are perceived to be “harder” appear to use more graphs, and more space for those graphs, than softer disciplines.<sup>75</sup> In Smith et al.’s (2000) study, medicine ranks lower than physics, chemistry, and biology (cf. Rowley-Jolivet 2004, 155, above) but higher than psychology, economics, and sociology in graph use. This, Smith et al. (2000) argue, provides some empirical support for Latour’s (1990) claim that graphs not only play a central role in the construction and

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<sup>75</sup> Based on the work of Cleveland (1984), Smith et al. (2000, 84–85) argue that the relation between graph use and “hardness” seems to be independent of the relative amount of quantitative data in a given study. As an example, Smith et al. (2000, 84) refer to the “soft” science of psychology, in which “journals were heavily laden with quantitative data, but that the data were usually presented in the form of tables; differences in graph use did not appear to correlate with the amount of data presented”.

communication of scientific knowledge, but that scientists' obsession with graphs and other visual inscriptions (Latour 1990, 39) —what Latour (1990) calls “graphism”—is part of what distinguishes science, and particularly natural science, from other forms of intellectual activity (Smith et al. 2000, 75, Arsenault, Smith, and Beauchamp 2006, 378).<sup>76</sup>

Arsenault, Smith, and Beauchamp (2006) extend the work of Smith et al. (2000) to examine the use of non-graph illustrations such as photographs, drawings, diagrams, and maps, as well as “non-visual inscriptions” (Arsenault, Smith, and Beauchamp 2006, 384) such as tables and mathematical formulae. They find that, in agreement with Smith et al. (2000), the number and size of non-graph illustrations correlates with hardness, with medicine showing a greater use of non-graph illustrations (particularly photographs) than psychology, economics, and sociology, but less than biology, chemistry, and physics.<sup>77</sup> For “non-visual inscriptions”, economics shows the greatest use of mathematical formulae, and medicine the greatest use of tables. With regard to the latter, tables are the only types of inscription (“visual” or “non-visual”) that are found in over half the articles in all seven disciplines in Arsenault, Smith, and Beauchamp's (2006) study, which prompts the authors to write that “tables are a workhorse of data reporting in scientific journals” (Arsenault, Smith, and Beauchamp 2006, 403). Like Smith et al. (2000), Arsenault, Smith, and Beauchamp (2006) conclude that their findings in general support Latour's (1990) claim that visual display or graphism is crucial to the construction of (hard) science, and is part of what Golinski (1998, cited in

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<sup>76</sup> Latour (Latour and Woolgar 1986, Latour 1990) uses the term “inscription” to refer to the way in which activities and material conditions (spaces, instruments, technicians) in the laboratory are transformed into two-dimensional representations. The term, borrowed from Derrida (1976), is used primarily to refer to diagrams, graphs, and tables; it does not refer to writing in Latour's work: “it is an operation more basic than writing [...] used here to summarize all traces, spots, points, histograms, recorded numbers, spectra, peaks, and so on” (Latour and Woolgar 1986, 88).

<sup>77</sup> Arsenault, Smith, and Beauchamp (2006, 395) comment on the potential difficulty of applying the “hard science” label to medicine. Their choice to classify medicine as “hard”, however, is based on the discipline's “close ties to biology and chemistry” and the hardness rating it was given by respondents in their studies (Smith et al. 2000, 77–78, Arsenault, Smith, and Beauchamp 2006, 395) (see section 4.4).

Arsenault, Smith, and Beauchamp 2006, 377) calls the “drive for ocular proof” among scientists.

Hirschauer (1991) examines relations between visual representations of the human body (“anatomical bodies”) and the actual “patient-bodies” of the operating theatre. Anatomical bodies in textbooks and research articles, while often highly intricate and seemingly “life-like”, are sometimes reduced to abstract shapes such as circles and squares (Hirschauer 1991, 289), and their use of colour may be “exaggerated [as a way of] attracting the eye” (Hirschauer 1991, 309). Such abstractions or reductions, however, are not just the result of resemiotization (cf. Iedema 2003, Jones 2013, above); they also reflect (or are comparable with) abstractions in the operating theatre. Patients are reduced to bodies, as they are prepared and positioned for surgery (Hirschauer 1991, 286–287), and the careful placement of sheets or covers reduces patient-bodies to specific “areas of operation”. Those areas undergo further abstraction when sterilizing iodine solution is applied, which may change the colour and texture of skin, and when “special diffuse light” is used (Hirschauer 1991, 299), which minimizes shadowing during surgery.

For Hirschauer (1991, 312, emphasis in original), the relationship between the anatomical body and the patient-body “is reflexive: they are *models* for one another”. The anatomical body, i.e. the visual representation, is not only an abstraction of the patient-body, a documentation of the process of dissection; it may also be an “aesthetic model” (Hirschauer 1991, 312) for what the patient-body should look like and, thus, how it should be treated.<sup>78</sup>

According to Lynch (1985, 37), visual displays such as photographs, diagrams, and graphs are “not only valuable as illustrations of scientific texts; they are irreplaceable as documents which enable objects of study to be initially perceived and analyzed”. Moreover, tables and graphs “create the impression that the objects or relations they represent are

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<sup>78</sup> Vihla (1999, 109) makes a similar point with regard to figures in medieval medical texts. The relative lack of anatomical accuracy in those texts (at least by contemporary standards) may be indicative of the limited knowledge of anatomical structures at that time. However, their “non-realistic nature” also suggests that certain figures were intended as models rather than life-like depictions (Vihla 1999, 109).

*inherently* mathematical” (Lynch 1990, 169, emphasis in original). In an ethnographic study of visual elements in a neuroscience journal, Lynch (1985) treats a graph as both an artefact of actual laboratory activities and an idealized account of the discipline-specific work carried out by scientists (Lynch 1985, 57–58). For example, the graph variously represents individual specimens, specific qualities or measurements of those specimens, and certain divisions of labour in the laboratory; it can also be “read by practitioners to evaluate whether the constructive practices were performed well, mistakes were made, or improvements should be devised” (Lynch 1985, 58). The marks and lines in a graph “[act] as a claim about the unremarkable character of the singular histories of each specimen, and of the practical actions and numerous assessments on the adequacy of the actions which accompanied and guided that history” (Lynch 1985, 59). For Lynch (1990, 181, emphasis in original), the graph is a scientific-object in which “[s]pecimen materials are ‘shaped’ in terms of the geometric parameters of the graph, so that mathematical analysis and natural phenomena do not so much *correspond* as do they *merge* indistinguishably on the ground of the literary [textual] representation”.

Lupton’s (2003) take on visual representation in medicine is concerned with the iconography of illness, disease, and death. In a discussion of medical imaging technology, Lupton (2003) describes how modern endoscopy and computer imaging allow access to the body’s interior, producing full-colour, three-dimensional (moving) images that are “seductive” and worthy of coffee-table art books and prime-time television documentaries (Lupton 2003, 79).

As noted in section 4.2.2.3, Herrando-Rodrigo’s (2010) study of metadiscourse in medical research articles and their online popularizations also includes a brief discussion of “potential non-verbal metadiscourse signals, such as italics, font, size, etc.” (Herrando-Rodrigo 2010, 260).<sup>79</sup> These resources, like linguistic metadiscourse, can be used to organize discourse, engage readers, and express various attitudes and

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<sup>79</sup> Hyland (2008, 28–29) provides a list of possible nonverbal metadiscourse signals that, in written contexts, include binding quality, paper quality, colour, font size and type, screen/print/handwritten, scare quotes, underlining, italics, bold, exclamation marks, and emoticons.

value positions (Hyland and Tse 2004, 156, Herrando-Rodrigo 2010, 255). Somewhat surprisingly, however, Herrando-Rodrigo (2010, 263) concludes that, in research articles, “no tokens [of nonverbal metadiscourse markers] were found because all the RAs [research articles] were published in highly specialized medical journals that share similar formats and layouts”. In contrast, online popularizations appear to be rich in such resources—13.5 per 1000 words, according to Herrando-Rodrigo (2010, 269)—where “colour, size, font, etc.” are used “to give the reader clearer guidance” and to “appeal to the readers and attract them to the text” (Herrando-Rodrigo 2010, 269). Herrando-Rodrigo (2010) is a primarily linguistic study, and no specific examples of nonverbal metadiscourse markers in online popularizations (or research articles) are provided.

#### **4.4 Disciplines and Ideologies of Modern Medicine**

As noted above, several studies of medical research articles highlight the potential relationships between (lexico)grammatical and semantic choices and the context and social practice of medical research. The discipline of medicine, or certain of its subdisciplines, is often described as a “hard science” (see, for example, Dahl 2004, Arsenault, Smith, and Beauchamp 2006, Fløttum, Dahl, and Kinn 2006, Hiltunen 2010, Hu and Wang 2014). Such claims emphasize the importance of observable, testable, and quantifiable findings, and the description of actions rather than the discussion of differing points of view or attitudes. According to this perspective, medical research discourse downplays the role of human agency, and frames propositions as more or less factual information, reflecting an objectivist ideal and a positivist epistemology. On the other hand, some studies suggest a “softer” discipline (Rowley-Jolivet 2002, 2004, Herrando-Rodrigo 2010, Lafuente Millán 2010, Yang, Zheng, and Ge 2015), in which greater emphasis is placed, for example, on the frequent use of self-mentions, the choice of low- and median-value modal resources, and the extensive use of colour. Such choices, it is claimed, reflect a more personal, (inter)subjective writing style and a more indicative rather than definitive approach to knowledge compared with “pure hard science”.

“Hard” and “soft” are relative terms (Biglan 1973, Becher 1994), and they might be more usefully thought of as poles on a cline or continuum (see Smith et al. 2000). According to a survey by Smith et al. (2000, 77–78), medicine is generally considered “softer” than physics, chemistry, and biology at one end of the continuum, but “harder” than psychology, economics, and sociology at the other.

For Bernstein (1996, 23, 65–66), distinctions between disciplines can be made with regard to their “singularity” or “regionality”. Singular discourses like physics and chemistry are knowledge structures based on specialized, discrete, and relatively isolated texts and practices that first and foremost refer to themselves. Regional discourses like medicine, however, are created by recontextualizing or appropriating various texts and practices from singular discourses. Regional discourses “operate both in the intellectual field of disciplines and in the field of external practice” (referred to as “hard-applied” in Becher and Trowler 2001), creating “an interface between disciplines (singulars) and the technologies they make possible” (Bernstein 1996, 65). From this perspective, modern medicine can be seen as a regionalization and technological application (or “exploitation”, Habermas 1987 [1968]) of singular discourses like biology and mathematics (see also Osborne 1998, 261, Becher and Trowler 2001, 35–36).<sup>80</sup>

With regard to forms of knowledge, Bernstein (1996, 1999) makes a distinction between the hierarchical knowledge structures of natural science and the horizontal knowledge structures more typical of the humanities and social sciences. Maton (2007, 2014), in his discussion of the “two cultures debate” (see Snow 2013 [1956], 1961), adds to this broad distinction by categorizing natural sciences as typically having horizontal knower structures, with humanities and social sciences having relatively hierarchical knower structures. The studies reviewed in this

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<sup>80</sup> Wright and Treacher (1982, 7), however, argue that modern medicine, like physics, is a singular rather than regional discourse, which creates its own objects of analysis. They find support for this view in the work of Foucault (1973 [1963]), who holds that “‘patients’, ‘lesions’, ‘physical examinations’ and so on are not pre-formed entities in the real world existing independently of the discourse which embodies them”; rather, they are the product of that discourse, of its words and ideas, its social relationships and institutions (Wright and Treacher 1982, 7).



chapter suggest that, according to those knowledge–knower distinctions, medical science lies closer to the natural sciences. For example, Fløttum, Dahl, and Kinn (2006) suggest that the relatively high frequency of references in medical research articles (compared with linguistics and economics) is indicative of “the more cumulative nature of medicine,” where new research explicitly attempts to add to and build upon a “collective knowledge capital” (Fløttum, Dahl, and Kinn 2006, 261), i.e. a hierarchical knowledge structure. Moreover, the high relative frequency and standardization of non-integral, numerical-endnote references typically seen in medical research discourse (see Dubois 1988, Fløttum 2003b, 2004b, Fløttum, Dahl, and Kinn 2006, Hu and Wang 2014) might reflect a relatively horizontal knower structure in which knowledge of scientific principles and procedures is more highly valued or more strongly emphasized than the identities and social backgrounds of knowers (see Maton 2014, 71).

The kinds of distinctions and variations between “hard” and “soft”, “singular” and “regional”, or “hierarchical” and “horizontal” might also be seen at the level of genre, as the meanings encoded in texts unfold across different generic stages. Different stages of the medical research article encode different parts of the research process; those stages are “not an arbitrary publication format but rather a direct reflection of the process of scientific discovery” (ICMJE 2008, 11). Indeed, most of the studies reviewed above emphasize differences in (lexico)grammatical and semantic choices across different stages of the medical research article, with some stages being described as more evaluative and argumentative (Introduction, Discussion) and others as more descriptive (Methods, Results). MacDonald (2002) examines how some of those patterns of choices across the four main stages of the medical research article construe differences in register, and particularly differences in the roles and relations between writer and reader, i.e. tenor (see section 2.2.1.5.1). Author comment, as expressed by modal resources and evaluative lexis, “articulates the intervention of the medical research writer at varying degrees of explicitness with regard to the negotiation of new knowledge” (MacDonald 2002, 457). This form of intervention is most salient in the Introduction and Discussion sections, which “brackets the more objective

component of the research paper”, i.e. the Methods and Results, and makes the medical research article “a particularly hybrid text” (MacDonald 2002, 458). It is in this hybridity that we might see varying degrees of hardness, singularity/regionalism, and hierarchy/horizontality, depending on the generic stage and the particular goal-oriented social process(es) expressed by that stage (cf. Martin 1992, 505, section 2.2.1.5.2).

Lupton (2003) highlights the important role of medical sociology, medical anthropology, and social history in enhancing our understanding of medicine as culture. Foucault’s (1973 [1963]) historical-philosophical study of the social and epistemological changes in eighteenth-century medicine is of particular note. In *Birth of the Clinic*, Foucault (1973 [1963]) describes how the relatively sudden emergence and development of the *clinique* (the clinic or teaching hospital) allowed new ways of seeing and investigating the diseased body. This new way of seeing, what Foucault (1973 [1963]) calls the “medical gaze”, transformed the body into a “positivist object” (Bernstein 1999, 171) and was part of an epistemological change or rupture (a “scientific revolution” or “paradigm shift” in Kuhn’s (1970) terms) that occurred in the late eighteenth century. This change was not confined to medicine; rather, it marked a new era in the organization of knowledge, moving from a classical to a modern *episteme*, that, for Foucault (2002 [1966]), also included shifts from “general grammar” to “linguistics” and from “natural history” to “biology”. For medicine, the change included a shift from the investigation and treatment of individual patients or cases to the observation and diagnosis of large patient groups, and thus to new forms of empiricism (epidemiology) and the institutionalization of medicine (see also Atkinson 1992, 362). In the classical *episteme*, medicine “referred [...] to qualities of vigour, suppleness, and fluidity, which were lost in illness and which it was the task of medicine to restore” (Foucault 1973 [1963], 35). In the modern *episteme*, there was a shift towards what Foucault (1973 [1963], 35–36) calls a “bipolarity” between what was considered ‘normal’ and what was considered ‘pathological’.<sup>81</sup>

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<sup>81</sup> Osborne (1998, 268–269) writes that this idea of normality, originally conceived as one part of a “normal-pathological” dyad, developed first in medicine before it evolved (in the

Gordon (1988b) takes Foucault's notion of the "gaze" and applies it to modern medicine itself, in an attempt to describe the "hidden cultural scaffolding and social processes that shape [medical] practice and knowledge" (Gordon 1988b, 20). For Gordon (1988b) and others (e.g. Wright and Treacher 1982, Comaroff 1982, Lock 1988, Lupton 2003), health and illness are not only physical/biological processes or states; they are also "ultimately related to and constituted by the social nature of human life" (Lock 1988, 8). Yet, according to Comaroff (1982) and Gordon (1988b), the defining ideologies of modern (western) medicine tend towards naturalism and individualism, rather than (and often to the exclusion of) potentially complementary social and/or political-economic views (cf. Jordanova 1995). According to Gordon (1988b, 24), "[b]iomedical practitioners approach sickness as a natural phenomenon" that is largely atomistic and separate from human social activities. The cultural dimension in modern medicine, when accounted for, is usually restricted to "the superficial, to apply to patients' behavior and understandings, to exist primarily in 'others' beliefs" (Gordon 1988b, 28) and is often reduced to decontextualized variables that can be easily quantified (Navarro 1980, 200, Comaroff 1982, 61, Gordon 1988b, 27).

Modern medicine, it seems, is dominated by the "natural science paradigm" (Gordon 1988b, 22). For some scholars (e.g. Navarro 1976a, 1980, Lock 1988, Waitzkin 1989), this paradigm forms an ideological complex (cf. Gramsci 1971) with the "value system characteristic of an industrial-capitalistic view of the world in which the idea that science represents an objective and value free body of knowledge is dominant" (Lock 1988, 3). Waitzkin (1989), for example, emphasizes definitions or interpretations of (good) health as the ability to work.<sup>82</sup> A "healthy person is one who produces economically", and one of the measures of the effectiveness of medicine is thus "its contribution to patients' subsequent work productivity" (Waitzkin 1989, 222). Waitzkin (1989, 224) likens the

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early nineteenth century) into its present, more common meaning—usual, average, or typical—and moved into other spheres of human activity.

<sup>82</sup> The World Health Organization (WHO) definition of health is "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO 1948). As Jones (2013, 5) notes, rather dryly, "it is hard to imagine many people who would describe themselves as being in this state".

role of medicine to that of the family, education, electoral politics, and the mass media—all examples of Althusser's (2014 [1995]) "ideological state apparatuses" (see section 2.2.1.5.3)—and the way that such institutions serve to legitimize, maintain, and encourage people's participation in economic production. More generally, for Navarro (1976a, 1980), the positivism of medical science, in which biological and social phenomena are investigated as rules of nature, directly reflects the social order in which class differences and exploitation are also treated as "natural". According to Navarro (1980, 199), "it was the victory of the industrial bourgeoisie which established [the] positivist conception of science and of medicine" rather than a "mere linear evolution" based on a steady accumulation of past discoveries.

For Lupton (2003), those dominant ideologies can be seen in some of the metaphors of modern medicine. For example, the human body is often conceived of as a machine, in which individual parts can be isolated and repaired.<sup>83</sup> This view has been especially pervasive since the Industrial Revolution (Navarro 1980, 199, Lupton 2003, 62) and more recently with comparisons of the human body to computerized systems (Lupton 2003, 63–64). Talk of "chemical building blocks" or "mental hardware" is essentially mechanistic and atomistic, and presents the body as "a multitude of tiny interchangeable parts [...] amenable to objectification and technological tinkering" (Lupton 2003, 64). It locates sickness firmly within the individual, writes Lupton (2003, 64–65), "requiring the intervention of technology to 'correct' the faulty code [the use of machinery to fix machinery]", hence drawing attention away from the examination of the social context of illness such as poverty, racism and sexism".

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<sup>83</sup> Military metaphors and sports metaphors are also characteristic of medical research discourse, according to Lupton (2003, 65–70) and Hirschauer (1991, 281).

## 5 Material and Methods

In this chapter, I describe the material and methods used to tackle the research questions posed in chapter 1. I begin with a description of the collection and compilation of a corpus of texts, referred to in this thesis as the Medical Research Article Corpus (MRAC). Subsequent sections describe the annotation and the quantitative and qualitative analysis of MRAC. I also acknowledge some of the methodological challenges encountered, and I discuss how some of those challenges were accounted for and/or overcome.

### 5.1 The Medical Research Article Corpus (MRAC)

Material for this study was selected from five general medical journals: the *New England Journal of Medicine* (NEJM), the *Lancet* (LAN), *JAMA: Journal of the American Medical Association* (JAMA), the *Annals of Internal Medicine* (AIM), and the *British Medical Journal* (BMJ). Journals were selected according to their “Impact Factors” for the year 2009 (NEJM 47.050, LAN 30.758, JAMA 28.899, AIM 16.225, and BMJ 13.660) and were the five highest-ranking publications in the category “Medicine, General & Internal” (Thomson-Reuters 2010).<sup>84</sup> The most highly cited original research articles (RAs) published in those journals during a 20-year period, 1991–2010, were selected, based on citation data from the Thomson-Reuters Web of Knowledge database (Thomson-Reuters 2013b).<sup>85</sup> Other types of research-based publications, such as review articles, short communications, and case reports, were excluded.

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<sup>84</sup> “The journal Impact Factor is the average number of times articles from the journal published in the past two years have been cited in the JCR [Journal Citation Report] year. The Impact Factor is calculated by dividing the number of citations in the JCR year by the total number of articles published in the two previous years. An Impact Factor of 1.0 means that, *on average*, the articles published one or two year [sic] ago have been cited one time. An Impact Factor of 2.5 means that, on average, the articles published one or two year [sic] ago have been cited two and a half times. The citing works may be articles published in the same journal. However, most citing works are from different journals, proceedings, or books indexed by Web of Science”—from Thomson-Reuters Web of Knowledge (Thomson-Reuters 2013a, emphasis in original).

<sup>85</sup> It should be noted that Impact Factor and citation data are not necessarily measures of quality. If they tell us anything at all, it is that a particular journal and a particular article

Using this method, 50 RAs were identified and collected (see list in Table A1 in Appendix), all of which are available digitally in Portable Document Format (PDF) and Hypertext Markup Language (HTML). At the time of collection, in June 2010, the RAs had been cited 1960–8167 times since their original publication (see Table A1).

The years in which the RAs were published range from 1991 to 2006, with notable “clusters” in 1998 (n=12, 24%), 2001 (n=7, 14%), and 2002 (n=6, 12%). None of the 50 RAs was published in the years 2003, 2005, and 2007–2010. The majority of selected RAs were published in NEJM (n=36, 72%), followed by LAN (n=7, 14%), JAMA (n=6, 12%), and BMJ (n=1, 2%). None of the 50 RAs was published in AIM.

MRAC contains a total of 298,152 word-tokens (18,845 word-types), with an average of 5963 words per RA (range 2112–9515 words). MRAC also includes 194 tables and 159 figures, with roughly four tables and three figures per RA (range 1–9 and 0–11, respectively); six tables and 23 figures are reproduced in colour. All RAs are organized according to the IMRaD format (see section 4.1.1).

## 5.2 Corpus Annotation

Annotations were made in UAM CorpusTool and UAM ImageTool (Wagsoft 2016). These software packages are designed for corpus annotation using systemic functional (SF) system networks (see section 2.2.1.1.4), and they allow contiguous layers of annotation to be made on the same text. UAM CorpusTool and UAM ImageTool can also be adapted for non-SF-related annotations, as described in section 5.2.1.

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are (for a certain period of time) widely discussed in other journals and other articles. In other words, they are a central part of the “academic conversation”—regardless of whether the research or the writing is considered “good” or “bad”—and thus an important part of the background of different utterances that Bakhtin refers to (Bakhtin 1981 [1935], 281). This particular method of selection was deemed more appropriate for the study and its aims (see section 1.2) than a corpus based on recommendations from colleagues or other expert informants (cf. Gledhill 1995a, b).

### 5.2.1 Basic Annotations

All RAs were annotated for Title, Abstract, Introduction, Methods, Results, and Discussion (n=50, 100% of RAs); some RAs also include Acknowledgments (n=48, 96%), Appendices (n=24, 48%), Conflict-of-Interest Statements (COI; n=2, 4%), Role of the Funding Source (ROFS; n=2, 4%), and Summary Boxes (n=1, 2%). Other parts of the RA—such as reference lists, running heads, and author names and contact details—were not tagged. Excluding those parts from the corpus gives a word-token count of 254,693.

RAs were also annotated for Year of Publication, Source Journal, and Author Affiliation (by country). As noted above (section 5.1), the selected RAs are published in the years 1991–2006, most frequently in the years 1998 (n=12, 24%), 2001 (n=7, 14%), and 2002 (n=6, 12%), and the majority of the RAs are published in NEJM (n=36, 72%). Most RAs are authored by researchers based in the United States (n=31, 62%) or by transnational research teams (n=6, 12%). Other affiliations are the United Kingdom (n=5, 10%), Canada (n=2, 4%), Australia, Belgium, Finland, France, Netherlands, and Sweden (all n=1, 2%).<sup>86</sup> The number of authors per RA ranges from one to 648 (see Table A1).<sup>87</sup>

RAs were annotated for their Medical Subject Heading (MeSH) Major Topic Key Words and their Publication Type. This information was retrieved from the PubMed database maintained by the United States National Library of Medicine (URL: <http://www.ncbi.nlm.nih.gov/pubmed>; accessed February 23, 2016). Common MeSH Major Topic Key Words in MRAC include “anticholesteremic agents/therapeutic use” (five instances), “coronary disease/prevention & control” (five instances), and “diabetes mellitus type 2/complications” (five instances) (for a full list of all MeSH Major Topic Key Words in MRAC, see Table A2 in the Appendix). According to Publication Type, which refers to the type of study conducted, many of the

<sup>86</sup> Author affiliation was determined according to the country of the first author and was recorded as a single country if 50% or more of the authors were affiliated to institutions in the same country as the first author. If no single country accounted for 50% of the authors' affiliations in an RA, the RA was categorized as “transnational”.

<sup>87</sup> In some RAs, a full list of contributors is provided in a separate Appendix or Acknowledgments; in others, names are listed directly under the article title.

RAs in MRAC report on “multicenter” (29 RAs), “clinical” (37 RAs), “randomized controlled trials” (37 RAs), some of which are considered “comparative studies” (eight RAs).<sup>88</sup> Thirteen RAs in MRAC have no specific publication type according to the United States National Library of Medicine classification system.

MRAC was automatically parsed for part of speech (word class), using the Stanford Parser (estimated accuracy c. 97%; Stanford Parser 2016). The Stanford Parser is integrated into UAM CorpusTool.

Visual elements in MRAC were annotated based on Rowley-Jolivet’s (2002, 2004) typology, as graphical, figurative, or numerical (see section 4.3). MRAC contains 130 graphical images (112 graphs, 18 diagrams), five figurative images (four photomicrographs, one computed tomography image), and 199 numerical images (194 tables and five freestanding mathematical equations). A further 24 figures are classified as hybrid numerical-graphical (22 combined tables + graphs) or graphical-figurative (one combined Western blot + graph, and one combined electrogram + angiogram). With regard to colour, 13 graphical images, five figurative images, seven numerical images, and five hybrid images were reproduced in colour; all other figures were tagged as black and white and/or greytone.

## 5.2.2 Annotating Engagement

### 5.2.2.1 Verbal and Mathematical Resources

MRAC was annotated for verbally and mathematically construed [engagement] using the descriptors summarized in 3.1 and 3.3.<sup>89</sup> I read

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<sup>88</sup> Clinical trials test the safety and efficacy of medications, medical devices, treatment regimens, and/or diagnostic tools. Multicenter trials are conducted at more than one clinic or center. Randomized Controlled Trials (RCTs) refer to the type of experiment conducted, in which study participants are randomly allocated to different medications or treatments, and are compared with so-called “control groups” that receive no medication/treatment or some previously tested medication/treatment.

<sup>89</sup> Mathematical symbols in MRAC include  $p$ ,  $<$ , and  $=$ . I annotated certain of these and other mathematical symbols and expressions (e.g. *risk*, *confidence interval*) as part of the verbal analysis, rather than having a separate layer of annotation for mathematical resources. Since the annotation distinguishes between features and their lexicogrammatical or symbolic realizations, mathematical [engagement] can easily be discerned from verbal [engagement].



through each RA, and identified and labelled the relevant [engagement] features. Although wordings and symbols were annotated manually, UAM CorpusTool automated part of the process by suggesting tags based on previously annotated matching wordings/symbols. I read through each RA at least three times, so as to avoid missing possible annotations, and I returned to them several times after the annotations were recorded in the UAM CorpusTool database. In addition to the [engagement] features summarized in 3.1 and 3.3, I included a category for “unclear” examples, which I returned to on several occasions. For difficult categorizations, I consulted colleagues, some of whom were familiar with the ENGAGEMENT system. I also referred to the *Oxford English Dictionary* (OED) and to *Dorland’s Illustrated Medical Dictionary* (DIMD; Dorland 2000), to decide whether “standard” definitions or meanings of certain words/phrases might infer “dialogistic functionality” (Martin and White 2005).

Figure 5.1 shows a screenshot from UAM CorpusTool version 3. In this example, the modal auxiliary *may*, marked in grey, has been tagged as encoding [engagement: heterogloss: expand: entertain] (see section 3.1.2.2.1). That is, from a dialogic point of view, *may* signals that the proposition is but one among a number of possible alternatives. The textual voice ‘entertains’ the possibility of those alternatives and opens up the dialogic space for any number of propositions (actual or anticipated) that might fall between the poles of “Therapeutic concentrations of the drug in the fetus and the newborn HAVE prevented HIV infection” and “Therapeutic concentrations of the drug in the fetus and the newborn HAVE NOT prevented HIV infection”.

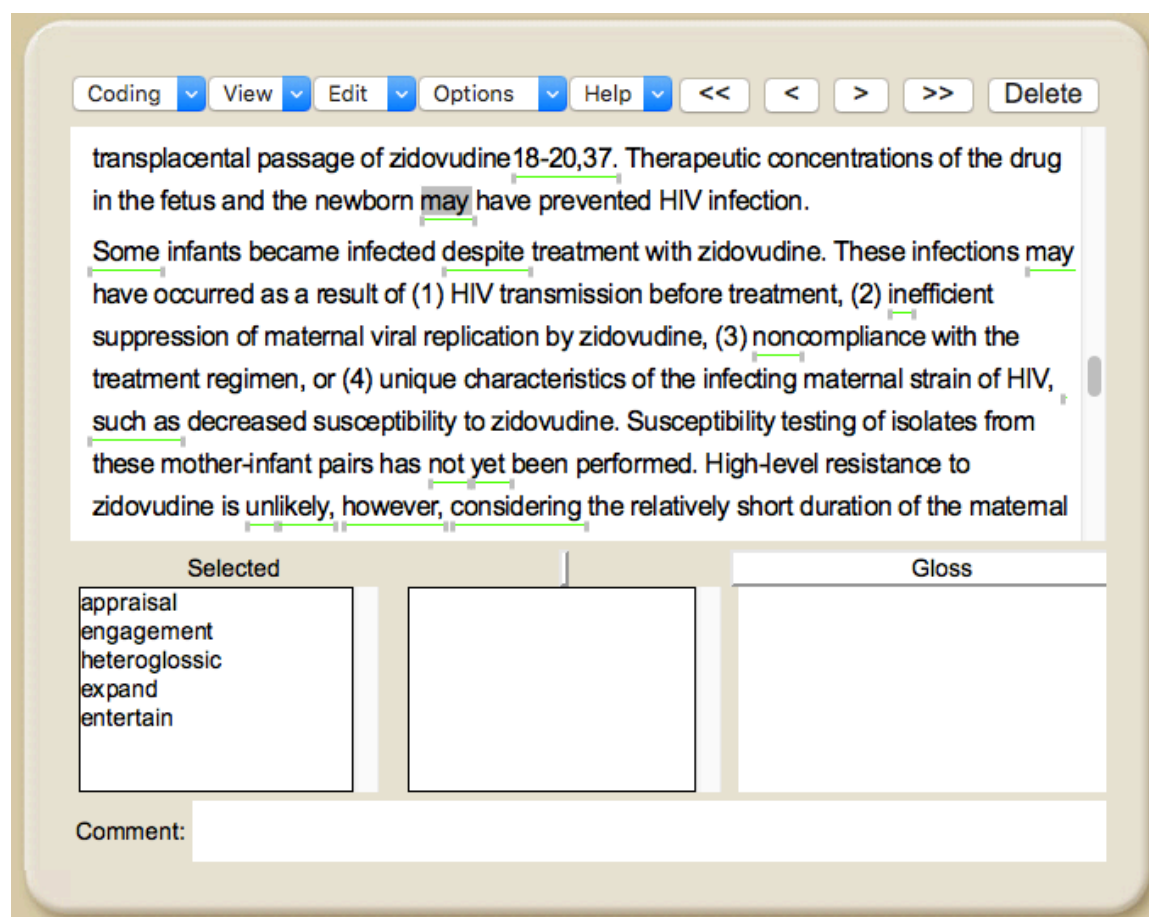


Figure 5.1. Screenshot from UAM CorpusTool version 3 showing annotation of verbal [engagement].

Other annotations visible within the annotation window in Figure 5.1 include *18-20,37* (numbered references, encoding [acknowledge]), *some* (encoding [entertain]), *despite* (encoding [counter]), *may* (encoding [entertain]), *in-* (encoding [deny]), *non-* (encoding [deny]), *such as* (encoding [entertain]), *not* (encoding [deny]), *yet* (encoding [counter]), *un- likely* (encoding [deny]+[entertain]), *however* (encoding [counter]), and *considering* (encoding [entertain]). These and other annotations will be discussed in more detail in chapter 6.

Instances of [monogloss] were identified and annotated in main clauses and matrix clauses that contained no 'heteroglossic' resources. In (5.1), for example, the underlined main/matrix clauses were all annotated for construing [monogloss]. The final sentence in (5.1) is 'heteroglossic', since *none* and *considered* construe [deny] and [entertain], respectively. If embedded or dependent clauses (or parts thereof) were considered to construe [heterogloss] (see underlined clauses in (5.2) and (5.3)), the

overall matrix clause was not annotated as ‘monoglossic’. (For further discussion, see sections 6.1.3 and 6.1.4.)

- (5.1) Three patients died after the end of treatment. One patient who had received interferon alfa-2b plus ribavirin died of a hypertensive heart disease, and two who had received peginterferon alfa-2a plus placebo died, one from drowning and the other from liver cancer. None of the deaths were considered related to treatment.
- (5.2) Compared with total mortality, which may be too insensitive, this index assigns additional weight to the 7 listed diseases.
- (5.3) Among patients with bacteremia, those treated with intensive insulin therapy had a lower mortality rate than those treated conventionally (12.5 percent vs. 29.5 percent), although this difference was not statistically significant.

### 5.2.2.2 Visual Resources

Visual resources in the corpus were annotated for [engagement] using the descriptors summarized in section 3.2. Those resources include graphical images such as diagrams and graphs, figurative images such as photomicrographs and computer tomography scans, and numerical images such as tables and mathematical equations (cf. Rowley-Jolivet 2002) (see sections 4.3 and 5.2.1). Other visual elements such as page layout, font type and size, and bold and italics (see Hyland 2008, Herrando-Rodrigo 2010) were not annotated, unless part of graphical, figurative, or numerical images. Those visual resources do, however, form part of the visual and intersemiotic analyses in chapters 7 and 8 (see also Fryer 2019).

Figure 5.2 shows a screenshot from UAM ImageTool version 2. In this example, a red-pink vertical line on the right side of the image, demarcated in the software by a dark rectangular frame, has been tagged as encoding [engagement: heterogloss: expand: entertain] (see section 3.2). The line, and the horizontal marks at its upper and lower ends, represents a 95% confidence interval, a statistical estimate that is intended to account for the inherent uncertainty that comes from generalizing results from randomly selected samples. In Figure 5.2, the bar indicates that, if the procedure were repeated on comparable samples,

95% of values for those parameters would be expected to fall within the depicted interval, i.e. a survival rate of between 25% and 65% at 8 years from the start of study. Any data point falling outside of this interval has a 5% probability of having happened by chance. From a dialogic perspective, the level and range of any confidence interval indicates the degree to which we might ‘entertain’ alternative values in other samples.

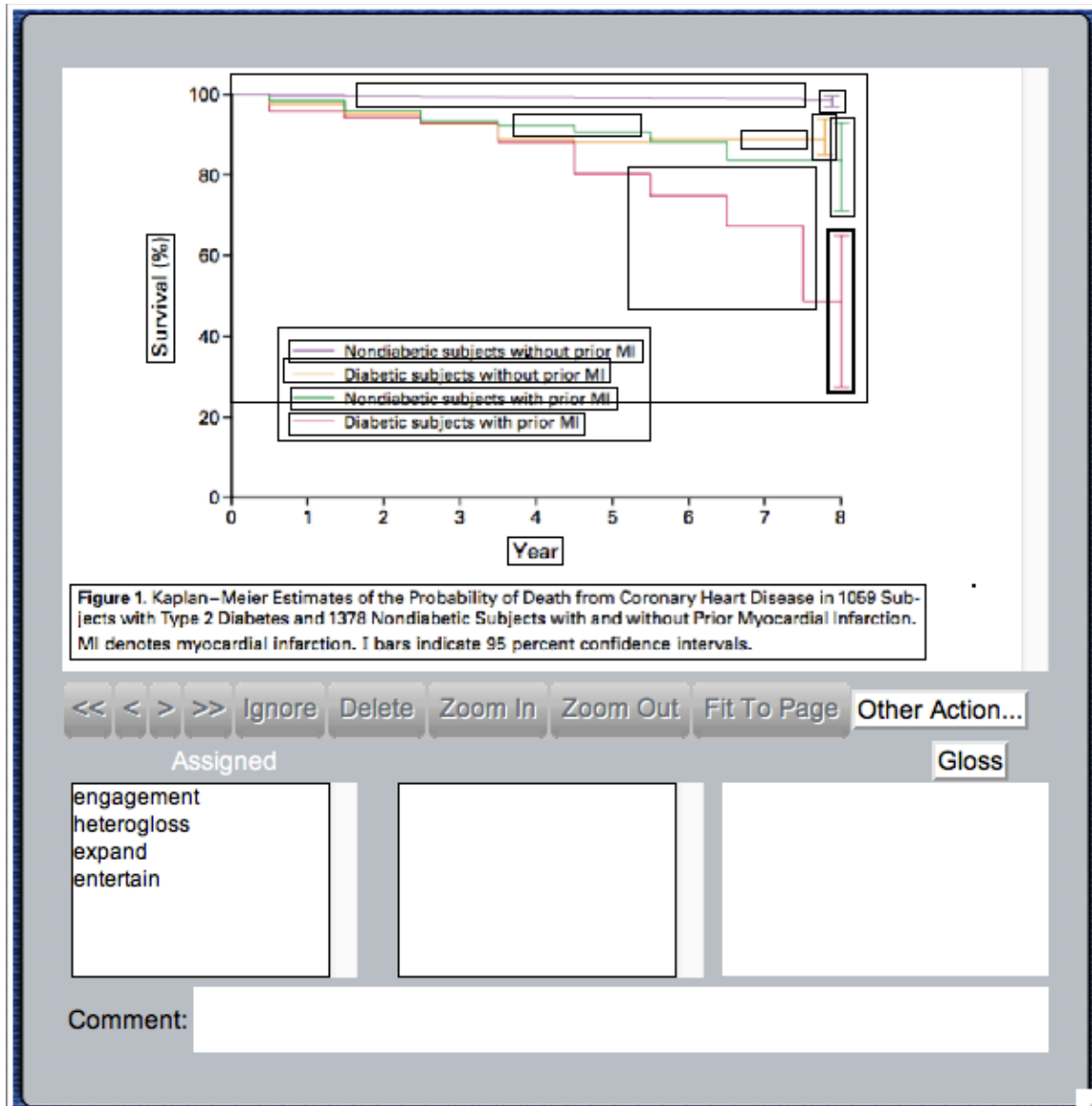


Figure 5.2. Screenshot from UAM ImageTool version 2 showing annotation of visual [engagement].

Other annotations visible within the annotation window in Figure 5.2 include additional confidence bars (encoding [entertain]), verbal labels (encoding [proclaim]), and colour (encoding prominence or [proclaim]).

These and other annotations will be discussed in more detail in section 5.3.2 and in chapter 7.

## 5.3 Analyses

In sections 5.3.1 and 5.3.2, I make a distinction between analyses conducted within the corpus software environment and those done outside of that environment. This could be described as a distinction between quantitative and qualitative analyses. However, this distinction is not so clear-cut. The corpus techniques described in 5.3.1 are automated, but the data upon which this automation is based are for the most part manual annotations made according to a theoretically motivated model. The “elaborate bean counting” (Biber and Conrad 2001, 332) described in 5.3.1 is itself part of a fine-grained qualitative analysis.<sup>90</sup>

### 5.3.1 Corpus-Analytic Techniques

UAM CorpusTool and UAM ImageTool were used to generate and analyse frequencies of [engagement] features, and their multisemiotic realizations, in MRAC as a whole, in individual RAs, in RA sections, and according to affiliation, year of publication, source journal, publication type, and MeSH key word. They were also used to produce tables and system networks showing raw frequencies and selection probabilities (see section 2.2.1.1.4), as well as relative frequencies per 1000 words in the case of verbal resources.

In addition to UAM CorpusTool, I used AntConc (AntConc 2016) to generate keyword lists and concordances, collocates, and n-grams (or clusters) for certain words and phrases. Microsoft Excel was used to edit tables produced in UAM CorpusTool and UAM ImageTool, and to create bar graphs and line graphs from those tables.

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<sup>90</sup> Biber and Conrad (2001) comment here primarily on the use of corpus-based (or corpus-informed) approaches to teaching English as a foreign language, but their observations are equally relevant for corpus-based research in general. Indeed, they specifically mention the importance of corpus-analytic techniques in uncovering potentially hard-to-discern patterns of use in the quantitative and qualitative study of register and genre variation (Biber and Conrad 2001, 332).

The British National Corpus (BNC) and the Corpus of Contemporary American English (COCA) were used for comparative purposes. Both corpora contain subcorpora of written academic texts, including research articles, and COCA contains a medical subcorpus that includes selected texts from the *Lancet* among others. Neither corpus, however, is annotated for visual resources. BNC and COCA were accessed via the URL <http://corpus.byu.edu> (accessed 25 February 2016).

### 5.3.2 Qualitative Analyses

One of the aims of this thesis is to explore how the deployment of [engagement] resources develops as texts unfold (see section 1.2). The annotation of RA sections captures some of those changes (see section 5.2.1 above). However, in order to gain a more fine-grained impression of the patterns of [engagement] across texts, I examined the distribution of verbal, mathematical, and visual [engagement] features (and their realizations) across different generic phases *within* RA sections. Those phases were identified and categorized using the models described in sections 2.2.1.5.2 and 4.1 (and Table 4.1, in particular).

In addition to examining the kinds and amounts of [engagement] deployed as texts unfold, this study attempts to account for the scope of [engagement] and the clusters or “syndromes” (Halliday 2004 [1998], Halliday and Matthiessen 1999) that result from the interaction and combination of different instances of [engagement]. For example, the short excerpt in (5.4) below appears to encode several instances of verbal [engagement]: [endorse] is signalled by *shown*, [acknowledge] by <sup>8-11</sup>, [counter] by *however*, [deny] by *not* (×2), [affirm] by *clear*, and [entertain] by *whether* and *can*.

- (5.4) Clinical trials have shown that lowering elevated LDL [low-density lipoprotein] cholesterol levels prevents both first and recurrent coronary events.<sup>8-11</sup> However, it has not been clear whether coronary events can be prevented by cholesterol-lowering therapy in patients who do not have hypercholesterolemia.

The first sentence of (5.4) ‘endorses’ the findings of a particular set of ‘acknowledged’ trials or studies. The second sentence appears to question

or ‘counter’ the focus of those studies and the broader field, and more generally refutes or ‘denies’ the existence of trials or studies that might otherwise ‘affirm’ the possibility ([entertain] ×2) of preventing coronary events among a group of patients who are defined in terms of a condition that they do not have ([deny]).

The types and numbers of instances of [engagement] in this short excerpt suggest a text that is more dialogically ‘contractive’ than dialogically ‘expansive’ (n=5 and n=3, respectively), and one that ‘entertains’ (n=2) and ‘denies’ (n=2) more than it ‘endorses,’ ‘acknowledges,’ ‘counters,’ or ‘affirms’ (all n=1). As the text unfolds, those meanings are likely to be foregrounded and backgrounded to different degrees, creating a text that variably expands and contracts, pushes and pulls, or ebbs and flows in terms of its dialogic functionality (Fryer 2013, 193). However, an examination of the types and amounts of [engagement] alone may not account for this. For example, while the [counter] feature expressed by *however* is the only instance of [counter] in (5.4), its dialogic function appears to extend across a larger part of the text than the [affirm], [entertain], and [deny] features signalled by *clear*, *whether*, *can*, and *not* (×2) (see Figure 5.3). The [counter] feature subsumes or is superordinate to the other [engagement] features instantiated in this excerpt.

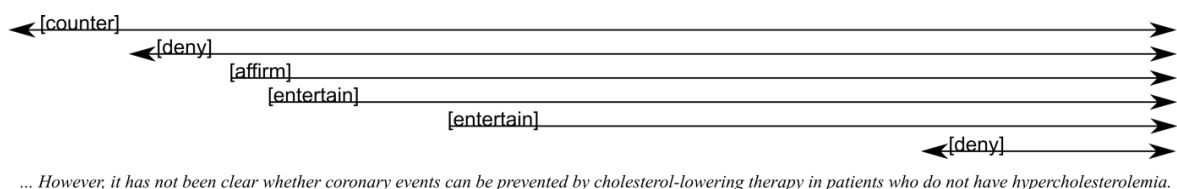


Figure 5.3. Visualization of the scope and hierarchy of instances of [engagement].

An analysis of rank (see section 2.2.1.1.5) may help to account for differences in scope and the subsequent clustering and interaction of [engagement] in text. For example, in (5.4), the dialogic function of *however* extends (prospectively and retrospectively) over two clause-complexes or semantic sequences, while *can* extends over a dependent clause or figure (see Figure 5.3). Similarly, the two instances of [deny], although both signalled by the negative operator *not*, also differ in scope: the first extends over a clause-complex or sequence; the second extends

over a postmodifier in a nominal group, part of a semantic figure or element.<sup>91</sup>

A similar case can be made for the visual construal of [engagement]. For example, the types and amounts of [engagement] in Figure 5.2 above (see section 5.2.2.2) suggest a text that is more dialogically ‘contractive’ than dialogically ‘expansive’ (n=12 [proclaim] and n=5 [entertain], respectively). As the reader follows a particular reading path, some of those features will be foregrounded or backgrounded to varying degrees. For example, the reader’s attention may be drawn to the coloured lines in the graph and then to the confidence bars on the right. In terms of rank scale, the coloured lines represent episodes that are given special prominence and that, dialogically, are considered particularly compelling, noteworthy, or important ([proclaim]). As indicated by the x-axis, each of those episodes develops chronologically, from left to right, ending with a figure, the confidence interval, which indicates the degree to which we might [entertain] alternative values in other samples (see 5.2.2.2 above). It is at this point in the episode that instances of [proclaim] and [entertain] overlap, creating a dialogic space that is potentially both ‘contractive’ and ‘expansive’. In chapters 6 and 7, I attempt to account for the scope and interaction of these and other verbal and visual [engagement] resources, as well as their numbers and distributions, by looking more closely at the rank scales of features and their realizations.

The analysis of visual, verbal, and mathematical resources forms the basis for a multi- and intersemiotic account of [engagement] in medical research articles (see section 2.2.2.3). In chapter 8, I examine and compare the contributions made by each semiotic system, and consider how some of those contributions are “coupled” or combined to create meanings that

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<sup>91</sup> The kinds of propositions that are being ‘denied’ here are fundamentally different. The first ‘denies’ a particular value-position, one of clarity, while the second ‘denies’ or rejects membership of a particular group, a distinction that Fløttum, Dahl, and Kinn (2006, 244–245, 247) describe in terms of “refutative negation” and “descriptive negation”, respectively. For Fløttum, Dahl, and Kinn (2006, 247), the latter type of negation is less polemic or polyphonic than the former. According to Givón (2001a, 396), there is also a difference here in the “strength of negation”, which correlates with “the depth of embedding of the negative operator”. Negation at the level of the main or matrix clause is generally considered “stronger” than negation at the level of a dependent clause or complement (Givón 2001a, 396).



are potentially more than the sum of their individual parts (Zappavigna, Dwyer, and Martin 2008, 169), what Lemke (1998) calls “multiplying meaning”. Such an analysis requires a close reading that is not particularly amenable to corpus-analytic study. The chapter focuses primarily on a single text from MRAC—with somewhat brief analyses and discussions of MRAC as a whole—examining how [engagement] resources across and within semiotic systems converge or diverge as the text unfolds.

The findings from the methods described above are used as the basis for a wider discussion of some of the disciplinary and ideological aspects of medical research discourse. According to the stratified model of language and other semiotic systems presented in section 2.2, patterns of choices at one stratum redound with patterns of choices at the next. Thus, ideology, as the uppermost stratum in Martin’s (1992) model (see Figure 2.4, section 2.2.1.5), is realized by recurrent configurations of genre, genre by recurrent configurations of register, and register by recurrent configurations of verbal, mathematical, and visual resources. Throughout chapters 6–8, I discuss patterns of [engagement] and how those patterns might redound with higher-level contextual strata.

## 5.4 Methodological Considerations

Several theoretical and methodological challenges need to be mentioned. The first, and perhaps the most important, is my own position with regard to MRAC and the field of medicine. I have studied medical research discourse, run writing courses for medical students, and worked with writers and editors of medical journals for many years, but I have no formal training or education in medicine. Clearly, I am an “outsider” or, at best, a peripheral member of this particular discourse community. My readings of the texts in MRAC are my own, individualized readings, and I acknowledge that those readings may differ from those of a medical student or an experienced medical researcher. For Bernstein (1996), Martin (2008a), and others, a text has a particular meaning potential, and the interpretation of that text depends in part on the experiences and “repertoires” of the reader in relation to the “reservoir” of meanings in a given community (see opening paragraph of chapter 3). However, whether or not I understand a term like *steatosis* has little or no bearing on whether

I consider the proposition *some of these patients may have steatosis* as opening up dialogic space and ‘entertaining’ the possibility of alternative positions or propositions in the discourse.<sup>92</sup> My intention in this study is not to assess the quality of the research or the writing in MRAC. Rather, it is to consider how the articles in MRAC might construe a dialogic space in which the textual voice positions itself and its potential readers (of whom I am one, of course). This research is firmly grounded in the field of discourse analysis, not medical research per se.

As noted in section 5.2, MRAC was annotated manually, with the exception of the part-of-speech/word-class analysis. Manual annotations are common in corpus-based social-semiotic studies, especially those that focus on semantic annotation. This is not to say, however, that automated analysis is not possible. Kaltenbacher (2006), for example, proposes several ways of automating, or partially automating, the annotation of ATTITUDE (see section 3.1). These include the use of predetermined lists, the creation of such lists based on a manual analysis of a sample of texts, and the use of automatically generated frequency lists as the basis for identifying relevant, high-frequency items in a corpus. One of the advantages of partially or fully automated annotation is that the analyst can examine relatively large data sets. However, in doing so, one may miss low-frequency items that could be specific to certain genres or individual texts (Kaltenbacher 2006, 275, Fryer 2013, 192). For the purposes of this study, I chose to annotate the corpus manually. This limits the overall size of the data set compared with automated analyses, but it also reduces the chance of missing potentially important low-frequency items (Fryer 2013, 192).

The manual annotation of semantic features like those in the ENGAGEMENT system can be “a complex and subjective process” that may hinder “transparent, reliable and replicable analyses” (Fuoli and Hommerberg 2015, 326). Some corpus-based studies of ENGAGEMENT, or APPRAISAL more generally (e.g. Fuoli 2013, Fuoli and Hommerberg 2015, Hommerberg and Don 2015), attempt to account for this by using two or

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<sup>92</sup> Steatosis, incidentally, is the “infiltration of liver cells with fat, associated with disturbance of the metabolism by, for example, alcoholism, malnutrition, pregnancy, or drug therapy” (OED).

more annotators and by testing the “inter-rater reliability” (IRR; the degree of agreement) of their annotations. While such techniques might help “control for [possible] bias and subjectivity” (Fuoli 2013, 217), multiple analysts were not used in this study. This was primarily due to the time and resources needed to train annotators and carry out annotations (see further comments in Fuoli 2013, 230).<sup>93</sup> Another reason is that, while IRR might be a useful test for the “reliability” of text annotations, low levels of agreement do not necessarily indicate that “the coding scheme is defective or not sufficiently explicit, or that the annotators need more training” (Fuoli and Hommerberg 2015, 331). They may also reflect the polysemy of language (and other semiotic systems), the meaning potential of text, and annotators’ experiences of reading such texts. That analysts or readers annotate or read differently need not be understood as a methodological or theoretical shortcoming.

As Thompson and Hunston (2006, 3) note, there may be challenges in thinking that one has to squeeze, or “shoehorn”, verbal and visual resources into existing or predetermined grammatical or semantic categories. Vold (2006) provides an interesting example of this (see section 4.2.3.2). In the case of *indicate*, “two meanings [‘suggest’ and ‘show’] may co-occur in one single form and are not necessarily mutually exclusive” (Vold 2006, 70–71). In (5.5), for example, *indicate* can be seen to construe [entertain] ( $\approx$  *suggest*) or [endorse] ( $\approx$  *show*). “Shoehorning” the item into one category rather than another overlooks this polysemy. In this study, I use dual or multiple categorizations for examples like these, acknowledging that, in (5.5), *indicate* has the potential to construe both [entertain] and [endorse], at least “for the brief textual moment” (Martin and White 2005, 99).<sup>94</sup> As I note in Fryer (2013, 192–193), however, not

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<sup>93</sup> Part of the original project description for this study included a proposal to consult a panel of medical researchers of varying levels of experience and expertise, but the creation and organization of such a focus group proved difficult. Instead, I chose to consult colleagues on an ad hoc, instance-by-instance basis as a means of crosschecking annotations (see section 5.2.2).

<sup>94</sup> Multiple categorizations such as these emphasize the importance of qualitative analysis. That *indicate* appears to construe [entertain] and [endorse] simultaneously does not make it *more* dialogic than resources that might construe either [entertain] or [endorse] (see examples in section 3.1.2), even if some of the quantitative analyses described in section 5.3.1 suggest otherwise, i.e. two instances of [heterogloss] versus one.

all instances of *indicate* have this kind of dialogic functionality. In (5.6), *indicate* encodes neither [entertain] nor [endorse]; it is part of a ‘monoglossic’ rather ‘heteroglossic’ proposition (see section 3.1.1).

- (5.5) Results from WHI indicate that the combined postmenopausal hormones CEE, 0.625 mg/d, plus MPA, 2.5 mg/d, should not be initiated or continued for the primary prevention of CHD.
- (5.6) [...] asterisks indicate principal investigators, and daggers program coordinators.

Another interesting example is the use of the verb *claim*. Martin and White (2005, 103–104, 113–114) discuss its ability to construe [distance]. However, as noted in section 3.1.2.2, they also emphasize that the “rhetorical potential” of *claim*—like other exemplifications of dialogic resources—varies depending on co-textual and contextual conditions (Martin and White 2005, 103–104). *Claim* might construe [entertain] (≈ “suggest”) and/or [acknowledge] (≈ “state”), and the ‘distancing’ effect may only become apparent as more of the text unfolds and different [engagement] resources are deployed (see example (3.18) in section 3.1.2.2). Moreover, those meanings are likely to be foregrounded, or backgrounded, to different degrees depending on the attributed source itself, and the reader’s familiarity with that source. For example, if I, as a functional linguist, write *Halliday claims that X*, it may be intended as an ‘endorsement’ or ‘acknowledgment’ of a certain proposition X, based on a source that I consider “highly credible” (cf. Martin and White 2005, 116). In contrast, if a linguist working in a different theoretical paradigm were to write the same, the framing proposition might be intended to ‘distance’ the textual voice and reader from proposition X, perhaps implying a less credible or reliable source. All these examples show the importance of co-textual and contextual factors when annotating for [engagement], and they demonstrate the need for a fine-grained close reading of the text.

A final point to mention when analysing texts for [engagement] is the interrelation of the other APPRAISAL subsystems, i.e. ATTITUDE and GRADUATION (for a brief description of the APPRAISAL system and its three main subsystems, see section 3.1). With regard to verbal [engagement], most dialogic resources can be graded according to “the degree of the

speaker/writer's intensity, or the degree of their investment in the utterance" (Martin and White 2005, 135–136). One can identify, for example, clines of gradability, from lower to higher, in *it is possible/probable/certain that [...]* and in *a few/some/most studies suggest/state/insist that [...]*, which construe differing degrees of [entertain] and [attribute] (Fryer 2013, 193, see also Martin and White 2005, 136, Hood 2010, 185–189). Clines of gradability also affect the way visual elements construe [engagement]. For example, the use of different colours, or different shades of a particular colour, will likely affect the prominence of certain episodes or figures in an image and thus the degree of [proclaim] expressed by those elements (see, for example, Figure 5.2 above). Relative size and placement are likely to have similar effects. I attempt to account for these and other interrelations of visual/verbal [engagement] with [graduation] and [attitude] throughout chapters 6–8.



## 6 Verbal and Mathematical Engagement

In this chapter, I present and discuss findings for verbally and mathematically construed [engagement] in MRAC. Section 6.1 looks at the instantiation and realization of [engagement] across the corpus as a whole, on a feature-by-feature basis. Section 6.2 examines the distribution and logogenetic variability of verbal and mathematical [engagement] resources as they are deployed across different generic stages and phases of the MRAC articles. The possible effects of contextual variables such as MeSH, affiliation, year of publication, source journal, and type of publication are discussed in section 6.3, and the potential relations between [engagement] and the discipline and ideologies of medical research are considered in section 6.4. Findings are summarized and discussed in section 6.5.

### 6.1 Instantiation and Realization

A total of 19,217 instances of verbal and mathematical [engagement] were identified and annotated in MRAC, giving a relative frequency (RF) of 63.09 instances per 1000 words. Among these, [heterogloss] is more common than [monogloss], with relative frequencies of 59.27 and 3.82 instances per 1000 words, respectively. Dialogically ‘expansive’ resources occur more frequently than dialogically ‘contractive’ resources, accounting for 61.68% and 38.32% of selections from within the ENGAGEMENT: HETEROGLOSS subsystem, respectively (see Figure 6.1). The dialogically ‘expansive’ [entertain] feature is the most commonly occurring [engagement] feature in MRAC, followed by the dialogically ‘contractive’ [deny] feature (see Figure 6.1). The dialogically ‘contractive’ [concede] option is not instantiated verbally or mathematically in MRAC.

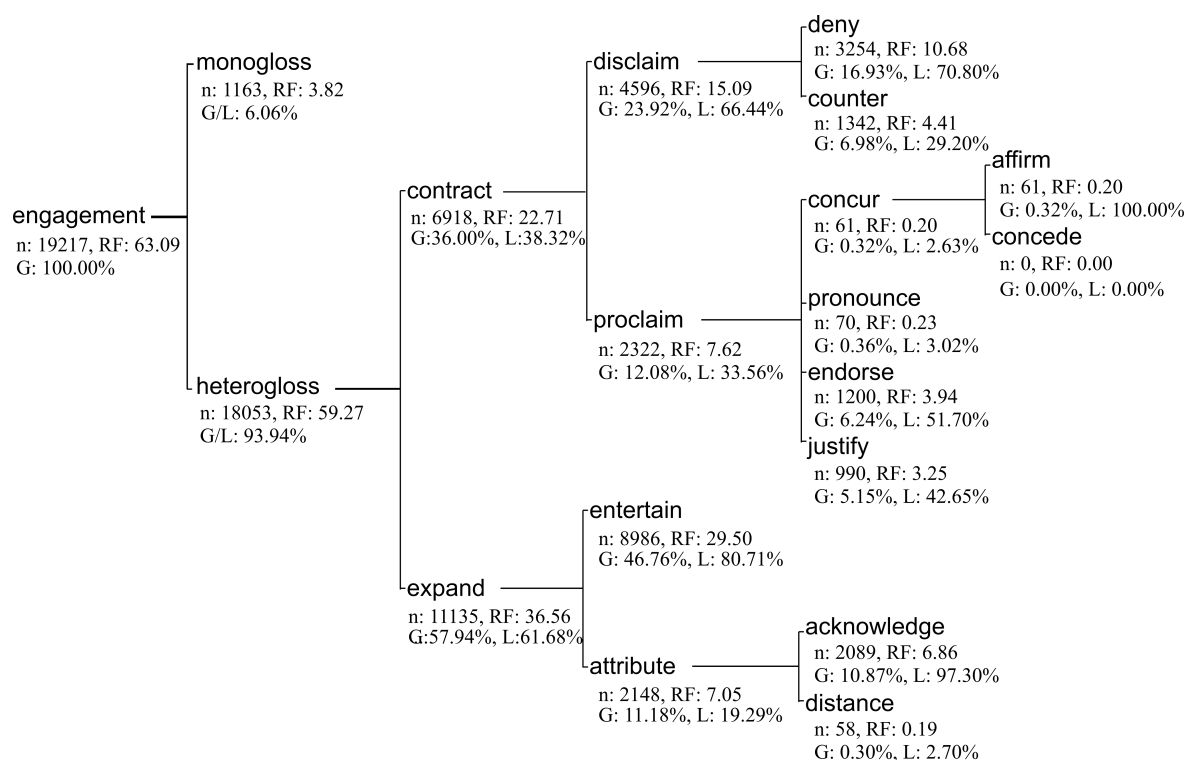


Figure 6.1. Instantiation of [engagement] in MRAC as a whole: number of instances (n), relative frequencies per 1000 words (RF), and global and local selection probabilities (G, L).

In the following sections, I examine in more detail the instantiation and realization of [engagement] across the corpus. Sections 6.1.1 and 6.1.2 examine [heterogloss: contract] and [heterogloss: expand], respectively. In section 6.1.3, I comment on ‘monoglossic’ utterances in the corpus, before discussing, in 6.1.4, the scope and interaction of [engagement] in MRAC. Section 6.1.5 concludes with a summary of findings.

### 6.1.1 Heterogloss: Contract

Dialogically ‘contractive’ resources act “to challenge, fend off or restrict the scope” of alternative voices in the discourse (Martin and White 2005, 102), narrowing the dialogic space for alternative viewpoints or propositions (see section 3.1.2.1). In MRAC, these resources account for over one-third of all instances of verbal and mathematical [heterogloss] (6918/18053 instances; 38.32%), occurring at a relative frequency of 22.71 instances per 1000 words (see Figure 6.1). In the two sections that follow (6.1.1.1 and 6.1.1.2), I present findings for the [disclaim] and [proclaim] subtypes



of [engagement: contract] and the more delicate options within each of those subsystems.

#### 6.1.1.1 Disclaim

'Disclaim' indicates that the textual voice is in some way at odds with a prior or alternative contrary proposition, one that is explicitly "rejected, replaced or held to be unsustainable" (Martin and White 2005, 118). There are 4596 instances of [disclaim] in MRAC (RF 15.09 per 1000 words). These instantiations account for 23.92% of instances of [engagement], 25.46% of instances of [heterogloss], and 66.44% of instances of dialogic 'contraction' (see Figure 6.1). Within the system of DISCLAIM, there are two options: [deny] and [counter].

##### 6.1.1.1.1 Deny

In selecting [deny], the textual voice acknowledges and rejects actual or potential alternative propositions, and thus restricts the dialogic space for alternative viewpoints in the discourse (see Martin and White 2005, 118). 'Deny' generally enhances solidarity, according to Martin and White (2005, 118–120), by closing down the dialogic space and construing the reader as being in agreement with the textual voice. However, this solidarity may be at risk if the proposition conflicts with or challenges the knowledge, beliefs, or values of the reader.

In MRAC as a whole, [deny] is the second most common verbal [engagement] feature ( $n=3254$ , RF 10.68 per 1000 words). It accounts for 16.93% of [engagement], 18.02% of [heterogloss], 47.04% of [contract], and 70.80% of [disclaim] (see Figure 6.1).

According to the Stanford Parser, 28.51% of instances of [deny] are signalled by adjectives, 27.76% by adverbs, 18.90% by nouns, 12.00% by determiners, 7.06% by prepositions, 5.10% by verbs, and 0.57% by conjunctions.<sup>95</sup> Most typically, [deny] is signalled by the negative operator

<sup>95</sup> The Stanford Parser tags negative prefixes like *non-* and *un-* according to the word class they modify. Those affixed to adjectival forms like *fatal* or *known* are tagged as adjectives; those affixed to nouns like *availability* or *compliance* are treated as nouns. The negative operator *not* is tagged as an adverb.

*not*, the negative prefixes *non-* and *un-*, and the negative determiner *no* (see examples (6.1)–(6.4)). These four realization types, of a total of 33, account for almost two-thirds (63.40%) of all encodings of [deny] in MRAC. A full list of realization-types and examples, ordered according to frequency of use and selection probability, is provided in Table A3 in the Appendix.<sup>96,97</sup>

- (6.1) Trends did not differ significantly by age or racial/ethnic group. (MRAC\_26)
- (6.2) One hundred seventy three patients had a nonfatal myocardial infarction in the placebo group [...]. (MRAC\_35)
- (6.3) The reasons why pulmonary veins become arrhythmogenic are unknown. (MRAC\_15)
- (6.4) There was no evidence that intensive treatment with chlorpropamide, glibenclamide, or insulin had a specific adverse effect on macrovascular disease. (MRAC\_44)

As examples (6.1)–(6.4) demonstrate, and as the realizations in Table A3 in the Appendix suggest, the scope and strength of negation in MRAC varies. In some cases, the negation extends over a clause or clause-complex; in others, it is restricted to phrases, groups, or words. In (6.1), for example, the negation extends from the negative operator to the end of the clause, and back over the auxiliary *did*—what Quirk et al. (1985, 775) and Biber et al. (1999, 175) call “clausal negation”. Here, potential alternative (positive) propositions such as “trends differ significantly by age or racial/ethnic group” or “trends might differ significantly by age or racial/ethnic group” are denied or rejected. In (6.2), however, it is not the proposition that is ‘denied’, but part of a semantic element, realized by a

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<sup>96</sup> The RFs for *non-* and *un-* in MRAC contrast with Quirk et al.’s (1985, 1540) observations for English in general, where *un-* is considered “by far the most productive [negative prefix].” This may be partly due to the high productivity of *non-* in medical terminology, e.g. *non-small cell lung cancer*, *non-fatal myocardial infarction*, and *non-proliferative retinopathy* (all examples from MRAC).

<sup>97</sup> Due to the inclusion of large amounts of data, the size and formatting of Tables A3–A11 in the Appendix may make them difficult to read. Full-size charts are available on request.

Complement, within the proposition. The negation here is restricted to the nominal group, *a nonfatal myocardial infarction*. What is ‘denied’ is a figure/proposition that could be more congruently expressed as a clause, e.g. “some myocardial infarctions are/were not fatal”.

Morphologic or affixal negation, like that in (6.2) and (6.3), is one of the resources of what Quirk et al. (1985, 775) and Biber et al. (1999, 175) call “local negation”, “in which one constituent (not necessarily a clause element) is negated” (Quirk et al. 1985, 775). Other markers of “local negation” include the negative determiner *no*, as in example (6.4), in which the negation is restricted to the nominal group that functions as Complement (or notional subject). Similarly, the negative scope of *not* can be limited to embedded or dependent clauses, nominal groups, or adverb groups, as in examples (6.5), (6.6), and (6.7), respectively. All these forms of “local negation” are seen as construing [deny], albeit in a potentially less congruent form than that construed by clausal negation (cf. White 2003, 271).

(6.5) [...] the benefit of spironolactone in these patients was similar to that in patients who did not use potassium supplements. (MRAC\_31)

(6.6) Obesity is a risk factor for these conditions; however, not everyone with these conditions is obese, and not all obese people have these conditions.<sup>26-27</sup> (MRAC\_11)

(6.7) Not unexpectedly, the incidence of major bleeding complications was significantly higher in the stent group (13.5 percent) than in the angioplasty group (3.1 percent). (MRAC\_36)

Although Martin and White (2005) do not discuss morphologic negation with regard to the ‘contraction’ of dialogic space, they do briefly discuss its role in the construal of [attitude] (for a brief account of [attitude], see section 3.1). The negation in *X is unhappy*, unlike the clausal negation of *X is not happy*, occurs “outside Halliday’s Mood function”, potentially reducing the arguability of the proposition (Martin and White 2005, 73).<sup>98</sup>

<sup>98</sup> Quirk et al. (1985, 776) treat such examples as “approximately synonymous [...] eg : *That is not true* ~ *That is untrue*”. While they clearly have similar meanings, I do not wish to

Mood (i.e. Subject + Finite) “carries the burden of the clause as an interactive event” (Halliday and Matthiessen 2004, 120), and it is this unit that, in the case of a proposition, “carries the argument forward” (Halliday and Matthiessen 2004, 111). In (6.2), for example, it is not whether the myocardial infarction is fatal or not that is at stake, but rather the number of patients that suffered from the condition (cf. “Myocardial infarction was not fatal in 173 patients”).

Its potentially reduced “arguability” makes the morphologic form of negation particularly interesting in terms of reader alignment. If, as noted above, [deny] formulations generally enhance solidarity, by closing down the dialogic space and construing the reader as being in agreement with the textual voice (Martin and White 2005, 118–120), then morphologic negation may augment this effect, by restricting the “arguability” of the negated semantic element and construing the denial as ‘taken for granted’ or not up for discussion. Based on the figures in Table A3, morphologic negation in MRAC accounts for over one-third (36.60%) of all instances of [deny]. A comparison can be made here with Tottie’s (1991) study of negation in registers of spoken and written English, in which affixal negation accounts for 8% and 33% of all negation, respectively (Tottie 1991, 45–46). According to Tottie (1991, 57–59, 84–85), this difference between spoken and written registers can be partly accounted for by production constraints—the distinction between “unprepared” speech and “prepared” writing—which give rise to relatively “fragmented” or “integrated” styles of expression (after Chafe 1982). It is this latter, “integrated” style, typical of writing, that allows for “the denser packing of idea units” and that partly conditions the choice of affixal negation (Tottie 1991, 84). This denser packing of idea units is a widely recognized phenomenon in English-language medical research writing (e.g. Guillén Galve 1998, Gao 2012) and in scientific writing in general, particularly with regard to increased lexical density and nominalization (Halliday and Martin 1994b, Banks 2005).

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claim that *X is unhappy* and *X is not happy* are synonymous. Rather, the two forms of negation are different, and their abilities to construe ‘denial’ are qualitatively different because of this.

Other resources used to construe [deny] in MRAC include a limited set of semantically negative verbs (and, in some instances, their nominalized forms) as well as certain negative nouns and adjectives (see Table A3) that express what Fairclough (1992, 122) and Givón (2001a, 395 ff.) term “semantic negation” or “inherent (lexical) negation”, respectively. One of the most common of these is *exclude* (and *exclusion*), used primarily to indicate which variables, e.g. patient groups or disease types, are *not* included in the study or are subsequently removed from data analyses (see section 6.2 for a generic-structural account). *Absence* and *absent*; *lack* (as both noun and verb); *fail* and *failure*; *rule out*; *refuse*, *refusal*, and *refuser* (i.e. “one who refuses”); and *refute* and *refutation* are used in similar ways, to reject or ‘deny’ various alternative (polar-positive) propositions. The negation expressed by these resources may be clausal or local, as the examples in (6.8)–(6.14) show.

(6.8) We excluded volunteers with uncontrolled hypertension, secondary hyperlipidemia, or type 1 or type 2 diabetes mellitus that was either managed with insulin or associated with a glycohemoglobin level of at least 10% (20% above the upper limit of normal).

(MRAC\_08)

(6.9) It is possible that cofactors in the pathogenesis of *H. pylori*-related ulcer disease protect against the subsequent development of gastric carcinoma. For example, acid might be necessary for peptic ulcer disease to occur but might inhibit gastric carcinogenesis. Similarly, ulcer disease might reflect the occurrence of an acute infection in adulthood and the absence of a chronic infection in childhood.

(MRAC\_29)

(6.10) The lack of observed benefit of clopidogrel over aspirin in the myocardial infarction subgroup and the evidence of possible heterogeneity of treatment effect among the clinical subgroups prompted a single additional analysis.

(MRAC\_13)

(6.11) The effect of the intervention on the incidence of diabetes was most pronounced among subjects who made comprehensive changes in lifestyle; on the other hand, the failure to make any changes resulted in an incidence of diabetes that was close to the estimate of 35 percent for this high-risk population.

(MRAC\_43)

(6.12) It may be argued that the difference in drug therapy between the two study groups accounts for the observed differences in angiographic outcome and rate of restenosis. However, a number of clinical studies collectively rule out any beneficial effect of anticoagulant therapy on restenosis in humans<sup>20-25</sup>.

(MRAC\_36)

(6.13) Of the 328 patients assigned to surgery, only 1 refused the operation and received medical treatment alone.

(MRAC\_41)

(6.14) The records were reviewed by a committee of physicians using standardized criteria to confirm or refute reported events.

(MRAC\_32)

With regard to writer–reader alignment, Martin and White (2005, 118–119) suggest two main types of ‘denial’: one that is directed outwards, away from the writer–reader relation, usually indicating disalignment with some third party; and one that is directed at the reader, usually as a means of correction. Both may enhance solidarity between the writer and reader, provided the ‘denial’ is not considered confrontational to readers’ knowledge, beliefs, and values. The instantiations of [deny] in MRAC suggest, however, a third type, one that may be a hybrid of the other two and appears to be directed at the textual voice itself. In (6.1) above, the actual or potential propositions that are rejected or ‘denied’, e.g. “that trends might differ significantly by age or racial/ethnic group”, are set up earlier, internally within the research article, as part of the Introduction or Methods section, e.g. *To test for trends, the NHANES survey years were included as an ordinal variable in logistic regression models that included age group and race/ethnicity* (MRAC\_26) (see section 6.2 for further discussion with regard to generic staging). Like the other two types of ‘denial’ mentioned above, this text-internal ‘denial’ is unlikely to challenge readers’ knowledge, beliefs, or values—unless the methods that lead to such a rejection are thought to be at fault. Indeed, there are few (if any) examples in MRAC that openly appear to threaten the solidarity between writer and reader. One possible example (see (6.15) below), which includes a variety of [engagement] resources, and which is discussed further in sections 6.1.2.1 and 6.1.2.2, includes a negation that is directed at “those who commonly argue”, an unnamed third party that likely includes certain putative readers. However, this ‘denial’ is so carefully

negotiated, in part through other [engagement] resources (e.g. *commonly*, *may*; see section 6.1.2.1 on [entertain]), that it is unlikely to create disalignment.

- (6.15) It is commonly argued that it is difficult to change the lifestyle of obese and sedentary people, but such pessimism may not be justified. The reasonably low dropout rate in our study also indicates that subjects with impaired glucose tolerance are willing and able to participate in a demanding intervention program if it is made available to them.

(MRAC\_43)

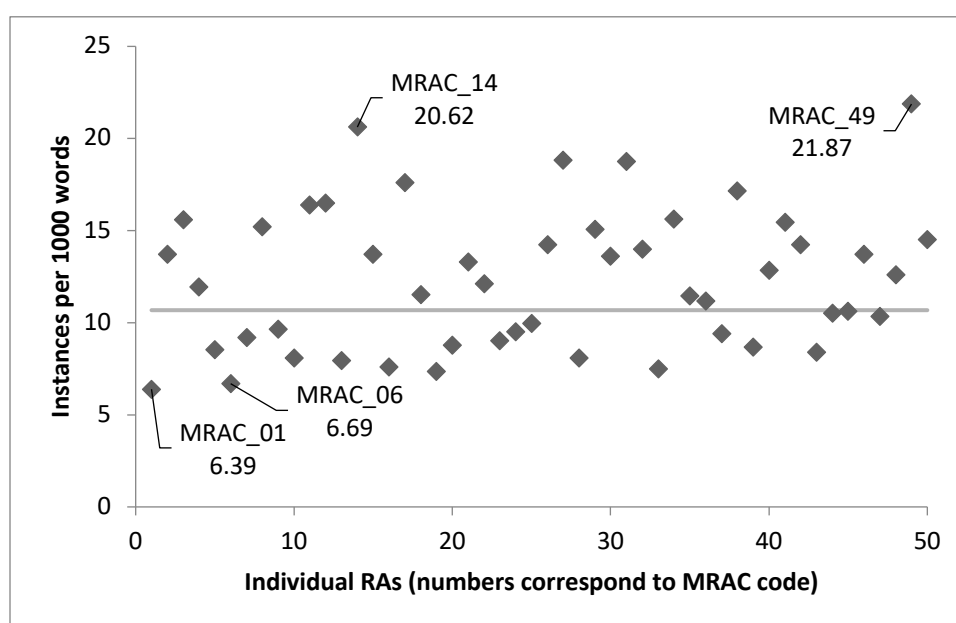


Figure 6.2. Instantiation of [deny] (relative frequency) per research article. Horizontal grey line indicates relative frequency for MRAC as a whole (10.68 per 1000 words).

Figure 6.2 shows the variation in relative frequency of [deny] in individual texts in MRAC, with values ranging from 6.39 to 21.87 instances per 1000 words (corpus as a whole: 10.68 instances per 1000 words). Potential “outliers” here include MRAC\_49, MRAC\_14, MRAC\_01, and MRAC\_06, with relative frequencies of 21.87, 20.62, 6.39, and 6.69 instances per 1000 words, respectively (see Figure 6.2). MRAC\_49 investigates heart disease, and includes the term (*heart*) *failure*, i.e. “the action or state of not functioning” (OED), 67 times, accounting for 51% (67/131) of all instances of [deny] in the article. MRAC\_14 compares incidence rates of myocardial infarction among diabetic and nondiabetic patients. The term *nondiabetic*

(where *non-* indicates “not of the kind or class described”; OED) accounts for 41% (30/74) of all instances of [deny] in the article. In contrast, MRAC\_01, which tests whether a particular treatment reduces mortality in patients with severe sepsis, contains relatively few instances of [deny], possibly because the results of the study confirm or support the main hypothesis that the treatment does reduce mortality rates (see section 6.2 for a generic-structural account of findings). Moreover, none of the main medical terms or keywords used in MRAC\_01 (e.g. *drotrecogin alpha*, *activated protein*, *sepsis*, *infusion*, and so on) contains morphologic or semantic negation à la *nondiabetic* or *heart failure*. Similarly, for MRAC\_06, the main hypothesis of the study—that “losartan would be more effective than  $\beta$ -blockade with atenolol in reducing cardiovascular morbidity and death in patients with essential hypertension and signs of LVH”—seems to be supported by the study’s findings. Moreover, like MRAC\_01, relatively few of the main medical terms or keywords in MRAC\_06 contain morphologic or semantic negation. Exceptions include *non-cardiovascular mortality* and *heart failure*.

In summary, [deny] is a frequently construed feature in MRAC (10.68 instances per 1000 words), although the range of relative frequencies of instantiation varies widely across individual research articles. The main verbal resources used to ‘deny’ or reject propositions (or semantic elements) are *not*, *no*, *non-*, and *un-*. While these forms of negation may differ in their relative strength and scope, they all act to close down the dialogic space for alternatives. They ‘deny’ or reject actual or potential propositions (or semantic elements), and they generally position the reader as being in alignment with the textual voice.

#### **6.1.1.1.2 Counter**

The [counter] feature signals that a particular proposition replaces, supplants, or ‘counters’ an otherwise expected claim or position (see section 3.1.2.1.1). Such formulations can construe complex interrelations between the textual voice and the reader. On the one hand, the ‘countering’ of an expected claim or position may conflict with the expectations, beliefs, or values of the reader, and therefore act to disalign the textual voice from its readership. On the other hand, the counterexpectancy may characterize



the supplanted proposition as “to some degree understandable or even logical since it is shown to be based on a not unreasonable expectation” (White 2003, 271); in such instances, [counter] generally serves to enhance solidarity between the textual voice and the reader (see Martin and White 2005, 120–121).

In MRAC as a whole, there are 1342 instances (RF 4.41 per 1000 words) of [counter]. The feature has a selection probability of 6.98% for [engagement], 7.43% for [heterogloss], and 29.20% for [disclaim] (see Figure 6.1).

According to the Stanford Parser, 40.99% of instances of [counter] are signalled by adverbs, 23.38% by prepositions, 22.58% by conjunctions, 7.85% by verbs, 4.48% by adjectives, and 0.64% by nouns.<sup>99</sup> The [counter] feature is most commonly signalled by *but*, *only*, *however*, and *although* (see examples (6.16)–(6.19)). These four realizations account for over half (57.07%) of all verbal encodings of [counter] in the corpus. For a full list of all 45 realization-types in MRAC, including their frequencies of occurrence and selection probabilities, see Table A4.

(6.16) In two patients who received intensive insulin therapy, hypoglycemia was associated with sweating and agitation, but there were no instances of hemodynamic deterioration or convulsions.

(MRAC\_46)

(6.17) Treatment was begun in the hospital for only 1.2 percent of patients.

(MRAC\_49)

(6.18) Prospective studies of the effect of strict blood glucose control in patients with type 1 or type 2 diabetes have not shown a reduction in mortality.<sup>45,46</sup> During pregnancy, however, this approach has been shown to prevent intrauterine and perinatal death.<sup>47</sup>

(MRAC\_46)

(6.19) Although dyslipidemia, diabetes, smoking, and hypertension are major risk factors for cardiovascular disease, they do not fully account for the risk.

(MRAC\_50)

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<sup>99</sup> The Stanford Parser classes the following items as prepositions: *although*, *despite*, *whereas*, *except*, *unless*, *while*, *though*, *albeit*, and *besides*. Based on their use in MRAC, only *despite*, *except (for)*, and *besides* are prepositions; the others are conjunctions.

Instances of [counter] are largely signalled by contrastive or adversative conjunctions and adverbs (see Table A4). However, a limited set of verbs, e.g. *remain*, *persist*, and *continue*, as well as the emphatic *do* auxiliary, also have a counterexpectant function, as can be seen in examples (6.20)–(6.22).

(6.20) Finally, bleeding and vascular complications and the prolonged hospitalization remain major drawbacks of stent implantation and continue to hamper its acceptance in clinical practice.

(MRAC\_36)

(6.21) The lower rate of CHD [coronary heart disease] in hormone users compared with nonusers persists after statistical adjustment for differences in CHD risk factors,<sup>22</sup> but differences in unmeasured factors remain a possible explanation.

(MRAC\_17)

(6.22) The WHI [Women’s Health Initiative] is the first randomized control trial to confirm that combined estrogen plus progestin does increase the risk of incident breast cancer and to quantify the degree of risk.

(MRAC\_34)

Other verbal resources used to construe [counter] in MRAC include *actual/actually*, *true*, and *in fact* (see Table A4). In (6.23), *actually* serves to ‘counter’ or contrast with “planned, intended, or expected treatment”. *Actual* and *true* are used in a similar manner, e.g. *actual treatment* and *true benefit*.

(6.23) When the data were analyzed according to the treatment actually received, pravastatin was found to have lowered plasma levels of cholesterol by 20 percent, LDL [low-density lipoprotein] cholesterol by 26 percent (Figure 1), and triglycerides by 12 percent, whereas HDL [high-density lipoprotein] cholesterol was increased by 5 percent.

(MRAC\_38)

Some of these same resources may also construe [pronounce] (see section 6.1.1.2.2). For example, in (6.24), *in fact* suggests both counterexpectation and a certain amount of author assertiveness (see similar example in Martin and White 2005, 106). The same might be said of *actually* in (6.23), especially in cases where it is used as a comment Adjunct (see (6.25) below).

(6.24) The ribavirin dose of 800 mg/day was selected because of concern that the higher dose of peginterferon alfa-2b might be associated with anaemia that would be additive to the anaemia associated with ribavirin. In fact, this did not occur, and perhaps a higher dose of ribavirin could have been used safely, as is suggested in our weight-based dosing analysis and profile.

(MRAC\_23)

(6.25) Within Finland, rates of coronary heart disease vary widely,<sup>23</sup> ranging from very high in eastern Finland (Kuopio) to lower in western Finland (Turku). In Turku, the rate of coronary heart disease in men is somewhat higher than that in men in the United States, whereas the rate of coronary heart disease in women in Turku is actually lower than that in women in the United States.<sup>23</sup>

(MRAC\_14)

Like the instantiations of [deny] discussed in 6.1.1.1.1, [counter] resources differ in scope. Some extend over one or more propositions or semantic sequences, as is frequently the case with formulations marked by *but* or *however* (see (6.16) and (6.18)). Others are restricted to semantic elements, as in the examples of *actual/actually* above.

The ‘countering’ resources in MRAC do not appear to disalign the textual voice from its readers. Many of the expectations that are ‘countered’ are set up text-internally, as part of the aims or methods of the studies. These expectations (often in the form of hypotheses) are meant to be tested—to be confirmed or overturned—by findings in the study. Such expectations are likely to be understood as “logical” or “reasonable” (cf. White 2003, 271), and their subsequent ‘countering’ is unlikely to construe disalignment or opposition. Logogenetic variations in the instantiation of the [counter] feature, and its potential to align or disalign readers with the textual voice in different stages and phases of the medical research article, are explored in more detail in section 6.2.

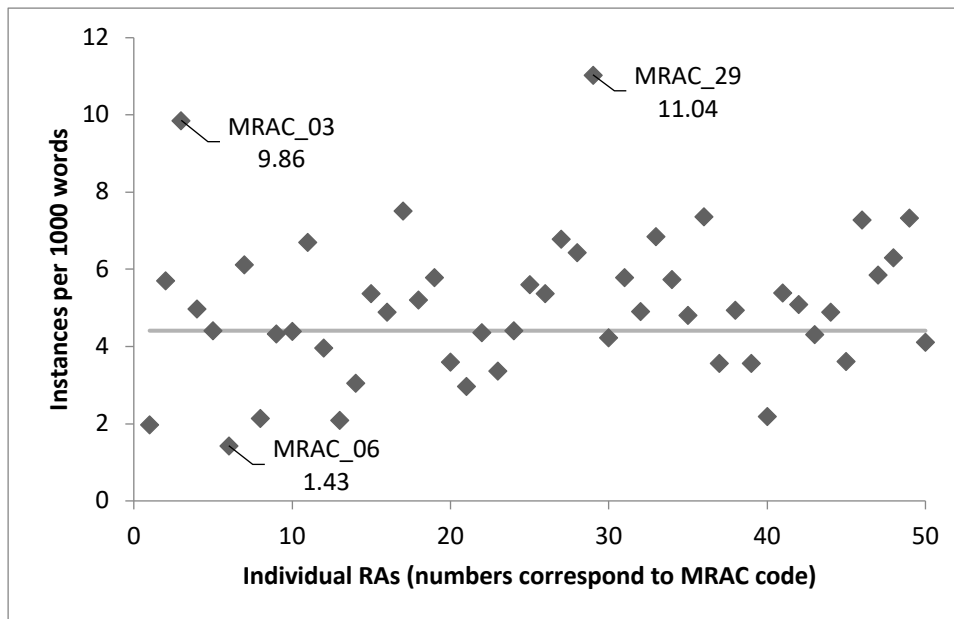


Figure 6.3. Instantiation of [counter] (relative frequency) per research article. Horizontal grey line indicates relative frequency for MRAC as a whole (4.41 per 1000 words).

Figure 6.3 shows variation in the relative frequency of [counter] for individual RAs in MRAC. Values range from 1.43 to 11.04 instances per 1000 words (corpus as a whole: 4.41 instances per 1000 words). Potential “outliers” include MRAC\_29, MRAC\_03, and MRAC\_06, with relative frequencies of 11.04, 9.86, and 1.43 instances per 1000 words, respectively (see Figure 6.3). MRAC\_29, a case-control study to explore “whether *H. pylori* infection increases the risk of gastric carcinoma”, contains almost two-and-a-half times the number of instantiations of [counter] as the MRAC average, including seven instances of *but* and six instances each of *although* and *however*. Most of those instances are found in the Introduction and Discussion sections of the article (see section 6.2 for more on logogenetic variability). Here, their main function is to highlight “a paucity of data in the existing research, or contradictory results in the literature” (Fryer 2012, 13), or to emphasize potential limitations in the study or possible contradictions in the interpretation of study findings (see examples (6.26) and (6.27) below).

- (6.26) Although the dramatic decline in the incidence of gastric carcinoma in the United States and Western Europe over the past 50 years has led some to proclaim an “unplanned triumph,”<sup>2</sup> in much of Latin America and Asia the incidence remains very high.<sup>3,4</sup>

(MRAC\_29)

- (6.27) The negative association with peptic ulcer disease, however, was unanticipated. In the light of the close association of H. pylori infection with both ulcer disease and gastric carcinoma, one would expect ulcer disease and gastric carcinoma to be directly, rather than inversely, related.

(MRAC\_29)

MRAC\_03 is a randomised controlled trial designed to test the effects of cholesterol-lowering medicine (simvastatin) among patients at risk of vascular disease. Like MRAC\_29, MRAC\_03 contains a large number of [counter] instantiations, especially [counter *but*] (n=23). The majority of these resources are deployed in the Results section, usually highlighting some contrastive or counterexpectational finding, e.g. ... *but this difference was not conventionally significant*.

Conversely, the number of instances of [counter] in MRAC\_06 is less than one-third of the MRAC average. MRAC\_06 investigates “whether selective blocking of angiotensin II improves LVH [left ventricular hypertrophy]” and “reduces cardiovascular morbidity and death”. The few instances of [counter] in MRAC\_06 (nine instances, encoded verbally by *however* ×2, *but* ×2, *despite* ×2, *only*, *still*, and *unless*) are concerned with specifying or clarifying certain methods and results (see example (6.28)) and reporting and discussing findings that deviate from the study’s hypotheses. However, unlike MRAC\_29 and MRAC as a whole, ‘countering’ as a means of highlighting limitations and contradictions is minimal in MRAC\_06, perhaps due to the relatively high level of agreement between the study’s hypotheses and its findings (see discussion of [deny] above).

- (6.28) Patients who underwent more than one endpoint event were counted as having had an event in all relevant endpoint analyses; however, only the first event in a specific category was counted in individual analyses.

(MRAC\_6)

With regard to [deny], it is worth noting, in general, its frequent co-occurrence with [counter]. Examples (6.16), (6.18), (6.19), (6.24), and (6.27) above illustrate a tendency in MRAC for those two features to be deployed together. In those examples, it is the ‘denied’ proposition (or semantic element) that is considered counterexpectational. Such [counter]

+ [deny] pairings are noted elsewhere (Martin and White 2005, 120), and their close semantic relation (as well as their close proximity) may explain why they are sometimes dealt with together under broader headings of ‘negation’ or ‘denial’ (e.g. Kress and Hodge 1979, 140 ff., Tottie 1987, 160).

In summary, [counter], while not as frequently instantiated as [deny] (1342 instances compared with 3254 instances), has a relatively high number of realization-types in MRAC (45 compared with 33 for [deny]) and a wide range in the frequency of instantiations across individual research articles. The main verbal resources used to construe [counter] are *but*, *only*, *however*, and *although*. Instances of [counter] are frequently coupled with [deny]. Like [deny], [counter] in MRAC generally functions to position the reader and textual voice as aligned.

### **6.1.1.2 Proclaim**

‘Proclaim’ allows the textual voice to emphasize its own position or other positions it considers maximally warrantable. There are 2322 instances of [proclaim] in MRAC (RF 7.62 per 1000 words). These instantiations account for 12.08% of all instances of [engagement], 12.86% of instances of [heterogloss], and 33.56% of instances of [contract] (see Figure 6.1). Within the PROCLAIM system, there are four main options: [concur], [pronounce], [endorse], and [justify].

#### **6.1.1.2.1 Concur**

The [concur] feature announces the textual voice as being in agreement with or sharing the same knowledge as some projected dialogic partner (White 2003, 269, Martin and White 2005, 122). More delicate options of [concur] act to [affirm] or [concede] a general point or position. Both generally construe solidarity between the textual voice and its readers, but, like other [proclaim] features, they convey a “heightened personal involvement” and imply a certain amount of interpersonal risk (White 2003, 269, and section 3.1.2.1.2).

There are 61 instances of [concur] in MRAC (RF 0.20 per 1000 words). The feature accounts for 0.32% of all instances of [engagement], 0.34% of [heterogloss], and 2.63% of instances of [proclaim]. All 61

occurrences are of the [concur: affirm] subtype; there are no instances of [concur: concede] (see Figure 6.1).

According to the Stanford Parser, 66.15% of instances of [concur: affirm] are signalled by adjectives, and 33.85% by adverbs. The most common of these are *clear*, *clearly*, *evident*, and *obvious*. Examples of these and the other two realization-types (*logical* and *inevitably*) are given in (6.29)–(6.34). The frequencies of occurrence and selection probabilities for these realizations are listed in Table A5 in the Appendix.

(6.29) Obesity clearly has an important role in sleep-disordered breathing.  
(MRAC\_48)

(6.30) The investigation of the effects of a small dose of acetylsalicylic acid versus placebo in treated patients with hypertension, as we did in this study, provide very clear evidence of a substantial beneficial action of acetylsalicylic acid on fatal and non-fatal acute myocardial infarctions [...].  
(MRAC\_16)

(6.31) This difference was evident in both the subgroup that received an anthracycline, cyclophosphamide, and trastuzumab [...] and the subgroup that received paclitaxel and trastuzumab [...].  
(MRAC\_39)

(6.32) However, it is obvious that treated patients with hypertension remain at a greater risk of developing cardiovascular complications than matched normotensive individuals.<sup>4 and 5</sup>  
(MRAC\_16)

(6.33) Previous trials tested the effect of lowering cholesterol levels in patients with hypercholesterolemia. This approach was logical, since the relation between blood cholesterol levels and coronary artery events is stronger, and rates of coronary events are greater, in patients with elevated, rather than average, values.<sup>1-4</sup>  
(MRAC\_35)

(6.34) This approach was considered most objective, but it inevitably reduced the APACHE II scores.<sup>27</sup>  
(MRAC\_46)

In all the above examples, the textual voice seems to ‘affirm’ a particular position or proposition, e.g. “that obesity has an important role in sleep-disordered breathing” in (6.29) or “that there was evidence of a substantial beneficial action of acetylsalicylic acid on fatal and non-fatal

acute myocardial infarctions” in (6.30). In example (6.33), *logical* is used in the sense of “natural or sensible given the circumstances” rather than “according to the rules of logic or formal argument” (OED). Like the other examples, (6.33) emphasizes a dialogic space in which the reader and textual voice seem to be aligned, a space in which they are construed as having “the same belief or attitude or ‘knowledge’” (White 2003, 269). In (6.33), substantiation is also provided, clarifying why such a position might be considered *logical* (see section 6.1.1.2.4 on [proclaim: justify]).

As noted above, there are no instances of [concede] in MRAC. This may not be surprising, given the potentially controversial or confrontational nature of concessions (see section 3.1.2.1.2). While [concur: affirm] generally construes a position of solidarity between the textual voice and reader, ‘concessions’ are often made grudgingly or with a sense of reluctance, according to Martin and White (2005, 124–125). Such formulations can construe alignment with the reader, but they are often a precursor for potentially less agreeable counter-positions (see example (3.5) in section 3.1.2.1). The following example, which is not from MRAC, may illustrate this point.

- (6.35) Second, such discussions could assist patients who are willing to trade off some chance of medical benefit for less financial distress. *Admittedly*, the trade-off between cost and potential benefit is complex and ethically charged. *Yet* when costs are not included in decision making, patients are deprived of the option, and patient engagement is harmed. Presenting this trade-off to patients makes clinical sense if we think of financial costs as treatment side effects.

(from *New England Journal of Medicine*, 2013, volume 369, “Perspective Article”)

Example (6.35), from an opinion piece in NEJM, contains a [concede] + [counter] pair, signalled by *admittedly* and *yet*, respectively. Here, the textual voice concedes that there are potential problems, but that those problems might be counterbalanced by certain benefits. No such pairings are found in MRAC, and the absence of [concur: concede] is likely a reflection of register and genre differences between medical research articles and opinion pieces (for more on genre, see section 6.2).



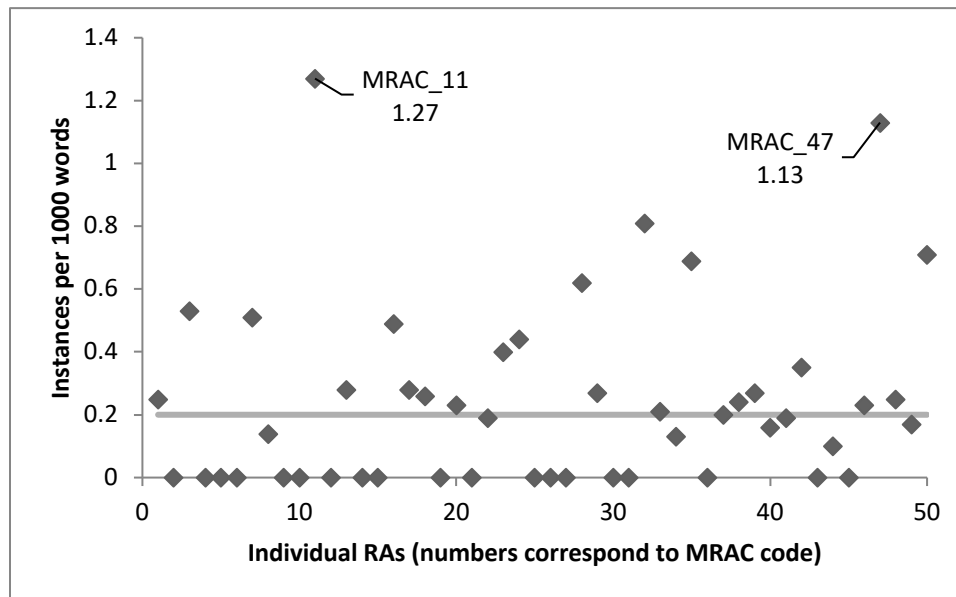


Figure 6.4. Instantiation of [concur] (relative frequency) per research article. Horizontal grey line indicates relative frequency for MRAC as a whole (0.20 per 1000 words).

Figure 6.4 shows variation in the relative frequency of [concur] for individual RAs in MRAC. Values range from 0 to 1.27 instances per 1000 words (corpus as a whole: 0.20 instances per 1000 words). Since there are so few instances across the corpus as a whole (19 of 50 RAs contain no instances of [concur] at all), it is difficult to identify and discuss potential outliers for the feature. The two RAs that contribute most, however, MRAC\_11 and MRAC\_47, contain seven and five instances of [concur], respectively, all of which are realized lexicographically by *clear* or *clearly*. MRAC\_11 examines changes in the prevalence of obesity among US adults and MRAC\_47 investigates the possible relation between tumour angiogenesis (the development of blood vessels in tumours) and metastasis among patients with breast cancer. In these articles, [concur *clear*] and [concur *clearly*] generally function to add emphasis to conclusive or inconclusive findings, pairing in the latter case with [deny], e.g. *the increase in the prevalence of obesity is clear* (MRAC\_11) and *whether capillaries will grow or not grow toward a tumor may depend on one or more events that are not clearly understood at this time* (MRAC\_47).

In summary, of the 61 instances of [concur] in MRAC, all 61 are of the [concur: affirm] subtype; there are no instantiations of [concur: concede]. Only 31 of 50 RAs appear to use [concur] as an [engagement]

resource. In addition to relatively few instances, the [concur] feature has relatively few realization-types (n=6) in the corpus, compared with other low-frequency [engagement] features such as [pronounce] (n=25; see 6.1.1.2.2). All instances of [concur] in the corpus suggest a ‘heteroglossic’ relation of alignment between the textual voice and putative reader.

#### 6.1.1.2.2 Pronounce

The [pronounce] feature allows the textual voice to add explicit, subjective emphasis to propositions that are “directed against some assumed or directly referenced counter position” (Martin and White 2005, 129). Such ‘pronouncements’ reduce the space for dialogic diversity and may increase the interpersonal risk of disalignment with putative readers (see section 3.1.2.1).

In MRAC as a whole, there are 70 instances of [pronounce] (relative frequency 0.23 per 1000 words). The feature accounts for 0.36% of all recorded instances of [engagement], 0.39% of [heterogloss], and 3.02% of [proclaim] (see Figure 6.1).

Of the instances of [pronounce] in MRAC, 53.19% are signalled by adverbs, 23.40% by verbs, 19.15% by adjectives, and 4.26% by nouns, according to the Stanford Parser. The [pronounce] feature is most commonly realized by the adverb *indeed*, by “fact clauses” serving as Qualifiers of the noun *fact* (Halliday & Matthiessen 2004, 470 ff.), by postposed clauses with Carrier *to note...* and Attribute *important* (and variants containing the noun *note* and the adjective *noteworthy*), and by the prepositional phrase *in fact*. Examples of these are provided in (6.36)–(6.39), respectively. For frequencies of occurrence and selection probabilities for all 19 realization-types, see Table A6 in the Appendix.

- (6.36) The initial rationale for our study was the hypothesis that the attenuation of ventricular enlargement would result in clinical benefit. A quantitative echocardiographic study in a subgroup of the study patients was designed to determine whether the proposed benefit of captopril therapy in terms of clinical outcome could be attributed to such an attenuation. Ventricular size, quantitated as the echocardiographically determined area of the chamber in either systole or diastole, at base line, was indeed the most powerful independent predictor of adverse cardiovascular outcome.<sup>31</sup>

(MRAC\_30)

(6.37) In the two multicenter studies,<sup>19,20</sup> treatment with metoprolol or bisoprolol did not significantly decrease the risk of death. One of the trials retrospectively noted a reduction in mortality only among patients with nonischemic dilated cardiomyopathy.<sup>20</sup> In contrast, in our study, carvedilol therapy was associated with a decrease in mortality, and the benefits of the drug were apparent in all the subgroups we examined, including patients with underlying ischemic heart disease. The fact that two earlier multicenter studies did not find an effect on survival may have been related to the sample sizes, to the study designs, or to chance.

(MRAC\_27)

(6.38) These cutoff points are widely used to describe sleep apnea, but it is important to note that the clinical importance of any particular cutoff point has not been adequately determined.

(MRAC\_48)

(6.39) The ribavirin dose of 800 mg/day was selected because of concern that the higher dose of peginterferon alfa-2b might be associated with anaemia that would be additive to the anaemia associated with ribavirin. In fact, this did not occur, and perhaps a higher dose of ribavirin could have been used safely, as is suggested in our weight-based dosing analysis and profile.

(MRAC\_23)

In MRAC, most ‘pronouncements’ are directed towards counter-positions that are explicitly ‘denied’—polar-negative clauses such as *the clinical importance of any particular cutoff point has not been adequately determined* or *this did not occur* (see examples (6.38) and (6.39) above). Only *indeed* is consistently, in all 11 of its occurrences, directed towards polar-positive clauses (see example (6.36)).

Other lexicogrammatical realizations of [pronounce] include the adjective *true* (e.g. *this was especially true for combination regimens that included protease inhibitors*; MRAC\_28; cf. section 6.1.1.1.2), as well as the verbs *emphasize* (e.g. *it must be emphasized, however, that...*; MRAC\_27), *merit* (*several mechanisms merit discussion*; MRAC\_06), and *deserve* (*four patients deserve special emphasis*; MRAC\_47). All of these instances act in various ways to add particular emphasis to propositions that are directed towards perceived counter-positions.

The counter-positions emphasized by the textual voice frequently ‘counter’ text-internal propositions such as hypotheses, which are unlikely to construe disalignment (see section 6.1.1.1.2 above). Even in cases

where the counter-position can be construed as text-external, as in (6.37), the ‘pronouncement’ is so carefully negotiated that disalignment with the reader or a third-party (*two earlier multicenter studies*) is highly unlikely.

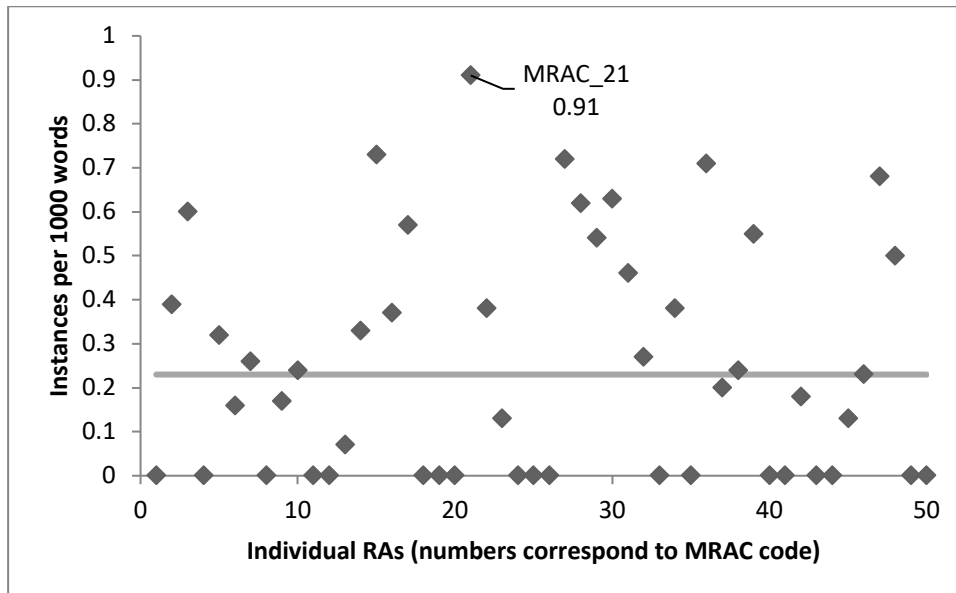


Figure 6.5. Instantiation of [pronounce] (relative frequency) per research article. Horizontal grey line indicates relative frequency for MRAC as a whole (0.23 per 1000 words).

Figure 6.5 shows variation in the relative frequency of [pronounce] for individual RAs in MRAC. Values range from 0 to 0.91 instances per 1000 words (corpus as a whole: 0.23 instances per 1000 words). Like [concur], [pronounce] has relatively few instantiations, and 19 of 50 RAs contain no selections of the feature.<sup>100</sup> MRAC\_21 contains the most instances of [pronounce], with four occurrences. The article compares the possible protective effects of two medications on the progression of kidney disease caused by type 2 diabetes mellitus. ‘Pronouncements’ vary, but all are paired with [counter] and/or [deny] and all attempt to highlight some aspect of importance or noteworthiness.

In summary, [pronounce] is a low-frequency feature in MRAC, occurring only 70 times. The realization-types of [pronounce], however, are more diverse than those of the almost-equally-low-frequency [concur] feature (see section 6.1.1.2.1). When they do appear, ‘pronouncements’

<sup>100</sup> These 19 RAs are not the same 19 as those that do not contain [concur]. Only six RAs contain neither [pronounce] nor [concur]: MRAC\_4, MRAC\_12, MRAC\_19, MRAC\_25, MRAC\_26, and MRAC\_43.

are often part of [pronounce] + [counter] pairings. The generally high interpersonal risk associated with ‘pronouncements’ may explain their relatively low occurrence in MRAC.

### 6.1.1.2.3 Endorse

The [endorse] feature allows the textual voice to construe a particular position as being “correct, valid, undeniable or otherwise maximally warrantable” (Martin and White 2005, 126). ‘Endorsements’ restrict the dialogic space for alternatives and, according to Martin and White (2005, 127), generally act to align the addressee with the position advanced by the textual voice (see section 3.1.2.1.2).

There are 1200 instances of [endorse] in MRAC (relative frequency 3.94 per 1000 words). The feature accounts for 6.24% of all recorded instances of [engagement], 6.65% of [heterogloss], and 51.70% of [proclaim] (see Figure 6.1).

According to the Stanford Parser, 67.87% of instances of [endorse] are signalled by verbs, 26.19% by nouns, 5.85% by adjectives, and 0.08% (one instance) by adverbs. The [endorse] feature has 48 realization-types in MRAC, the most common of which are the verbs *show*, *indicate*, *find*, *determine*, *demonstrate*, and *confirm*, and the nouns *finding* and *evidence*, examples of which are given in (6.40)–(6.47). These eight realization-types account for 68.42% of all realizations of [endorse] in MRAC. For frequencies of occurrence, selection probabilities, and examples for all 48 realization-types, see Table A7 in the Appendix.

(6.40) Previous preclinical and clinical studies showed that the administration of activated protein C may improve the outcome of severe sepsis.

(MRAC\_01)

(6.41) This issue is particularly intriguing because recent data from the Cholesterol and Recurrent Events trial indicate that long term therapy with pravastatin significantly lowers plasma levels of hs-CRP [high-sensitivity C-reactive protein]<sup>21</sup> and that the efficacy of pravastatin in lowering the rate of cardiovascular events is greatest in those with increased levels of hs-CRP.<sup>22</sup>

(MRAC\_33)

- (6.42) However, follow-up studies have found that levels of hs-CRP are stable over long periods, as long as measurements are not made within two to three weeks of an acute infection.<sup>21,23</sup>  
(MRAC\_32)
- (6.43) In May 1997, after the data and safety monitoring committee determined that the prespecified boundary for a difference in overall mortality had been crossed, all patients were advised that the study would end.  
(MRAC\_42)
- (6.44) Animal models of retroviral infection demonstrate that zidovudine may prevent or alter the course of maternally transmitted HIV infection<sup>12-16</sup>.  
(MRAC\_04)
- (6.45) Data from a survey in 1994<sup>2</sup> and a public opinion poll in 1997<sup>3</sup> confirmed the extensive use of alternative medical therapies in the United States.  
(MRAC\_09)
- (6.46) The finding of an increased risk after initiation of treatment in WHI [the Women's Health Initiative] is similar to HERS [Heart and Estrogen/Progestin Replacement Study].  
(MRAC\_34)
- (6.47) The results from previous studies in Sweden<sup>17</sup> and China<sup>18</sup> also provide evidence that changes in lifestyle are effective in preventing diabetes, and the magnitude of the benefit in these studies was similar to that in our study.  
(MRAC\_43)

Most of the 48 realization types for [endorse] can be considered in terms of two broad categories: 1) verbs such as *find*, *show*, *indicate*, and *demonstrate*, which, experientially, construe mental or relational processes of identification (Halliday and Matthiessen 2004, 197–248), and 2) nouns that, for the most part, are nominalizations of those verbs, reconfigured experientially as participants in other processes (see section 2.2.1.3 on grammatical metaphor). Examples of these can be seen in (6.42) and (6.46) for *find* and *finding*, respectively. Similar verb–noun pairs, such as *indicate–indication*, *demonstrate–demonstration*, and *confirm–confirmation*, are found in MRAC. In these and most other cases, the more congruent verb form (Halliday 1994, Halliday and Matthiessen 2004 chapter 10) is most commonly used to construe ‘endorsement’ (see Table A7). The only exceptions are the choices of the nouns *evidence* and *contraindication* (see (6.47) and Table A7) rather than the verbs *evidence*

and *contraindicate*.<sup>101</sup> *Adjudicate* and *adjudication* occur with approximately equal frequency, but a second nominal form, *adjudicator*, is also found (see Table A7).

Other realizations of [endorse] are primarily past-participle adjectives functioning as Epithets or Heads in adjectival/nominal groups. Examples are provided below in (6.48) and (6.49).

(6.48) Clinically established coronary heart disease itself is associated with an increase in mortality from coronary heart disease by a factor of three to seven, depending on the mode of presentation.<sup>5,6</sup>

(MRAC\_14)

(6.49) The magnitude of the benefit of treatment with ramipril with respect to the primary outcome was at least as large as that observed with other proven secondary prevention measures, such as treatment with beta-blockers,<sup>8</sup> aspirin,<sup>9</sup> and lipid-lowering agents,<sup>10</sup> during four years of treatment.

(MRAC\_50)

In (6.48) and (6.49), *established* and *proven* serve to validate or ‘endorse’ diagnoses of coronary heart disease and certain secondary prevention measures, respectively. These ‘endorsements,’ however, are restricted to semantic elements and thus have reduced scope or strength compared with propositional equivalents such as “coronary heart disease was established clinically” or “secondary prevention measures have been proven to have benefits”. Like the morphologic or local negation discussed in 6.1.1.1.1, these ‘local endorsements’ may have reduced arguability compared with their clausal or propositional counterparts. While ‘local endorsements’ themselves may not be at stake, they add to the overall warrantability of what are otherwise bare assertions or ‘monoglossic’

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<sup>101</sup> *Evidence* as a verb is generally rare in written and spoken registers of English, e.g. *as evidenced by the similar numbers of patients in the two groups* (MRAC\_02). According to figures from the BNC and COCA, *evidence* as noun has a relative frequency of 218.66 and 162.67 per million words, respectively, more than 80 times that of *evidence* as verb (relative frequency 2.07 and 4.39 per million words, respectively). This difference becomes more pronounced in the academic subcorpora of the BNC and COCA, i.e. 569.74 and 286.21 per million words, respectively, for the noun form, and 5.61 and 14.15 per million words, respectively, for the verb form. Note that the adjective form, *evident*, is used to [affirm] rather than [endorse] propositions (see section 6.1.1.2.1 and Table A5). Similarly, *contraindicate* is less frequent than *contraindication* in both the BNC and COCA.

utterances (see section 6.1.3). If, as suggested by Martin and White (2005, 127), [proclaim: endorse] generally serves to align the addressee with the position or proposition advanced by the textual voice, ‘local endorsements’ (like ‘local negation’) are likely to augment this effect.

Attributive Complements can also be used to construe ‘endorsement’. In (6.50), *known* signals that the proposition “angiotensin-converting-enzyme inhibitors decrease urinary protein excretion in patients with diabetes and other glomerulopathies” is undeniable or maximally warrantable (Martin and White 2005, 126). Support for this is ‘acknowledged’ or further ‘endorsed’ (Coffin 2009, 174) by a series of numerical references, indicated by superscript 31-33 (see section 6.1.2.2.1). In (6.51), what is undeniable is the lack of knowledge of “the exact mechanism responsible for the improved response that occurs when ribavirin is combined with interferon”. Note, here, the combination of [deny] and [endorse] (“un-known” ≈ “not known”; cf. Quirk et al. 1985, 776), as well as the lack of support or ‘acknowledgment’ for such a statement, and how that contrasts with previous statements in the same excerpt (for more on the interaction of [engagement] features, see section 6.1.4).

(6.50) Angiotensin-converting-enzyme inhibitors are known to decrease urinary protein excretion in patients with diabetes and other glomerulopathies<sup>31-33</sup>.  
(MRAC\_21)

(6.51) Ribavirin has been postulated to inhibit viral-dependent RNA polymerase, the capping structure of viral messenger RNA, and inosine monophosphate dehydrogenase.<sup>31</sup> Other immunomodulatory actions may also contribute to the drug’s beneficial effects.<sup>35</sup> Despite these potential actions, the exact mechanism responsible for the improved response that occurs when ribavirin is combined with interferon is unknown.  
(MRAC\_25)

All the above examples, perhaps with the exception of (6.51), ‘endorse’ externally sourced propositions.<sup>102</sup> Those sources include research

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<sup>102</sup> In some examples, e.g. (6.48) and (6.49), those propositions may have to be “unpacked” (see section 2.2.1.3 on grammatical metaphor). In the case of (6.51), while no specific source is given, what is being ‘endorsed’ is a proposition that will likely be understood as external to the text, i.e. one directed towards the medico-scientific community in general.



groups, studies, or the findings from those studies, e.g. *previous preclinical and clinical studies* or *recent data from the Cholesterol and Recurrent Events trial* (see examples (6.40) and (6.41) above). However, in MRAC, a second set of ‘endorsements’ appears to refer to internally sourced propositions, i.e. those of the textual voice. The resources used for text-internal ‘endorsements’ are similar to those used for text-external ‘endorsements’, e.g. *find, show, demonstrate, etc.*, although the two types of ‘endorsement’ are distributed differently across texts (see section 6.2 for further discussion). Text-internal ‘endorsements’ refer to the research group, the study, or the authors themselves, as can be seen in examples (6.52)–(6.54) below. Approximately one-third of ‘endorsements’ in MRAC are of this text-internal type (relative frequency 1.25 per 1000 words); the remaining two-thirds are externally sourced (relative frequency 2.60 per 1000 words).

(6.52) We found that treatment with spironolactone reduced the risk of death from all causes, death from cardiac causes, hospitalization for cardiac causes, and the combined end point of death from cardiac causes or hospitalization for cardiac causes among patients who had severe heart failure as a result of left ventricular systolic dysfunction and who were receiving standard therapy including an ACE inhibitor.

(MRAC\_31)

(6.53) Like the Coronary Angioplasty versus Excisional Atherectomy Trial (CAVEAT),<sup>7</sup> our study shows that the most important determinant of the luminal diameter at six months was the luminal diameter achieved immediately after the procedure.

(MRAC\_10)

(6.54) Our findings clearly demonstrate that ramipril, a long-acting angiotensin-converting-enzyme inhibitor, reduces the rates of death, myocardial infarction, stroke, revascularization, cardiac arrest, heart failure, complications related to diabetes, and new cases of diabetes in a broad spectrum of high-risk patients. Treating 1000 patients with ramipril for four years prevents about 150 events in approximately 70 patients.

(MRAC\_50)

‘Endorsements’ explicitly construe the textual voice as being in alignment with some external (or possibly internal) dialogic partner, and the examples above are no exception. However, like [pronounce], [endorse] implies a certain interpersonal risk. Readers may disagree with what has

been *shown*, *demonstrated*, or *proven* by others. This potential for disagreement or disalignment, however, can be negotiated through the use of other [engagement] resources. For example, in (6.44) above, and in (6.55) below, the ‘endorsement’ is tempered or mitigated by resources (*may* and *in general*) that present the proposition as being one among a number of possible alternatives (see section 6.1.2.1 on [expand: entertain]).

- (6.55) Previous studies with interferon alfa-2b plus ribavirin have shown that, in general, if patients do not respond by treatment week 24, an SVR will not be achieved; a similar pattern is observed with peginterferon alfa-2b plus ribavirin. (MRAC\_23)

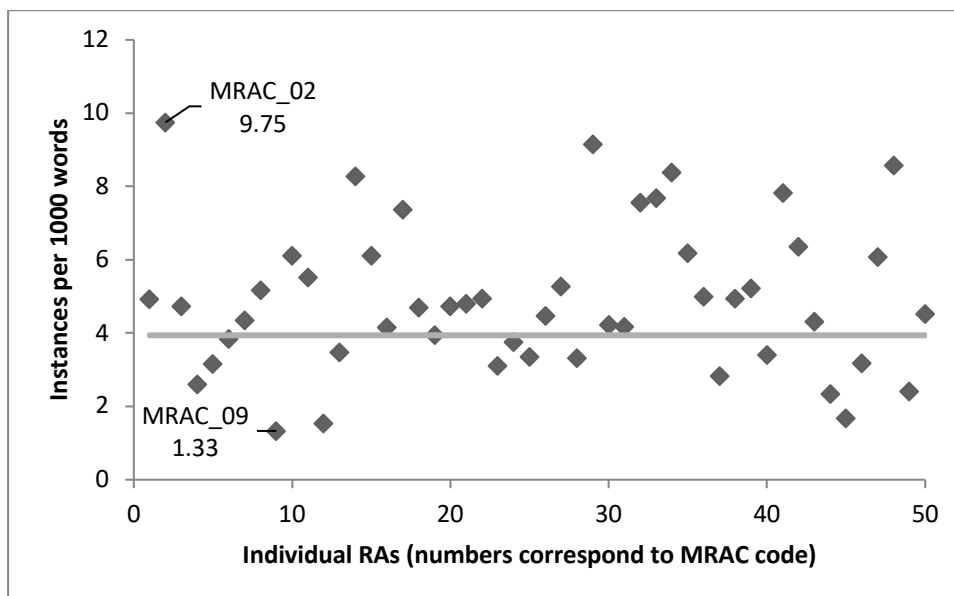


Figure 6.6. Instantiation of [endorse] (relative frequency) per research article. Horizontal grey line indicates relative frequency for MRAC as a whole (3.94 per 1000 words).

Figure 6.6 shows variation in the relative frequency of [endorse] for individual RAs in MRAC. Values range from 1.33 to 9.75 instances per 1000 words (corpus as a whole: 3.94 instances per 1000 words). There are no obvious “outliers” in Figure 6.6, compared with the distributions in Figures 6.2 and 6.3, but MRAC\_02 and MRAC\_09 represent the outer limits of variability across the corpus. MRAC\_02 is a transnational multicentre randomised control trial on the effects of a particular drug (losartan) on patients with type-2 diabetes and nephropathy (kidney disease). It contains a high relative frequency of text-external ‘endorsements’

compared with MRAC as a whole (7.02 vs. 2.60 instances per 1000 words, respectively), the majority of which are found in the article’s Discussion section, which contains an extensive comparison with the literature.<sup>103</sup> In contrast, MRAC\_09 is a national survey on the use and cost of complementary and alternative medicine in the United States. Its low relative frequency of both text-internal and text-external ‘endorsements’ (0.77 and 1.29 instances per 1000 words, respectively) might be related to study-type. Data from MRAC\_09 are based on self-reporting methods by patients, and the authors are careful not to ‘endorse’ or claim high validity or warrantability for the results of their own or comparative works, partly it seems because of the potential limitations of conducting this type of study.

In summary, [endorse] is a frequently instantiated feature in MRAC, with a wide range of realization types—wider, in fact, than those of the [deny] and [counter] features (see 6.1.1.1). Most instances of ‘endorsement’, both text-external and text-internal, are realized by reporting verbs and their nominalized forms, most typically *show*, *find*, and *demonstrate*. While ‘endorsements’ imply a certain interpersonal risk—and could lead to disalignment between the textual voice and the reader—this potential risk is frequently mitigated by more dialogically ‘expansive’ resources, thus (overall at least) allying the different voices and positions at play in the discourse.

#### **6.1.1.2.4 Justify**

The [justify] feature presents the textual voice as arguing for or substantiating a particular position, one that may be deemed contentious if left unsupported. It acknowledges or anticipates an addressee whose position may not be aligned with the textual voice, and it attempts to persuade or “win over those who might be dubious or resistant” to certain claims (White 2012, 64).

There are 990 instances of [justify] in MRAC (relative frequency 3.25 per 1000 words). The feature accounts for 5.15% of all recorded instances

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<sup>103</sup> The relative frequency of ‘endorsements’ in the Discussion section of MRAC\_02 is 18.29 instances per 1000 words.

of [engagement], 5.48% of [heterogloss], 14.31% of [contract], and 42.65% of [proclaim] (see Figure 6.1).

According to the Stanford Parser, 36.87% of instances of [justify] are introduced by prepositions, 32.72% by the infinitive marker *to*, 19.12% by adverbs, 6.34% by nouns, 4.38% by verbs, and 0.58% by adjectives.<sup>104</sup> The [justify] feature is most commonly encoded by finite or non-finite adverbial clauses of reason, typically introduced by the infinitive marker *to* or by the conjunctions *because* or *since* (see Table A8 in the Appendix). These hypotactic clauses function, dialogically, to ‘justify’ or clarify the reason(s) or purpose(s) for the claim(s) made in the main clause. Examples are provided in (6.56)–(6.58) below. A full list of all 27 realization-types, ordered according to frequency of occurrence and selection probability, is provided in Table A8.

(6.56) Data from longitudinal studies of asymptomatic, untreated sleep-disordered breathing are needed to determine its progression, acute and chronic pathophysiologic sequelae, and other vital aspects of its natural history.

(MRAC\_48)

(6.57) We chose to study a regimen that combined antepartum, intrapartum, and neonatal therapy, because the timing of maternal-infant HIV transmission is uncertain.

(MRAC\_4)

(6.58) An increase in atherosclerosis with insulin treatment has also been suggested, since plasma insulin concentrations are supraphysiological.<sup>11 and 12</sup>

(MRAC\_50)

Prepositional phrases are used in a similar way to hypotactic clauses, as circumstantial Adjuncts of reason. In (6.59), for example, the compound preposition *because of* indicates a reason or ‘justification’ for stratification. Similarly, in (6.60), the prepositional phrase *as a result* highlights the reasons (encoded in a series of preceding clauses) for the study’s short and fixed follow-up period.

(6.59) Because of the factorial design, all analyses were stratified for the randomization to vitamin E or placebo.

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<sup>104</sup> Many of the words categorized as prepositions by the parser are actually used as conjunctions, e.g. *as*, *because*, *since*, and *so*.

(MRAC\_50)

(6.60) Our findings should be interpreted with the knowledge that the trial program had several unusual characteristics for a study of the effect of a drug on survival. Most such trials are designed as long-term studies in which nonfatal events are considered to be secondary end points. In our program, however, the individual protocols were designed first to evaluate nonfatal end points as components of a single stratified trial program, and then mortality was specified a priori to assess safety and potential benefit. As a result, the duration of follow-up was short and fixed.

(MRAC\_27)

Example (6.59) above demonstrates the close relation between prepositional phrases and clauses. For Halliday and Matthiessen (2004, 311), prepositional phrases are different from nominal groups, verb groups, adjective groups, and adverb groups in that, “whereas a group is an expansion of a word, a phrase is a contraction of a clause”. In (6.59), *because of the factorial design* might be considered a contracted form of “because we chose a factorial design” or “because factorial design requires it”. Similarly, in (6.57) above, *because the timing of maternal-infant HIV transmission is uncertain* could be contracted to read “because of the uncertain timing of maternal-infant HIV transmission”. All of these examples encode ‘justification’, but they do so at different levels on the rank scale (see section 2.2.1.1.5). Like the examples discussed in 6.1.1.1.1 and 6.1.1.2.3, prepositional phrases of this kind not only take up less space than their clausal equivalents; they also reduce, dialogically speaking, the arguability of the ‘justification’. By encoding this position as a semantic figure rather than as a move or proposition, the risk of disalignment may be reduced, since the ‘justification’ itself is not what is at stake in the exchange.

Conjunct-adverbs like *therefore* and *thus* are also common markers of the [justify] feature. In example (6.61), *therefore* highlights the reason or ‘justification’ for conducting the study. Similarly, in (6.62), *thus* highlights why only past information was used. Note that this latter example also includes two instances of *since*. Only the first, the subordinating conjunction *since*, suggests ‘justification’, however.

(6.61) This therapy exposes the patient to an increased risk of major bleeding and vascular complications, which may prolong the hospital stay<sup>7</sup>. Despite these drawbacks and although the superiority of stent implantation over standard balloon angioplasty has not yet been proved, stenting has been used increasingly. Therefore, we conducted a multicenter, randomized study comparing stent implantation and balloon angioplasty with respect to their safety and efficacy in patients with stable angina pectoris and a single new lesion in a coronary artery.

(MRAC\_36)

(6.62) A time-dependent model—ie, a model updated in its covariates—was used. Since the model updated past mean of blood pressure, the time since randomisation, and the age every 6 months, no future information was used to analyse prospective event rate. Thus, only appropriate past information was used in estimation of curves and confidence bands.

(MRAC\_16)

As White (2003: 274) notes, ‘justifications’ are not always signalled explicitly—or at least not verbally. In (6.63), for example, the reason or ‘justification’ for the surprise is encoded in a clause-complex following a semicolon. The exact relation between the first clause in the sentence and the orthographically demarcated clause-complex is not indicated verbally, for example by *because* or *since*, but the kind of expansion and enhancement it construes is still easily understood (cf. Halliday and Matthiessen 2004: 423–426).

(6.63) The increased incidence of breast cancer in patients given pravastatin was surprising; it has not been reported in previous or ongoing trials with pravastatin or other related drugs, and testing in animals has not identified breast cancer as one that is increased by such therapy.

(MRAC\_35)

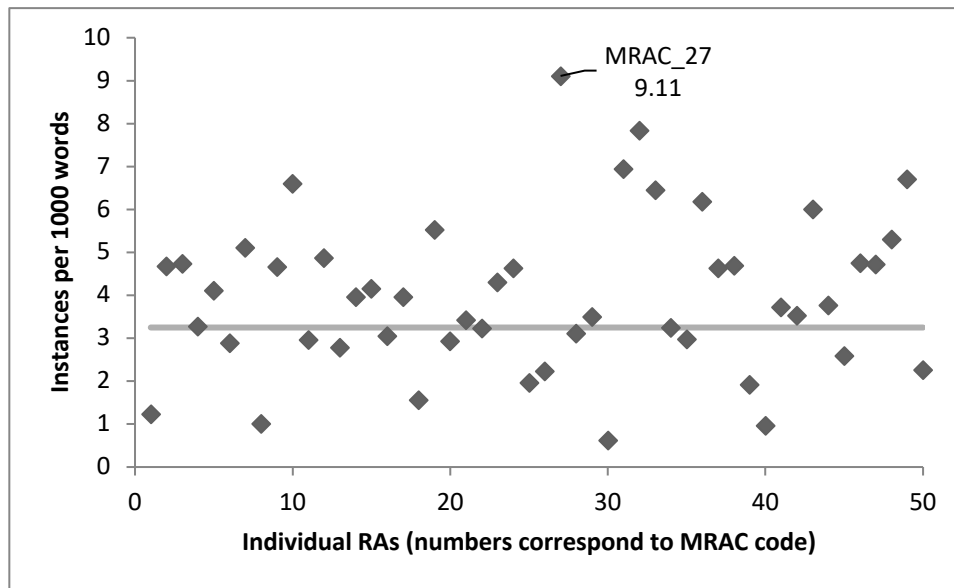


Figure 6.7. Instantiation of [justify] (relative frequency) per research article. Horizontal grey line indicates relative frequency for MRAC as a whole (3.25 per 1000 words).

Figure 6.7 shows variation in the relative frequency of [justify] for individual RAs in MRAC. Values range from 0.63 to 9.11 instances per 1000 words (corpus as a whole: 3.25 instances per 1000 words). A possible outlier here is MRAC\_27 (9.11 instances per 1000 words). This RA reports on a randomized controlled trial that investigates the effects of the beta-blocker carvedilol on rates of morbidity and mortality among patients with chronic heart failure. Many of the ‘justifications’ in MRAC\_27 refer to patients leaving the study due to poor or deteriorating health and to termination of the study because of marked differences in survival rates between the control and test groups. (Those in the test group showed much better rates of survival.) In addition to high relative frequencies of the infinitive marker *to* and the conjunctions *because* and *since* (see comments at start of section), MRAC\_27 contains seven instances of the noun *reason(s)*—a relatively common realization-type in MRAC as a whole (38 instances; see Table A8). An example is given below, in (6.64), in which “the cause, explanation, or justification for an action or event” (OED) is made explicit.

- (6.64) As a result of these discussions, an evaluation of mortality was prospectively defined for the present stratified trial program, primarily for reasons of safety, with the intent to enroll 1101 patients.

(MRAC\_27)

In summary, [justify] is a frequently instantiated feature in MRAC, indicated by a diverse set of explicit lexicogrammatical resources. The reasons for providing ‘justifications’ vary, but many of the instances described above seem to play an important role in construing for the text a sense of openness and accountability. Whether or not readers are “dubious or resistant” to claims made in the text (cf. White 2012, 64), ‘justifications’ in MRAC can be partly seen as a response to the sceptical reader and an attempt to convey some kind of scientific credibility. They play an important role in aligning the textual voice and the reader.

### **6.1.2 Heterogloss: Expand**

Dialogically ‘expansive’ resources serve to ‘expand’ or open up the dialogic space for alternative voices and propositions in the discourse (see section 3.1.2.2). In MRAC, those resources account for almost two-thirds of all instances of verbal and mathematical [heterogloss] (11,135/18,053 instances; 61.68%), occurring at a relative frequency of 36.56 instances per 1000 words (see Figure 6.1). In sections 6.1.2.1 and 6.1.2.2, I present findings for the [entertain] and [acknowledge] subtypes of [engage: expand] and more delicate categories within those features.

#### **6.1.2.1 Entertain**

The [entertain] option indicates that the viewpoint or proposition construed by the textual voice is overtly subjective, and thus one among a number of possible alternatives. In opening up the dialogic space for those alternatives, [entertain] generally construes solidarity between the textual voice and putative reader, even if their positions differ or appear to be at odds (see section 3.1.2.2.1).

‘Entertain’ is the most commonly instantiated [engagement] feature in MRAC (n=8986, RF 29.50 instances per 1000 words). It accounts for 46.76% of all recorded instances of verbal and mathematical [engagement], 49.78% of [heterogloss], and 80.71% of [expand] (see Figure 6.1).

According to the Stanford Parser, 39.83% of instances of [entertain] are signalled or realized by nouns, 25.45% by verbs, 20.63% by adjectives, 5.87% by prepositions, 5.29% by adverbs, 1.51% by *wh*- words, 0.72% by



determiners, and the remainder by “other”.<sup>105</sup> The [entertain] feature is most commonly realized by the noun *risk*, the mathematical symbol *p* (*p*-value), and the modal auxiliary *may* (see examples (6.65) and (6.66) below).<sup>106</sup> For a full list of all 233 realization-types in MRAC, including frequencies of occurrence, selection probabilities, and examples, see Table A9.

(6.65) The risk of albuminuria was reduced by 56 percent (p = 0.01) in the secondary-intervention cohort.

(MRAC\_37)

(6.66) These infections may have occurred as a result of (1) HIV transmission before treatment, (2) inefficient suppression of maternal viral replication by zidovudine, (3) noncompliance with the treatment regimen, or (4) unique characteristics of the infecting maternal strain of HIV, such as decreased susceptibility to zidovudine.

(MRAC\_04)

While typical realizations of [entertain] are lexicogrammatical features associated with modality, hedging, and evidentiality (see sections 3.1.2.2 and 4.2.3, and Table A9), it is notable that the two most common realizations in MRAC are mathematical-verbal (*risk*) and mathematical-symbolic (*p*). *Risk*, in the sense of “a possibility of harm or damage” or “the possibility that something unpleasant or unwelcome will happen” (OED), is a statistically quantifiable entity in MRAC. In other words, it not only encodes the meaning of possibility; it also numerically scales that meaning. Considered dialogically, *risk* ‘entertains’ the extent to which some outcome or endpoint is likely, and therefore also unlikely. While this may not ground “the proposition in the contingent, individual subjectivity of the speaker/writer” (Martin and White 2005, 105)—but in some form of mathematical objectivity—it still ‘entertains’ the possibility of dialogic alternatives in the discourse, albeit in a potentially narrower sense than,

<sup>105</sup> The Stanford Parser categorizes *if* and *whether* as prepositions, but they are all conjunctions in MRAC. The parser also categorizes *when* as a *wh*-word, but all instances in MRAC are conjunctions. The category “other” includes the abbreviation *e.g./eg* (*exempli gratia*, “for the sake of example”, OED). Another category, not listed above, is that of “punctuation”, which includes eight question marks (see sections 3.1.2.2 and 4.2.3.2 regarding the dialogic function of questions).

<sup>106</sup> In (6.66), *such as* also encodes [entertain] (see Table A9 as well as example (6.71)).

say, “albuminuria was less likely to occur in the secondary-intervention group” (cf. example (6.65)). The quantifiable possibility expressed by *risk* (or related terms such as *relative risk* or *risk factor*) is exemplified in (6.67) below.

(6.67) The relative risk was 0.78 in the second year, 0.73 in the third year, and 0.74 in the fourth year, when the data on patients who were still alive at the end of the preceding year were analyzed.

(MRAC\_50)

Likewise, the dialogic expansion construed by *p* (or *p*-value), a statistical measure of the probability of some effect being due to chance, is narrower than that of, say, “the probability of this effect being one of chance is very low”. This narrowing seems to be a property of mathematical symbolism itself, in which the expression of interpersonal meanings seems to have been gradually reduced over time (cf. O’Halloran 2005, 114; sections 2.2.2.2 and 3.3). The same can be said for other mathematical-verbal or mathematical-symbolic expressions in MRAC, such as *95% CI* (*95% confidence interval*), *odds ratio*, and *hazard ratio (HR)* (see examples (6.68) and (6.69) below).<sup>107</sup>

(6.68) A small subset of women (n = 400; average follow-up, 57.4 months) in WHI (Women’s Health Initiative) reported conditions at baseline that would have made them eligible for HERS [Heart and Estrogen/progestin Replacement Study], ie, prior MI [myocardial infarction] or revascularization procedures. Among these women with established coronary disease, the HR for subsequent CHD [coronary heart disease] for estrogen plus progestin relative to placebo was 1.28 (95% CI, 0.64-2.56) with 19 vs 16 events. The remaining women, those without prior CHD, had an identical HR for CHD (145 vs 106; HR, 1.28; 95% CI, 1.00-1.65). Few women with a history of VTE were enrolled, but these data suggest a possibility that these women may be at greater risk of future VTE events when taking estrogen plus progestin (7 vs 1; HR, 4.90; 95% CI, 0.58-41.06) than those without a history of VTE (144 vs 66; HR, 2.06; 95% CI, 1.54-2.76)

(MRAC\_34)

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<sup>107</sup> Hazard ratio is a comparison of rates of event occurrence (e.g. death or onset of disease) between two groups. Confidence interval is a mathematical expression of the likelihood of some future result or value falling within a particular range. Odds ratio is a measure of the strength of association between two parameters.

(6.69) Of the 109 patients with confirmed gastric adenocarcinoma (excluding tumors of the gastroesophageal junction), 84 percent had been infected previously with *H. pylori*, as compared with 61 percent of the matched control subjects (odds ratio, 3.6; 95 percent confidence interval, 1.8 to 7.3). Tumors of the gastroesophageal junction were not linked to *H. pylori* infection, nor were tumors in the gastric cardia. *H. pylori* was a particularly strong risk factor for stomach cancer in women (odds ratio, 18) and blacks (odds ratio, 9). A history of gastric surgery was independently associated with the development of cancer (odds ratio, 17; P = 0.03), but a history of peptic ulcer disease was negatively associated with subsequent gastric carcinoma (odds ratio, 0.2; P = 0.02).

(MRAC\_29)

Mathematical-verbal and -symbolic resources like those above seem to be dialogically ‘contractive’, in that, compared with their verbally encoded equivalents, they appear to offer a narrower scope of dialogic alternatives. However, their role in relation to apparently ‘monoglossic’ utterances, such as that of (6.70) below, suggests otherwise. In (6.70), also quoted in Fryer (2013), the parenthetical addition opens up a space in which, in certain cases and under certain conditions, the effect of pravastatin was not always greater among women than among men. This potential dialogic ambiguity, then, between ‘contraction’ and ‘expansion’, mirrors in some ways comments by Vilha (1999) and Jones (2013) (see sections 4.2.3.2 and 4.3) on the role played by mathematics and mathematical symbolism more generally in construing both the uncertainty and provisionality of scientific medical knowledge and the “epistemological authority” of the research itself.

(6.70) The effect of pravastatin was greater among women than among men (P = 0.05 for the interaction between the patient’s sex and treatment).

(MRAC\_35)

As can be seen from Table A9, many instances of [entertain] can be grouped under the broad heading of modality (see also sections 3.1.3 and 4.2.3). Auxiliaries such as *may*, *could*, *can*, *will*, and *should*, while encoding different modal meanings, all function to open up the dialogic space for alternatives.<sup>108</sup> Other modal or modalized expressions, such as the

<sup>108</sup> While there may be differences in the kinds and degrees of modal meaning expressed by these auxiliaries, Martin and White (2005, 110–111) argue that markers of root or

reporting verbs *suggest*, *indicate*, and *estimate*, and adjectives, adverbs, and nouns such as *suggestion*, *indication*, and *estimation*, *possible/possibly/possibility*, and *usual/usually*, function in a similar manner.<sup>109</sup> Less canonically, expressions of exemplification and approximation can play an important role in construing for the text an ‘expanded’ dialogic space. For example, *e.g.*, *for example*, *like* and *such as* construe for the text a dialogic space in which the example or examples themselves are presented as one or several (perhaps the most central or typical) among a number of possible alternatives. Similarly, approximators of quantity, degree, frequency, and time (see Salager-Meyer 1994; section 4.2.3.2) such as *at least*, *about*, *most*, and *many* express in part the “impossibility or unwillingness of reaching absolute accuracy and of quantifying all the phenomena under observation” (Salager-Meyer 1994, 153) and seem to construe for the text a dialogic space in which different, more or less precise quantities, degrees, frequencies, and times can be ‘entertained’ as possible alternatives. Examples of some of these resources are highlighted in (6.71)–(6.75) below.

- (6.71) The clear demonstration of a reduction in ischaemic stroke, without any evidence of an adverse effect on haemorrhagic stroke, also suggests that statin therapy could produce substantial benefits among high-risk individuals in populations (such as China) where the risks of ischaemic stroke are relatively high, but LDL cholesterol concentrations and coronary disease risk are relatively low.<sup>3 and 52</sup>

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deontic modality (also known as “modulation”), e.g. *should* and *ought to*, also express the possibility of alternative actions. The dialogic potential of these lexicogrammatical resources lies in the directive or proposal as being grounded in the subjectivity of the speaker and as acknowledging the speaker’s and hearer’s roles as participants in a dialogic exchange (Martin and White 2005, 110–111).

<sup>109</sup> The verb *indicate* (“show” or “strongly suggest”, OED) can be used to construe either [entertain] or [endorse]. A basic distinction between those two types can be made with regard to who or what has been chosen as the framer of the proposition, i.e. text-internal or text-external sources (compare (6.74) with (6.41)), but this distinction is not always clear or explicit. Moreover, in (6.74), *indicate* could mean either “strongly suggest” or “show”, and may encode either [entertain] or some ‘text-internal endorsement’. This and similar examples in MRAC are annotated as potentially construing both [endorse] (“show”) and [entertain] (“suggest”). There are also several instances of *indicate* as “point or refer to”, e.g. *A broken vertical line indicates the overall RR for a particular subtotal or total* (MRAC\_03). Such instances are not annotated as construing [heterogloss].

(MRAC\_03)

(6.72) The significant correlation between the serum leptin concentration and the percentage of body fat suggests that adipocytes are signaling the brain about the size of the adipose-tissue depot. If the action of leptin in humans is similar to that in rodents,<sup>2-4</sup> appetite should decrease and energy expenditure should increase, which together should result in weight loss.

(MRAC\_05)

(6.73) The prevascular phase, which has been elucidated in studies of carcinoma of the cervix,<sup>7</sup> bladder,<sup>8</sup> and breast,<sup>9 10 11 12</sup> may persist for years and is usually associated with limited tumor growth (e.g., restricted thickness of melanoma<sup>13</sup>) and few or no metastases. The vascular phase is usually followed by rapid tumor growth, bleeding, and the potential for metastasis.

(MRAC\_47)

(6.74) The present findings indicate that the effect of aspirin in preventing a first myocardial infarction was greatest among the men with the highest base-line C-reactive protein concentrations and that the benefit diminished significantly with decreasing concentrations of this inflammatory marker. Thus, although the antiplatelet effects of aspirin may be modified by underlying inflammation, these data also suggest the possibility that the benefit of aspirin may have been due, at least in part, to antiinflammatory effects.<sup>31</sup>

(MRAC\_32)

(6.75) The discrepancy between the findings of HERS [Heart and Estrogen/progestin Replacement Study] and the observational studies may also reflect important differences between the study populations and treatments. Most of the observational studies of postmenopausal hormone therapy enrolled postmenopausal women who were relatively young and healthy and who took unopposed estrogen.<sup>1-3,23</sup> In contrast, participants in HERS were older, had coronary disease at the outset, and were treated with estrogen plus progestin. However, some observational studies did examine women with prior CHD, and all of these reported a beneficial association with postmenopausal hormone therapy.<sup>6-12</sup>

(MRAC\_17)

As can be seen from examples (6.65)–(6.75) above, some of the mathematical and verbal encodings of [entertain] extend across or beyond the level of the clause or proposition, e.g. *may, suggest, if*; others may be restricted to groups or phrases (or semantic elements), e.g. *risk, such as, possible*. This could have an effect on arguability and thus with the kinds and degrees of intersubjective relations construed between the textual voice and the putative reader (cf. similar comments in sections 6.1.1.1 and

6.1.1.2). However, none of the [entertain] resources in MRAC appears to construe conflicting or opposing positions between the textual voice and the reader, or between the textual voice and some other third party including or excluding the reader (see section 3.1.2.2.1). On the contrary, all instances of [entertain], to the extent that they can be clearly identified with some particular value-position, appear to construe a sense of solidarity between the textual voice and reader. This is especially apparent when considering [entertain] alongside other, interpersonally riskier types of [engagement] such as [deny], [counter], or [pronounce]. In (6.76), for example—cited above as (6.15)—[entertain *may*] mitigates the potential disalignment of ‘countering’ and ‘denying’ a commonly held position or belief.

(6.76) It is commonly argued that it is difficult to change the lifestyle of obese and sedentary people, but such pessimism may not be justified. The reasonably low dropout rate in our study also indicates that subjects with impaired glucose tolerance are willing and able to participate in a demanding intervention program if it is made available to them.

(MRAC\_43)

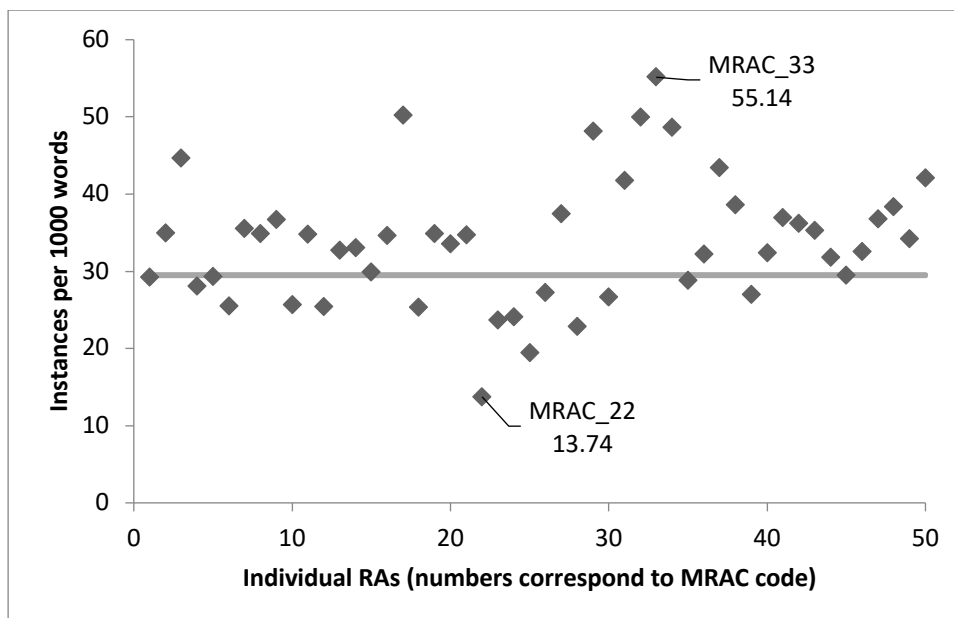


Figure 6.8. Instantiation of [entertain] (relative frequency) per research article. Horizontal grey line indicates relative frequency for MRAC as a whole (29.50 per 1000 words).

Figure 6.8 shows variation in the relative frequency of [entertain] for individual RAs in MRAC. Values range from 13.74 to 55.14 instances per

1000 words (corpus as a whole: 29.50 instances per 1000 words). MRAC\_22 and MRAC\_33 lie at the lower and upper limits of this range, respectively. MRAC\_22 investigates a specific genetic mutation among patients with non-small-cell lung cancer treated with and responding positively to the drug gefitinib. Although MRAC\_22 includes many instances of verbal [entertain], especially *may* (n=11) and *suggest* (n=9), it contains only two instances of mathematical [entertain], both of which are *p* (once in the results section, and once—repeated—in the abstract; see example (6.77) below).<sup>110</sup> The study sample in MRAC\_22 is relatively small, restricted to a primary group of just nine patients. It is perhaps for this reason that mathematical-statistical [entertain] plays such a limited role. In contrast, MRAC\_33, a case-control study of the prediction of cardiovascular disease among over 28,000 patients, contains large numbers of mathematical [entertain] resources. *Risk* (including *relative risk*), for example, occurs 66 times, and *p* appears 29 times in MRAC\_33 (average 20 and 15 times, respectively, per RA in MRAC as a whole; see example (6.78) below). Verbal [entertain] resources such as *may* and *suggest*, however, occur with very low or no occurrence (n=5 and n=0, respectively; compare with MRAC\_22 above). The main aim of MRAC\_33 is to test the role of specific markers or parameters in determining cardiovascular disease, and the kinds or levels of risk that apply to those factors. Relatively little space is given to speculation as to why such markers might play a role in the development of cardiovascular disease. It is the development of a model, and not necessarily an explanation of the mechanisms underpinning that model, that is of central concern in MRAC\_33.

- (6.77) Matched normal tissue was available for Patients 1, 4, 5, and 6 and showed only the wild-type sequence, indicating that the mutations had arisen somatically during tumor formation. By comparison, no mutations were observed in seven patients with non-small-cell lung cancer who had had no response to gefitinib ( $P < 0.001$  by a two-sided Fisher's exact test).

(MRAC\_22)

<sup>110</sup> With regard to the potentially dialogically 'expansive' and/or 'contractive' meanings of *indicate*, see earlier footnote.

(6.78) Measurements of hs-CRP, serum amyloid A, sICAM-1, and interleukin-6 were predictive of the risk of future cardiovascular events. Of the 12 measures, the level of hs-CRP was the most powerful predictor of risk in the univariate analysis (relative risk for women in the highest quartile as compared with the lowest quartile, 4.4; 95 percent confidence interval, 2.2 to 8.9; P<0.001).

(MRAC\_33)

In summary, [entertain] is the most frequently instantiated [engagement] feature in MRAC. It is encoded by a large and diverse set of realization-types, most typically modal expressions such as *may*, *suggest*, and *indicate*, as well as mathematical-symbolic and mathematical-verbal forms such as *risk*, *p*, and *CI*. While mathematical [entertain] differs from verbal [entertain] in its being grounded in a mathematically construed dialogic space rather than an individually subjective one, its function is still one of opening up that space for alternatives. ‘Entertain’ plays a crucial role in maintaining reader–writer relations and may help to mitigate the interpersonal risk involved in ‘countering’ or ‘denying’ other, potentially opposing positions.

### **6.1.2.2 Attribute**

‘Attributions’ assign a certain position or proposition to some external source, disassociating it from the textual voice and grounding it in the subjectivity of another. There are 2148 instances of [attribute] in MRAC, with [attribute] resources occurring at a relative frequency of 7.05 instances per 1000 words. Instances of [attribute] account for 11.18% of all instances of [engagement], 11.90% of [heterogloss], and 19.29% of [expand] (see Figure 6.1). Within the ATTRIBUTE subsystem, there are two main options: [acknowledge] and [distance].

#### **6.1.2.2.1 Acknowledge**

The [attribute: acknowledge] feature makes no overt reference to the position or stance of the textual voice with regard to the externally sourced proposition. Despite opening up the dialogic space for alternative positions or propositions, the textual voice maintains a certain intersubjective neutrality with regard to the ‘acknowledged’ proposition



and appears to “remain aloof from any relationships of either alignment or disalignment” (Martin and White 2005, 115).

There are 2089 instances of [acknowledge] in MRAC (relative frequency 6.86 per 1000 words). ‘Acknowledgments’ account for 10.87% of all recorded instances of [engagement], 11.57% of [heterogloss], 18.76% of [expand], and 97.30% of [attribute].

According to the Stanford Parser, 56.71% of instances of [acknowledge] are signalled or encoded by cardinal numbers, 28.12% by verbs, 12.89% by nouns, and 2.28% by adjectives. The [acknowledge] feature has 61 realization-types in MRAC, the most common of which are superscript numbers referring to endnote references, the verbs *report* and *describe*, and the noun *report*. Examples of these are given in (6.79)–(6.81) below. For frequencies of occurrence, selection probabilities, and examples for all 61 realization-types, see Table A10 in the Appendix.

(6.79) The UK Prospective Diabetes Study reported that intensive blood-glucose control with sulphonylureas or insulin substantially reduced the risk of complications but not macrovascular disease.<sup>1</sup>

(MRAC\_45)

(6.80) Commercial diet programs were described as “the kind you have to pay for, but not including trying to lose or gain weight on your own.”

(MRAC\_09)

(6.81) In previous reports, the excess risk of coronary events in patients with prior myocardial infarction (a six-to-sevenfold difference)<sup>5,6</sup> was higher than the excess risk in diabetic patients (a two-to-fourfold difference).<sup>1-4</sup> However, comparisons across populations are difficult. Furthermore, diabetic patients are overrepresented among patients with myocardial infarction,<sup>1,4</sup> and diabetic patients with myocardial infarction have a worse prognosis than nondiabetic patients with myocardial infarction.<sup>14-16</sup>

(MRAC\_14)

Most of the instances of [acknowledge] in MRAC are indicated by superscript numerical-endnote references. In some cases, these ‘acknowledgments’ appear in addition to reporting clauses or prepositional phrases such as *Studies of migrants have reported that...* (MRAC\_29) or *according to World Health Organization (WHO) criteria...* (MRAC\_14), which frame the attributed source (see also examples (6.79) and the first sentence in (6.81) above). In other cases, they do not. In (6.82)

and (6.83), for example, the propositions ‘acknowledged’ are essentially ‘monoglossic’ (see section 6.1.3). Such uses of referencing may be dialogically ambiguous, since they could also represent ‘endorsements’ (cf. Coffin 2009) or ‘justifications’, as in example (6.83) in which the reference may account for why these two responses were assessed.

(6.82) The *ob* gene is an adipocyte-specific gene that encodes leptin, a protein that regulates body weight.<sup>1</sup> In mice, mutations in the *ob* gene that result in a lack of circulating leptin cause obesity. The administration of recombinant leptin causes weight loss in these mice.<sup>2-4</sup>

(MRAC\_5)

(6.83) The biochemical response and the sustained combined biochemical and virologic response were also assessed.<sup>1</sup>

(MRAC\_25)

A relatively limited set of reporting verbs is used to ‘acknowledge’ in MRAC. These include *report*, *recommend*, *suggest*, *consider*, *propose*, *estimate*, *state*, and *ask*, often as agentless passives. Depending on the source of the proposition, most of those verbs can variably construe [entertain] or [acknowledge] (cf. section 6.1.2.1). In (6.84), for example, the first occurrence of *suggest* likely encodes [entertain], while the second one encodes [acknowledge]. Similarly, the two uses of *estimate* in (6.85)—one as verb, the other as adjective—encode [acknowledge] and [entertain], respectively.

(6.84) This phenomenon is uncommon in patients who are treated with interferon alone, which suggests [to us] that stopping therapy at week 12 because of persist viremia, as recently suggested [by others],<sup>1,18,30</sup> may not be appropriate in the case of therapy with interferon and ribavirin.

(MRAC\_25)

(6.85) The 2002 BRFSS data<sup>3</sup> estimate an obesity prevalence of 19.8% among adults compared with the estimated prevalence of 30.5% in our study.

(MRAC\_11)

The verb *consider* can also encode [entertain] or [acknowledge] (see examples (6.86) and (6.87), respectively), depending on the assumed framer of the proposition. In (6.88), however, the framer is unclear. If we assume a shared position—an inclusive-*we* (the textual voice, the putative

reader, the medical profession, people in general)—then *considered* in this sense seems to encode [entertain] and [acknowledge] simultaneously.

(6.86) Subjects who withdrew from the study were considered to be at risk for diabetes until their last oral glucose-tolerance test, at which point data were censored.

(MRAC\_43)

(6.87) Deaths considered by the Central Validation Committee to be directly related to the qualifying event were classified as other vascular.

(MRAC\_13)

(6.88) The subjects slept, on average, less than the seven to eight hours considered usual.

(MRAC\_48)

The nominalized forms of the above-mentioned reporting verbs can also construe [acknowledge] (or [entertain]; see section 6.1.2.1). In example (6.89), we see the nominalization of *recommend*, i.e. *recommendation*. Here, both forms, the verb and the noun, function to [acknowledge] the same external source, but the latter does so at a lower rank in the lexicogrammar. In the second sentence, the clause-complex of the first sentence, *the Data and Safety Monitoring Board recommended that the trial be stopped early for efficacy*, is reconfigured as a nominal group, *the recommendation for early termination*. Something is lost or reduced, information-wise, in this process, i.e. the source and the issue of *efficacy*. Something is also lost or reduced in terms of negotiability, “since you can argue with a clause but you can’t argue with a nominal group” (Halliday and Martin 1994b, 39). Dialogically, the strength or scope of the ‘acknowledgement’ is reduced as we move from a clause-complex proposition to a nominal-group semantic element. A similar example for *suggest/suggestion* is shown in (6.90).

(6.89) Following a review of the second interim analysis (data from 267 participants who had experienced a primary end point event), the Data and Safety Monitoring Board recommended that the trial be stopped early for efficacy. The voting members of the steering committee agreed unanimously on July 3, 1997, to accept the recommendation for early termination.

(MRAC\_08)

- (6.90) Studies in animals suggested that first-generation sulphonylureas, such as chlorpropamide, might increase the risk of ventricular fibrillation,<sup>10</sup> but this suggestion was not supported by our findings since the rate of sudden death was similar in the groups assigned chlorpropamide, glibenclamide, or insulin. Thus, the UKPDS data do not support the suggestion of adverse cardiovascular effects from sulphonylureas.

(MRAC\_44)

*Informed consent*, a frequently occurring nominal group in MRAC (n=40; see Table A10), refers to permission given by patients to be included in studies. This permission is based on information given by researchers to prospective patients about the aims, methods, and possible outcomes of the study. In terms of [engagement], *informed consent* ‘acknowledges’ the patient or patients as the source of permission and the study or researchers as the source of information. The underlined examples in (6.91) and (6.92)—despite differences in “giving” and “getting” and the use of active and passive voice, respectively—can be reformulated to highlight this potential ‘double acknowledgement’. Both basically say, “patients said yes to inclusion in the study after researchers [or we] told them what the study was about”.

- (6.91) The study was approved by the ethics committees of Kuopio University Hospital and the Turku University Central Hospital. All subjects gave informed consent.

(MRAC\_14)

- (6.92) The institutional review board at each center approved the protocol, and written informed consent was obtained from all participants or their authorized representatives.

(MRAC\_01)

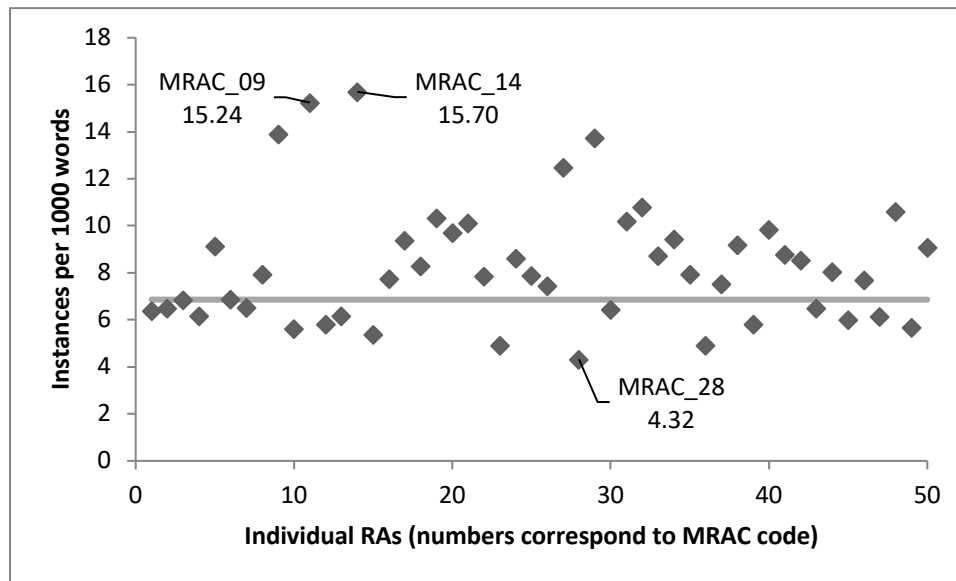


Figure 6.9. Instantiation of [acknowledge] (relative frequency) per research article. Horizontal grey line indicates relative frequency for MRAC as a whole (6.86 per 1000 words).

Figure 6.9 shows variation in the relative frequency of [attribute: acknowledge] for individual RAs in MRAC. Values range from 4.32 to 15.70 instances per 1000 words (corpus as a whole: 6.86 instances per 1000 words). MRAC\_11 and MRAC\_14 are at the upper limits of this range, with MRAC\_28 at the lower end.

Although MRAC\_28 contains relatively few verbal [acknowledge] resources, it is not an extreme outlier in relation to other MRAC articles (see Figure 6.9): superscript numerical references are used less frequently than in MRAC as a whole (2.47 vs. 4.93 instances per 1000 words), and there are nine instances of verbal [acknowledge] (1.85 vs. 2.80 instances per 1000 words). MRAC\_28 examines changes in hospitalization and mortality rates for a group of patients diagnosed with human immunodeficiency virus (HIV). Its relative lack of [acknowledge] resources compared with MRAC as a whole implies a text that only occasionally explicitly grounds propositions in the subjectivity of other voices; MRAC\_28 contains no instances of [distance] and relatively few [endorse] resources compared with other MRAC articles (see sections 6.1.1.2.3 and 6.1.2.2.2). Indeed, instances of [heterogloss] in general are fewer in number in MRAC\_28 than in MRAC as a whole (45.18 vs. 59.27 instances per 1000 words, respectively), suggesting a text that is more

‘monoglossic’, more single-voiced (9.07 vs. 3.82 instances per 1000 words, respectively), than other MRAC articles (see section 6.1.3).

MRAC\_11 studies the prevalence of overweight and obesity among US adults, and MRAC\_14 examines and compares the incidences of myocardial infarction (heart attack) among diabetic and nondiabetic patients in Finland. Both of these studies are part of wider national programmes to map, treat, and prevent certain medical conditions, and it is perhaps for this reason that both articles deploy large numbers of [acknowledge] resources, as they connect their work to other national and international studies and surveys. MRAC\_28 is also part of a nationwide study, but it seems to make fewer explicit connections to related research. A possible reason for this may lie in the research niche construed by the text; a narrower or more specialized niche generally means fewer previous studies to draw upon, and thus a relatively lower frequency of ‘acknowledgments’ (see discussion of generic structure in section 6.2). That HIV and AIDS are more recently identified medical phenomena than overweight/obesity and diabetes may also contribute to the relative lack of ‘acknowledgment’ resources in MRAC\_28 compared with MRAC\_11 and MRAC\_14 (see section 6.3.4 on Medical Subject Headings).<sup>111</sup>

In summary, [acknowledge] resources account for the majority of instances of [attribute] in MRAC. The feature is encoded by a diverse set of realization-types, most typically by superscript numbered references and by reporting verbs and nominalizations such as *report*, *recommend*, and *suggest*. Some [acknowledge] resources are similar to those used to ‘entertain’ alternative positions in the discourse (e.g. *recommend* and *suggest*), but they differ with regard to the explicit or implicit framer of the proposition and thus with regard to interpersonal risk, by grounding propositions or semantic elements in the subjectivity of an external source. In using [acknowledge] resources, the textual voice can position itself as relatively neutral towards the proposition or value-position being advanced.

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<sup>111</sup> Although unlikely to affect the deployment of ‘acknowledgement’ resources, another difference between MRAC\_28 and MRAC\_11/MRAC\_14 (apart from their topics) lies in the size of their study groups: 1255 vs. 4115/2432, respectively.

### 6.1.2.2.2 Distance

In selecting the [attribute: distance] feature, the textual voice dissociates and disaligns itself from some externally sourced proposition. Instantiation of this category of [engagement] implies a certain amount of interpersonal risk with regard to writer–reader solidarity.

There are 58 potential instances of [distance] in MRAC (relative frequency 0.19 per 1000 words). This ‘distancing’ accounts for 0.30% of all instances of [engagement], 0.32% of [heterogloss], 0.52% of [expand], and 2.70% of [attribute] in the corpus.

According to the Stanford Parser, 84.21% of instances of [distance] are signalled or encoded by punctuation (open-close quotes), 10.53% (six instances) by verbs, and 5.26% (three instances) by adjectives.<sup>112</sup> The [distance] feature has eight realization-types in MRAC, examples of which are given in (6.93)–(6.100).

Most instances of ‘distancing’ in MRAC are construed by quotation marks (see Table A11). In (6.93), those marks are suggestive of a general response or implied meaning associated with patients’ reporting of alternative medicine use, a position that the textual voice appears to disassociate and ‘distance’ itself from. In another instance, (6.94), the textual voice introduces a new term using quotation marks. Here, in addition to indicating a sense of [distance], the textual voice goes on to ‘acknowledge’ the potentially problematic nature of the new term it introduces and ‘entertain’ the possibility of more suitable terminology. The quotation marks highlight this potential dialogic ambiguity.

- (6.93) Despite the dramatic increases in use and expenditures associated with alternative medical care, the extent to which patients disclose their use of alternative therapies to their physicians remains low. Less than 40% of the alternative therapies used were disclosed to a physician in both 1990 and 1997. It would be overly simplistic to blame either the patient or their physician for this inadequacy in patient-physician communication. The current status quo, which can be described as “don't ask and don't tell,” needs to be abandoned.<sup>29</sup> Professional strategies for responsible dialogue in this area need to be further developed and refined.

(MRAC\_09)

<sup>112</sup> One instance of [distance], signalled by the conjunction *as if*, was not tagged by the parser.

- (6.94) We have used the term “onset of angiogenic activity” to describe marked neovascularization present within or at the periphery of a neoplastic focus. This usage should not imply knowledge of a mechanism. Whether capillaries will grow or not grow toward a tumor may depend on one or more events that are not clearly understood at this time.

(MRAC\_47)

The other resources suggestive of ‘distancing’ in MRAC are the verbs *argue*, *criticize*, *assume*, *purport*, and *think*, the attributive adjective *so-called*, and the conjunction *as if* (see Table A11). In (6.95), the textual voice chooses the verb *argue* to project some externally sourced position. This choice may primarily encode [attribute: acknowledge], but the subsequent overturning of the externally sourced position, *that it is difficult to change the lifestyle of obese and sedentary people*, and its evaluation as “pessimistic”, suggests a less intersubjectively neutral role for *argue* than might be expected with other reporting verbs such as *say*, *state*, or *believe*.<sup>113</sup>

- (6.95) It is commonly argued that it is difficult to change the lifestyle of obese and sedentary people, but such pessimism may not be justified. The reasonably low dropout rate in our study also indicates that subjects with impaired glucose tolerance are willing and able to participate in a demanding intervention program if it is made available to them.

(MRAC\_43)

In (6.96), the textual voice may be ‘distancing’ itself from the findings of studies that did not control for certain variables. The ‘distancing’ is construed in part by the verb *criticize*; but it is also underscored contextually by ‘justification’ (*because...*) and ‘denial’ (*they did not...*). (Note how the adverb *often* opens up a space in which not everyone criticizes these studies. Moreover, the criticisms themselves are not attributed to a specific text-internal or -external source.)

- (6.96) Several cross-sectional investigations have found associations between mortality rates and particulate air pollution in U.S. metropolitan areas<sup>1-3</sup>. A recent study reported associations between infant mortality and particulate air

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<sup>113</sup> Fløttum, Dahl, and Kinn (2006, 233–234) identify *argue* and *claim* as “position verbs”, contrasting them with “reporting verbs” such as *report*, *say*, and *write* (see section 4.2.2.2).



pollution in the Czech Republic<sup>4</sup>. These studies have often been criticized because they did not control directly for cigarette smoking or other covariates.  
(MRAC\_07)

In the opening paragraph of the Introduction of MRAC\_31—see (6.97) below—the use of the verb *assume* (“suppose to be the case, without proof”, OED) seems to cast doubt on a particular position held by *many physicians*. While this may have a ‘distancing’ effect, the textual voice is careful not to exemplify or identify those it potentially disagrees with; the ‘distancing’ proposition in (6.97) is the only proposition that does not explicitly ‘acknowledge’ any external voices. The verbs *purport* and *think* can function in a similar manner (see examples in Table A11).

(6.97) Aldosterone has an important role in the pathophysiology of heart failure.<sup>1-4</sup> Aldosterone promotes the retention of sodium, the loss of magnesium and potassium, sympathetic activation, parasympathetic inhibition, myocardial and vascular fibrosis, baroreceptor dysfunction, and vascular damage and impairs arterial compliance.<sup>4-8</sup> Many physicians have assumed that inhibition of the renin–angiotensin–aldosterone system by an angiotensin-converting-enzyme (ACE) inhibitor will suppress the formation of aldosterone. In addition, treatment with an aldosterone-receptor blocker in conjunction with an ACE inhibitor has been considered relatively contraindicated because of the potential for serious hyperkalemia.<sup>9,10</sup>

(MRAC\_31)

In (6.98), the textual voice seems to call into question the relevance of the term *J-curve concept*. This is first highlighted by the use of *so-called*, which indicates that the term may be “commonly designated” and/or “inappropriate” (OED). The potential inappropriateness of the term and the subsequent ‘distancing’ effect signalled by *so-called* become more apparent later in the excerpt when the textual voice identifies the *real issue* and insists upon the apparent truism of the term (*it must be*).

(6.98) In addition, concerns have been expressed that too vigorous reduction in blood pressure may be associated with increased cardiovascular risk—the so-called J-curve concept.<sup>9, 10, 11 and 12</sup> The issue of how far blood pressure should be lowered to achieve the greatest benefit, in terms of reduced cardiovascular morbidity and mortality, has been a matter of scientific debate.<sup>13</sup> The real issue is not whether the relation between achieved blood pressure and cardiovascular events is J-shaped (it must be), but whether there are additional benefits, or risks, in lowering blood pressure of patients with hypertension to fully

normotensive levels—ie, between 70 mm Hg and 85 mm Hg diastolic blood pressure—or whether there is little further benefit in lowering diastolic blood pressure much below 90 mm Hg.<sup>14</sup> This issue needed to be addressed in a randomised and prospective trial and this was one of the reasons for doing the present study.

(MRAC\_16)

In (6.99), the textual voice seems to ‘distance’ itself from the actions (or inactions) of *many referring physicians*. Like the example in (6.97), those physicians are not specified, but their actions are framed as questionable or contentious. Although I have tagged the instance of ‘distancing’ as being realized by the conjunction *as if* in the corpus annotation (see Table A11), the construal of [distance] in (6.99) is realized and negotiated through a composite of verbal resources, some but not all of which construe [engagement]. These include the negative judgment realized by *declining interest* and *acted as if...* and the negative appreciation realized by *deprived* (see Martin and White 2005, 52–69, and section 3.1 for brief discussion of [attitude: judgment] and [attitude: appreciation]). They also include [entertain] resources such as *may* and *some*, as well as [counter *now*] and [endorse *confirmed*].

(6.99) Over the past few years, many referring physicians have shown a declining interest in carotid endarterectomy and have acted as if the absence of proof were the proof of absence. In 1985, 107,000 carotid endarterectomies were performed in hospitals (excluding Veterans Affairs hospitals) in the United States. By 1989, the number had diminished to 70,000 (Dyken ML, Pokras R: personal communication). In the light of the results reported here, this reduction in the number of carotid endarterectomies may have deprived some patients with high-grade stenosis of what is now confirmed to be a beneficial operation.

(MRAC\_41)

The somewhat implicit ‘distancing’ effect in (6.99) can also be seen in (6.100), in which the textual voice is critical of those who make certain inferences based on group differences in randomized controlled trials. The negative appreciation realized by *misleading* is mitigated by the [entertain] resource *might*. Unlike many of the examples above, however, (6.100) explicitly ‘acknowledges’ the external sources it seems to want to distance itself from (superscript 36, 37 and 38) and provides what appears

to be an ‘endorsement’ for its position (superscript 32). Considering (6.100) as a whole, the textual voice first rejects or ‘denies’ a particular position (*cannot, unlikely*), then ostensibly ‘distances’ itself from inferences made on the basis of that position, and finally ‘counters’ (*by contrast*) with an alternative that it considers to be less biased.<sup>114</sup>

(6.100) In randomised trials of statin therapy versus placebo, groups of patients defined by the size of their postrandomisation cholesterol reductions cannot be guaranteed—and, indeed, are unlikely—to differ only randomly from each other (since factors related to the apparent lipid response may well also be related to outcome). Hence, inferences drawn from comparisons of outcome between such groups<sup>36,37 and 38</sup> might be misleading.<sup>32</sup> By contrast in the present trial, the use by all participants of a few weeks of simvastatin during the prerandomisation run-in period (see Methods) allows unbiased randomised comparisons of the effects of treatment on clinical outcomes within subgroups defined by each individual's apparent LDL cholesterol “responsiveness”.

(MRAC\_03)

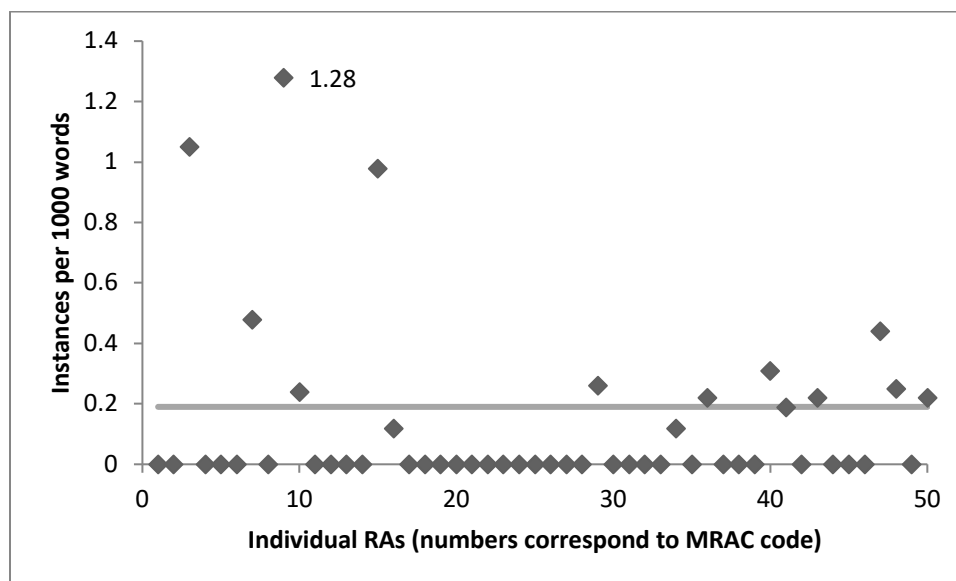


Figure 6.10. Instantiation of [distance] (relative frequency) per research article. Horizontal grey line indicates relative frequency for MRAC as a whole (0.19 per 1000 words).

Figure 6.10 shows variation in the relative frequency of [attribute: distance] for individual RAs in MRAC. Values range from 0 to 1.28 instances per 1000 words (corpus as a whole: 0.19 instances per 1000 words). Of the 15 MRAC articles in which [distance] resources were

<sup>114</sup> *Bias* is used here in its statistical sense, i.e. “a systematic distortion of a statistical result due to a factor not allowed for in its derivation” (OED).

identified, MRAC\_09 contains the most (n=8), all of which are realized by open-close quotes, an example of which can be seen in (6.93) above. MRAC\_09 presents the results of a US survey on the use, types, and costs of alternative medicine. The survey was conducted by telephone and contains several quotes or apparent quotes based on summarized and/or standardized responses. The article also contains several definitions placed in quotation marks. Whether or not the textual voice explicitly ‘distances’ itself from terms like “*more alternative*” and “*less alternative*”, or justifications for alternative medicine use such as to “*prevent future illness from occurring or to maintain health and vitality*”, is not clear from the immediate co-text. However, unlike the projection associated with [acknowledge] and [endorse], this form of direct-quote projection (see Martin and White 2005, 113, Martin and Rose 2007, 49–52, Hood 2010, 181) is more conspicuous in distinguishing the textual voice from some external voice. It is also more marked in general, since direct quotations are rare in contemporary medical research discourse (cf. Salager-Meyer 1999b, Hu and Wang 2014). The authors’ concern with regard to the “risk for potential adverse interactions involving prescription medications and herbs or high-dose vitamin supplements” and “the current status quo [of ‘don’t ask don’t tell’]” (quotes from MRAC\_09) provides further co-textual evidence for the possible ‘distancing’ effect of the quotation marks used in the article.<sup>115</sup>

In summary, [attribute: distance] is a low-frequency feature in MRAC. It is primarily realized by direct quotes, as well as by a set of “position verbs” (*argue, criticize, assume, purport, and think*) (see Fløttum, Dahl, and Kinn 2006, 233–234), the attributive adjective *so-called*, and the subordinating conjunction *as if*. ‘Distancing’ generally implies increased interpersonal risk, since dissociating oneself from an alternative voice or position in the discourse may threaten reader–writer solidarity if it conflicts with or challenges the knowledge, beliefs, or values of the reader. As shown above, the few instances of [distance] in MRAC are carefully negotiated so as to minimize this risk.

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<sup>115</sup> Note that MRAC\_09 also has a high relative frequency of [acknowledge] (see Figure 6.9 in section 6.1.2.2.1).

### 6.1.3 Monogloss

‘Monoglossic’ (single-voiced) utterances make no overt reference to other voices or viewpoints in the discourse. They are bare assertions that, for a given textual moment, represent “the textual voice’s single, autonomous and isolated subjecthood” (Martin and White 2005, 99).

In MRAC as a whole, there are 1163 instances of [monogloss] (RF 3.82 per 1000 words). The feature accounts for 6.06% of all recorded instances of [engagement] in the corpus (see Figure 6.1).

As bare assertions, ‘monoglossic’ utterances are not characterized or signalled by specific lexical items. Rather, in this study, they are identified as main or matrix clauses that lack the kinds of mathematical and verbal ‘heteroglossic’ resources described and discussed in sections 6.1.1 and 6.1.2. For example, (6.101) contains a series of bare assertions about what was done as part of a particular study protocol. Each main or matrix clause—each sentence—in (6.101) represents a single instance of [monogloss] (seven in total). There are no instances of mathematical or verbal [heterogloss] in (6.101).

- (6.101) The first treatment group received peginterferon alfa-2b (PEG-Intron, Schering Corp, Kenilworth, NJ, USA) at a dose of 1.5 ( $\mu\text{g}/\text{kg}$  each week subcutaneously plus oral ribavirin (Rebetol, Schering Corp) at a dose of 800 mg/day for 48 weeks (n=511). The second group received peginterferon alfa-2b subcutaneously at a dose of 1.5 ( $\mu\text{g}/\text{kg}$  each week for the first 4 weeks followed by 0.5 ( $\mu\text{g}/\text{kg}$  per week for the next 44 weeks plus 1000–1200 mg/day of ribavirin orally for 48 weeks (n=514). The third group received interferon alfa-2b (Intron A, Schering Corp), 3 million units subcutaneously three times per week, plus ribavirin 1000–1200 mg/day orally, both for 48 weeks (n=505). In the two groups receiving 1000–1200 mg ribavirin, the dose was adjusted according to bodyweight (1000 mg for weight below 75 kg, and 1200 mg for weight 75 kg or more). For all groups, ribavirin was administered in two divided doses per day. Peginterferon alfa-2b was administered subcutaneously once per week according to weight. Both drugs were started and stopped at the same time. Patients were followed up for 24 weeks after treatment.

(MRAC\_23)

The clauses in (6.101) are all material, i.e. “clauses of doing or happening” (Halliday and Matthiessen 2014, 224), as indeed are the majority of bare

assertions in MRAC (n=934, 77.00%).<sup>116</sup> Unmodulated relational clauses (“clauses of being and having”, Halliday and Matthiessen 2014, 259) like those in (6.102) and (6.103) are also commonly used to construe [monogloss] (n=223, 18.38%). Existential clauses, i.e. clauses that serve to introduce or bring into existence a particular entity (Halliday and Matthiessen 2014, 307–310), are used to similar effect (n=18, 1.48%; see (6.104)).

(6.102) Dr Gotto is a consultant and speaker for Merck & Co Inc. (MRAC\_08)

(6.103) The participation rate was 43 percent. (MRAC\_48)

(6.104) There were 53 fatal myocardial infarctions in the placebo group as compared with 40 in the enalapril group. (MRAC\_49)

The examples presented above are unlikely to disalign the textual voice and the reader; they are likely to be ‘taken for granted’, as generally accepted representations of domain-specific knowledge or fact (cf. White 2003, 263, Martin and White 2005, 100). Some instances of [monogloss], however, may carry greater interpersonal risk, potentially threatening writer–reader solidarity. In such cases, pairings of [monogloss] with [justify] and/or [attribute] may serve to anticipate and prevent or temper this risk. Examples of these pairings are given in (6.105) and (6.106) below.

(6.105) Peginterferon alfa-2b therapy in this study was optimised by dosing according to the patient's weight. The decision to dose the drug by weight was based on findings that response rates to interferon alfa-2b monotherapy are strongly associated with weight. (MRAC\_23)

(6.106) The *ob* gene is an adipocyte-specific gene that encodes leptin, a protein that regulates body weight.<sup>1</sup> In mice, mutations in the *ob* gene that result in a lack

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<sup>116</sup> For comparison, material clauses account for 69.18% (n=8658) of all clause-types in MRAC as a whole.

of circulating leptin cause obesity. The administration of recombinant leptin causes weight loss in these mice.<sup>2-4</sup>

(MRAC\_05)

In (6.105), the first matrix clause is a bare assertion that describes what was done; the second provides a clarification or ‘justification’ for that action (see section 6.1.1.2.4). In (6.106), all three matrix clauses appear to express [monogloss]. The first and the third matrix clauses, however, are marked with superscript numbers that ‘attribute’ the propositions to certain text-external sources. By ‘acknowledging’ these sources, the textual voice provides support for the propositions and grounds responsibility for their veracity or general acceptability in the subjectivity of some external voice. In an earlier section of MRAC\_05, a similar but unmodulated proposition expresses [monogloss] without [attribute: acknowledge]: *Leptin, the product of the ob gene, is a hormone secreted by adipocytes.* (See section 6.2 for an account of generic-structural differences.)

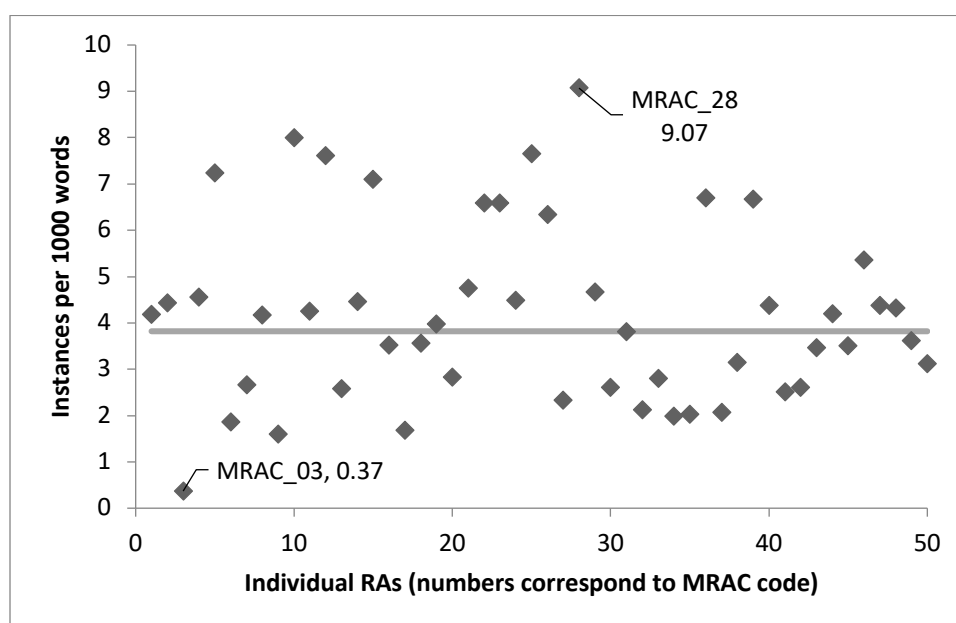


Figure 6.11. Instantiation of [monogloss] (relative frequency) per research article. Horizontal grey line indicates relative frequency for MRAC as a whole (3.82 per 1000 words).

Figure 6.11 shows variation in the relative frequency of [monogloss] for individual RAs in MRAC. Values cover a wide range, from 0.37 to 9.07 instances per 1000 words (corpus as a whole: 3.82 per 1000 words).

MRAC\_03 and MRAC\_28 lie at the lower and upper limits of this range, respectively. MRAC\_03 is a randomized controlled trial to test the effects of simvastatin, a cholesterol-lowering medicine, on patients at risk of vascular disease. The article contains five instances of [monogloss]: two in the Results, two in the Acknowledgments, and one in the Conflict-of-Interest statement (see section 6.2). The low relative frequency of [monogloss] in MRAC\_03 suggests an RA in which the textual voice is rarely construed as standing alone in its own subjecthood (cf. Martin and White 2005, 99).<sup>117</sup> In contrast, MRAC\_28, a study of hospitalization and mortality rates among patients with HIV, contains 46 instances of [monogloss]. Most of those instances are found in the Abstract, Methods, and Results (see section 6.2) and typically refer to study protocol and the classification or characterization of patient groups. Here, what was done and what was found are often construed in absolute terms, creating a text in which overt references to other voices and other texts in the discourse are relatively limited.<sup>118</sup> Examples are given below in (6.107) and (6.108).

(6.107) Deaths among observed patients were counted, and observation was standardized to 100 person-years.

(MRAC\_28)

(6.108) The difference in mortality between patients with private insurance and those covered by public funding narrowed in later quarters; by the second quarter of 1997, mortality among those with private insurance had fallen to 7.7 per 100 person-years; for those covered by Medicaid, mortality was 9.2 per 100 person-years.

(MRAC\_28)

In summary, the [monogloss] feature has a relatively low frequency of instantiation in MRAC, but its distribution across individual RAs has a wide range. Unlike most [heterogloss] resources, [monogloss] is not signalled

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<sup>117</sup> MRAC\_03 is a potential high-end outlier with regard to [disclaim: counter] (see section 6.1.1.1.2). It has a relative frequency of [heterogloss] that is well above the average for MRAC as a whole (88.43 vs. 59.27 instances per 1000 words, respectively) and is the fourth highest among individual RAs.

<sup>118</sup> MRAC\_28 is a potential low-end outlier with regard to [attribute: acknowledge] (see section 6.1.2.2.1). It has a relative frequency of [heterogloss] that is well below the average for MRAC as a whole (47.74 vs. 59.27 instances per 1000 words, respectively) and is the eighth lowest among individual RAs.



or realized lexically. Instead, it is characterized by an absence of multi- or other-voiced resources, most typically in the form of unqualified or unmodulated material clauses. Most instances of [monogloss] in MRAC carry little risk of disalignment or antagonism. Any potential threat to writer–reader solidarity can be mitigated by pairing with dialogically ‘contractive’ or ‘expansive’ resources.

#### 6.1.4 Scope and Interaction

As sections 6.1.1–6.1.3 show, instances of verbal [engagement] can be realized at different levels of the rank scale for lexicogrammar, creating in some cases clusters or “syndromes of meaning” expressed within and across clauses and clause-complexes (Halliday 2004 [1998], Halliday and Matthiessen 1999, Zappavigna, Dwyer, and Martin 2008). When instances of [engagement] overlap and interact, the effect seems to be more than one of addition. In (6.51), for example—reproduced here as (6.109)—[engagement] is encoded several times. There are three instances of [acknowledge], realized by *postulated* and the numerical references <sup>31</sup> and <sup>35</sup>; three instances of [entertain], realized by *may*, *potential*, and *when*; one instance of [counter], realized by *despite*; one instance of [deny], realized by *un-*; and one instance of [endorse], realized by *-known*. The lexicogrammatical and semantic scopes of these resources differ, however, with some extending over entire main and matrix clauses or propositions and sequences (*postulated*, <sup>31</sup>, <sup>35</sup>, *may*) and others restricted to embedded clauses, phrases, groups, and words, or semantic elements (*despite*, *potential*, *when*, *un-*, *-known*). The overall effect is not [attribute] + [attribute] + [entertain] + [attribute] + [counter] + [entertain] + [entertain] + [deny] + [endorse], even if the meanings themselves unfold in that particular order. Rather, it might be better described as ([attribute *postulated*])←[attribute <sup>31</sup>] + ([entertain *may*])←[attribute <sup>35</sup>] + [counter *despite*]→([entertain *potential*]) + [entertain *when*] + [deny *un-*]→([endorse *-known*]), where left-pointing or right-pointing arrows indicate, respectively, that a particular feature extends retroactively or proactively over the feature or features in parentheses.

(6.109) Ribavirin has been postulated to inhibit viral-dependent RNA polymerase, the capping structure of viral messenger RNA, and inosine monophosphate dehydrogenase.<sup>31</sup> Other immunomodulatory actions may also contribute to the drug's beneficial effects.<sup>35</sup> Despite these potential actions, the exact mechanism responsible for the improved response that occurs when ribavirin is combined with interferon is unknown.

(MRAC\_25)

Returning to the potentially more complex example highlighted in chapter 5—example (5.4), reproduced below as (6.110)—the scope and interaction of [engagement] features can be summarized as (([endorse *shown*])←[attribute <sup>8-11</sup>])←[counter *however*]→([deny *not*]→([affirm *clear*]))→([entertain *whether*]→([entertain *can*]→([deny *not*]))), where the central node in this 'engagement' syndrome is the instance of [counter] realized by *however*.

(6.110) Clinical trials have shown that lowering elevated LDL cholesterol levels prevents both first and recurrent coronary events.<sup>8-11</sup> However, it has not been clear whether coronary events can be prevented by cholesterol-lowering therapy in patients who do not have hypercholesterolemia.

(MRAC\_35)

A further complication or challenge with regard to the scope and interaction of [engagement] features concerns the relative strengths of those features as they extend across (parts of) propositions. Taking [counter *however*] in (6.110) as an example, the dialogic function of this feature extends retroactively and proactively over preceding and subsequent propositions. However, the semantic weight or strength of the feature is likely to be greatest at the moment of instantiation (or the moment of utterance or reading) than at any other point in its scope. Instantiations in closest proximity to [counter *however*], e.g. the first [deny *not*], are likely to be affected more than those peripheral to the semantic reach of [counter *however*], e.g. [entertain *can*] or the second instance of [deny *not*]. Representation of these potential hierarchies, scopes, and strengths of instantiated meaning can become rather unwieldy, but the

proactive scope and relative weight of [counter *however*] in (6.110) might be expressed diagrammatically as shown in Figure 6.12.<sup>119</sup>

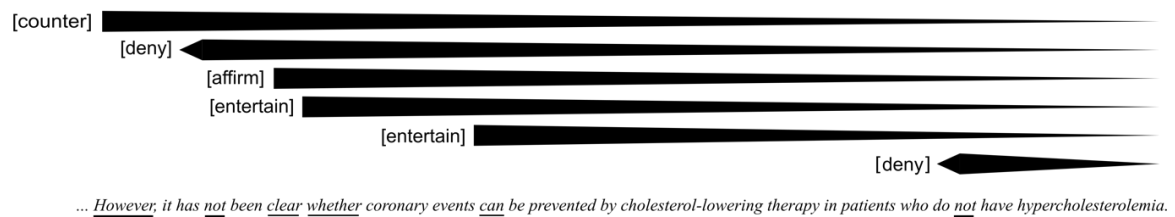


Figure 6.12. Scope and interaction of [engagement]: an example.

What Figure 6.12 shows is a proposition that is, overall, dialogically contractive, one that ‘counters’ and ‘denies’ a possible and expected proposition or position in which “coronary events are prevented by cholesterol-lowering therapy for certain patients”. Despite the narrow dialogic space construed by the [counter] + [deny] pairing, other instances of [engagement], subordinate to this pairing, can perturb the dialogic space in various ways and to varying degrees. The instances of [entertain], for example, serve to expand the space in which the countered and rejected proposition can be seen as one among several possibilities, e.g. that for some patients (but not this particular group) coronary events are preventable by cholesterol-lowering medication.

Mathematical [engagement] works in a similar way. In MRAC, mathematical [engagement] is most commonly realized through expressions like  $p < 0.05$ , where the likelihood of a particular effect being one of chance is quantified (and, according to Doran 2016, 168, ideationalized; see section 2.2.2.2). These expressions construe mathematical [entertain], which typically extends retroactively over some prior proposition, qualifying an otherwise ‘monoglossic’ bare assertion or

<sup>119</sup> Note that Figure 6.12 represents the initial semantic weights of each instance as being equal. There is, however, no reason to assume parity of semantic weight for each instance of [engagement]. The fact that the second [deny *not*] is rankshifted to part of a semantic element (structurally part of an embedded clause in a nominal group in a prepositional phrase in a nominal group, etc.) suggests that it may not carry the same semantic weight as the first [deny *not*] or indeed any of the other instances of [engagement] in the example. For lack of a systematic way to determine variation in semantic weight, I have chosen to keep initial semantic weight the same for each feature.

reinforcing verbally construed [heterogloss] (see examples (6.111) and (6.112), respectively).

(6.111) The benefit of intensive insulin therapy was attributable to its effect on mortality among patients who remained in the intensive care unit for more than five days (20.2 percent with conventional treatment, as compared with 10.6 percent with intensive insulin therapy;  $P=0.005$ ).

(MRAC\_46)

(6.112) The percentage of users paying entirely out-of-pocket for services provided by alternative medicine practitioners did not change significantly between 1990 (64.0%) and 1997 (58.3%) ( $P=.36$ ).

(MRAC\_09)

As a text unfolds, the dialogic space it construes ‘expands’ and ‘contracts’—sometimes more dramatically than others—pushing and pulling the text and the reader in different directions (Fryer 2013, 193). The effect this has across different generic stages and phases in MRAC is discussed in detail in section 6.2.

### 6.1.5 Summary

Propositions in MRAC tend to be dialogically ‘expansive’ and are often grounded in the subjectivity of the textual voice (see [entertain], section 6.1.2.1). A more neutral position may be taken in the form of ‘acknowledgements’. Less frequently, the textual voice disassociates itself from a particular proposition or position. When propositions in MRAC are dialogically ‘contractive’, they typically ‘reject’ or ‘counter’ alternatives in the discourse. The textual voice also ‘endorses’ externally sourced propositions or ‘justifies’ its own or others’ positions.

‘Engagement’ is realized by a diverse set of verbal and mathematical resources in MRAC. In the case of [entertain], there are 233 realization-types (see Table A9). Despite this diversity, the 15 most common verbal and mathematical resources account for more than 50% of all instances of [entertain] in MRAC. Other features, although arguably less diverse than [entertain], have similar core and peripheral realization-types (see, for example, [deny]; section 6.1.1.1.1).

Notwithstanding the varying types and degrees of [engagement] construed in MRAC, the textual voice rarely, if ever, directly challenges or disaligns itself with the reader or third parties. Where there is a risk of disalignment, the textual voice's position is so carefully negotiated—usually using resources that construe [entertain]—that the disalignment, to the extent that it occurs, is barely perceptible (see, for example, (6.15) in section 6.1.1.1.1). This contrasts, it seems, with Martin and White's discussions of [engagement] (e.g. White 1998, 2003, 2012, Martin and White 2005), in which disalignment and opposition are relatively common traits of mass-communicative texts in newspapers and online media. MRAC's relative lack of disalignment and its limited instantiation of [concur], [pronounce], [distance], and [monogloss], for example, may be indicative of the less polemic, potentially more consensus-seeking conventions of contemporary medical research articles. A summary of the instantiation of [engagement] in MRAC, organized according to relative frequency, is given in Table 6.1.

Table 6.1. 'Engagement' in MRAC as a whole, organized according to relative frequency per 1000 words.

Engagement feature	Relative frequency per 1000 words
Entertain	29.50
Deny	10.68
Acknowledge	6.86
Counter	4.41
Endorse	3.94
Justify	3.25
Pronounce	0.23
Concur	0.20
Distance	0.19

Despite the overall patterns of instantiation and realization in MRAC, there is considerable intertextual variation in the construal of verbal and mathematical [engagement]. A summary of this variation can be seen in Figure 6.13. The relative frequencies of [heterogloss] in each article are indicated in blue ('contract') and green ('expand'), with [monogloss] in red. The overall frequencies of [engagement] range from 49.22 to 106.38 instances per 1000 words, demonstrating the relative dialogic diversity of articles in MRAC.

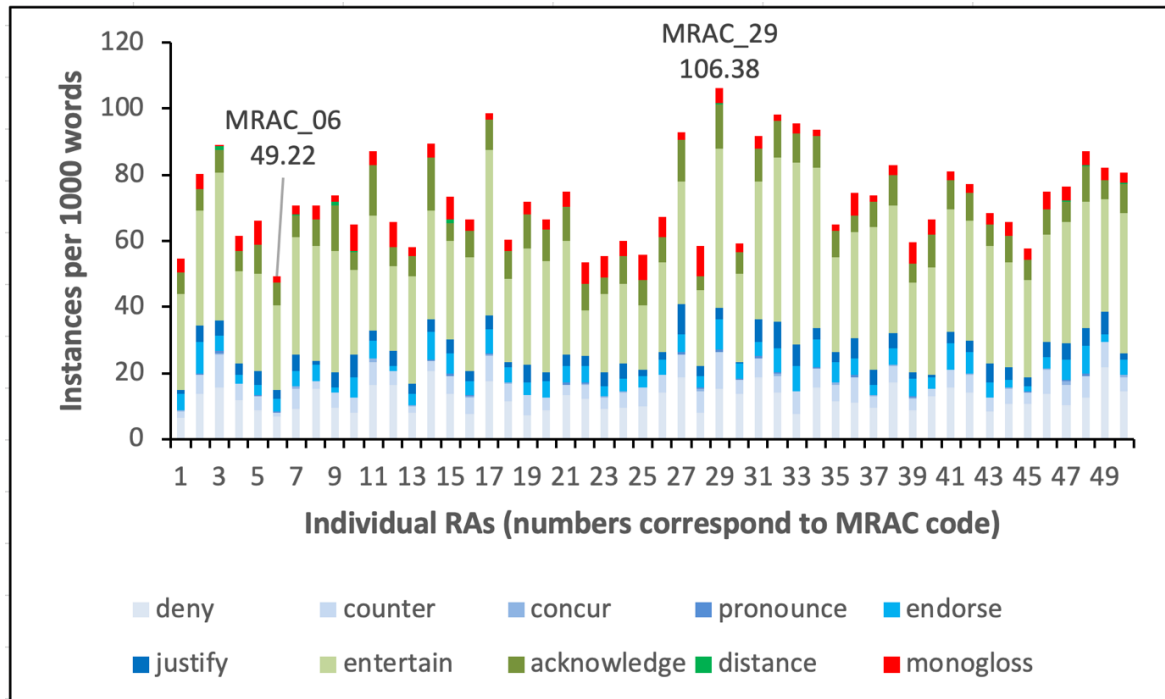


Figure 6.13. Instantiation of [engagement] (relative frequency) per research article.

## 6.2 Genre and Generic Staging

In the following sections, I examine how verbal and mathematical [engagement] resources are distributed across different generic stages and phases of the MRAC articles, considering how [engagement] evolves as texts unfold. I begin with the four main sections or stages of the medical research article: Introduction, Methods, Results, and Discussion. I then discuss other sections of the medical research article, including the Abstract, before concluding with an overall summary of logogenetic variability in MRAC. Figure 6.14 provides a comparative summary of the relative frequencies and global selection probabilities across the four main sections (Introductions, Methods, Results, and Discussions), the Abstract, and the corpus as a whole (cf. Figure 6.1).

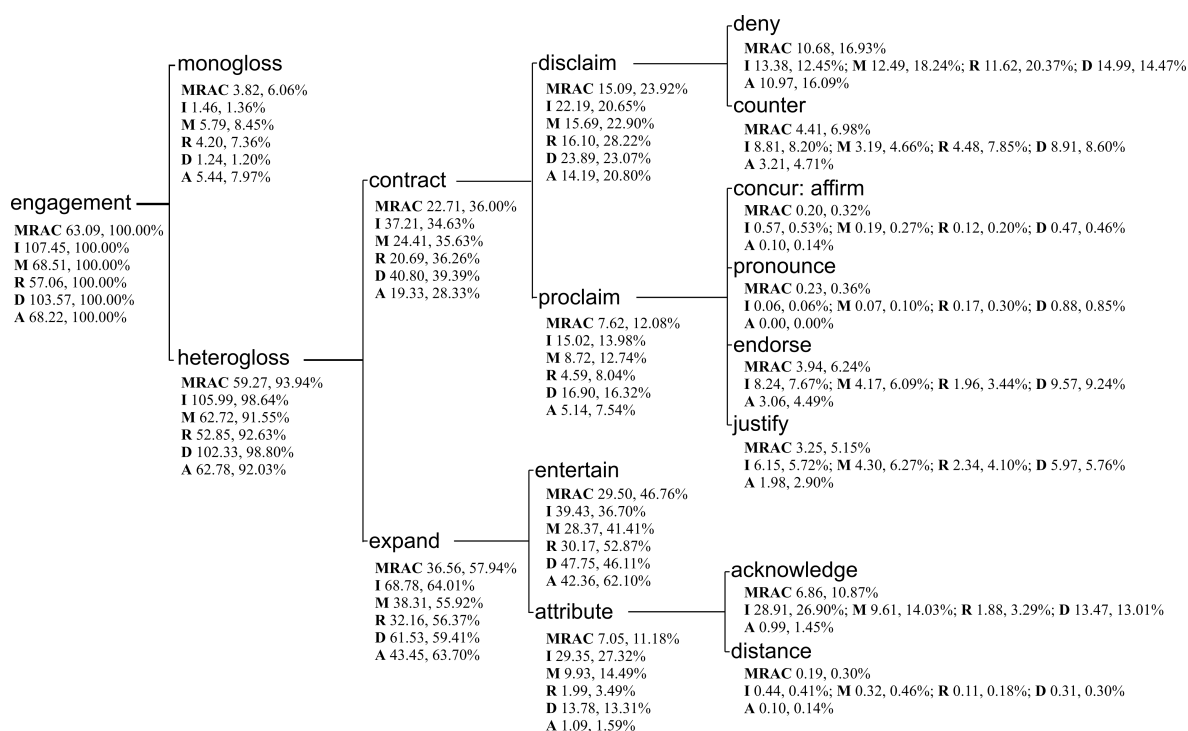


Figure 6.14. Generic variability of [engagement] across Introductions (I), Methods (M), Results (R), Discussions (D), Abstracts (A), and MRAC as a whole (MRAC): relative frequencies per 1000 words and global selection probabilities, %.

### 6.2.1 Introduction Sections

The Introduction section of the modern medical research article has three main functions or phases: describing the field of study, identifying a gap in the field, and stating the main research purposes (see section 4.1.1). There are 1695 instances of [engagement] in the combined Introduction sections in MRAC (RF 107.45 per 1000 words; range across individual RAs 69.62–160.12 per 1000 words). Compared with MRAC as a whole, the frequency of instantiation of [engagement], and especially [heterogloss] and [heterogloss: expand], is almost double in MRAC Introductions (see Figure 6.14). Table 6.2 summarizes global selection probabilities, relative frequencies, and the most common realizations of [engagement] in MRAC Introductions and includes comparison with MRAC as a whole. ‘Entertain’ and ‘acknowledge’ are the most frequently instantiated options, followed by ‘deny’, ‘counter’, ‘endorse’, and ‘justify’, although there is considerable variation among individual RAs, as can be seen from the ranges of relative frequencies in Table 6.2.

Table 6.2. Summary of global selection probabilities, relative frequencies, and most common realizations of [engagement] in MRAC Introductions.

Feature	Global selection prob., GSP	Rel. freq./1000 words (range/RA)	MRAC as a whole: GSP, rel. freq.	Most common realizations (most frequent first, max. five)
<b>Monogloss</b>	<b>1.36%</b>	<b>1.46 (0.00-8.20)</b>	<b>6.06%, 3.82</b>	<b>bare assertions: material (73.68%), relational (21.05%)</b>
<b>Heterogloss</b>	<b>98.64%</b>	<b>105.99 (69.62-160.12)</b>	<b>93.94%, 59.27</b>	<b>numerical references, risk (n), not, however, un-</b>
<b>Contract</b>	<b>34.63%</b>	<b>37.21 (15.21-77.46)</b>	<b>36.00%, 22.71</b>	<b>not, however, un-, failure, non-</b>
Deny	12.45%	13.38 (0.00-42.30)	16.93%, 10.68	<i>not, un-, non-, failure, in-</i>
Counter	8.20%	8.81 (0.00-35.21)	6.98%, 4.41	<i>however, but, although, only, despite</i>
Affirm	0.53%	0.57 (0.00-6.13)	0.32%, 0.20	<i>clear, clearly, logical, obvious</i>
Concede	0.00%	0.00	0.00, 0.00%	—
Pronounce	0.06%	0.06 (0.00-1.96)	0.36%, 0.23	<i>indeed</i>
Endorse	7.67%	8.24 (0.00-20.00)	6.24%, 3.94	<i>show, demonstrate, determine, evidence (n), find</i>
Justify	5.72%	6.15 (0.00-19.35)	5.15%, 3.25	<i>to (inf), because, therefore, thus, since (conj)</i>
<b>Expand</b>	<b>64.01%</b>	<b>68.78 (31.65-100.92)</b>	<b>57.94%, 36.56</b>	<b>numerical references, risk (n), may, whether, report (v)</b>
Entertain	36.70%	39.43 (9.13-69.36)	46.76%, 29.50	<i>risk (n), may, whether, can, include</i>
Acknowledge	26.90%	28.91 (6.33-64.22)	10.87%, 6.86	<i>numerical references, report (v), estimate, suggest, report (n)</i>
Distance	0.41%	0.44 (0.00-5.99)	0.30%, 0.19	<i>quotation marks, so-called, criticize</i>
<b>Engagement, total</b>	<b>100%</b>	<b>107.45 (69.62-160.12)</b>	<b>100%, 63.09</b>	<b>numerical references, risk (n), not, however, un-</b>

The first phase of the Introduction section, describing the field of study, is characterized by an opening generalized statement, a “centrality claim”



(Swales 1990, 143–145) that, when ‘monoglossic’ (as is sometimes the case), can generally be ‘taken for granted’ (Martin and White 2005, 100). Such opening statements are not usually ‘at issue’ or ‘up for discussion’ (Martin and White 2005, 100), but they may be in need of support or substantiation. This support generally takes the form of numerical references to largescale studies, which ground the proposition in the subjectivity of an external voice or voices and open up the dialogic space for alternatives. Examples of opening statements without externally sourced ‘acknowledgments’ and with externally sourced ‘acknowledgments’ are given in (6.113) and (6.114), respectively. In (6.113), the ‘monoglossic’ bare assertion is assumed to be taken for granted, and no obvious support for the claim is provided. (The references later in the paragraph appear to refer to causes rather than incidence.) In (6.114), however, the opening statement is accompanied by a numerical reference ‘acknowledging’ an external voice as both the source of the definition for *VEGF* and its claimed importance. The Themes in both opening statements in (6.113) and (6.114), i.e. *The incidence of type 2 diabetes mellitus* and *Vascular endothelial growth factor (VEGF), a diffusible glycoprotein produced by normal and neoplastic cells*, are central to the overall macro-Themes for each paper (see Martin and Rose 2007, 187–215, on Theme, hyper-Theme, and macro-Theme).

(6.113) The incidence of type 2 diabetes mellitus is increasing worldwide. Type 2 diabetes results from the interaction between a genetic predisposition and behavioral and environmental risk factors.<sup>1</sup> Although the genetic basis of type 2 diabetes has yet to be identified, there is strong evidence that such modifiable risk factors as obesity and physical inactivity are the main nongenetic determinants of the disease.<sup>2-9</sup>

(MRAC\_43)

(6.114) Vascular endothelial growth factor (VEGF), a diffusible glycoprotein produced by normal and neoplastic cells, is an important regulator of physiologic and pathologic angiogenesis.<sup>1</sup> Preclinical studies have shown that a murine antihuman monoclonal antibody against VEGF can inhibit the growth of human tumor xenografts,<sup>2</sup> and a humanized variant of this antibody (bevacizumab [Avastin])<sup>3</sup> is being evaluated in clinical trials as a treatment for various cancers.

(MRAC\_18)

In further describing the field of study, ‘monoglossic’ statements, which are almost exclusively associated with centrality claims in MRAC Introductions, give way to ‘heteroglossic’ propositions that bring other voices into the discourse. Previous studies are explicitly ‘acknowledged’, and the findings of those studies are evaluated (‘entertain’) and ‘endorsed’ as the textual voice establishes the overall field of study. Examples of some of these ‘heteroglossic’ resources are highlighted in (6.115) and (6.116) below.

(6.115) Patients with diabetic nephropathy have a progressive decline in glomerular function, and the treatment of hypertension in these patients slows the rate of loss of renal function<sup>1-5</sup>. Angiotensin-converting-enzyme inhibitors have been used in several trials<sup>6-8</sup>. Findings in studies of animals with diabetes mellitus suggested that angiotensin-converting-enzyme inhibitors could reduce glomerular damage by one or more mechanisms independent of their antihypertensive effects<sup>9-11</sup>.

(MRAC\_20)

(6.116) The treatment of human immunodeficiency virus (HIV) infection has undergone considerable change.<sup>1-3</sup> Protease inhibitors and non-nucleoside-analogue reverse-transcriptase inhibitors, when used as part of combination drug regimens, can profoundly suppress viral replication, with consequent repletion of CD4+ cell counts.<sup>4-7</sup> Multiple clinical trials have shown the virologic and immunologic efficacy of the newer, highly active antiretroviral-drug combinations<sup>7,8</sup> by measuring the plasma load of HIV RNA and CD4+ cell counts.<sup>9-16</sup>

(MRAC\_28)

The second phase of the Introduction, identifying a gap in the field, is typified by ‘contractive’ features such as [counter] and [deny], often as [counter] + [deny] pairings (Martin and White 2005, 120)—see (6.117) and (6.118). Conjunctive Adjuncts such as *however* and *although* and the conjunction *but* commonly signal adversativity or counterexpectancy, invoking a contrary position that is construed not to hold. Such counterexpectancy plays an important rhetorical role in convincing the reader that not only are there gaps in the research, but that these gaps need to be addressed (see (6.117)).<sup>120</sup> Similarly, [deny] resources such as

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<sup>120</sup> In the third sentence of (6.117), the textual voice gives an explicit reason (‘justify’) as to why “[t]his issue is of importance”, signalled by the conjunction *because*.

the negative operator *not* (see (6.117)) and the negative determiner *no*, as well as certain negative prefixes such as *un-* (see (6.118)) and *non-*, invoke and reject alternative (polar-positive and modal) positions.

- (6.117) Clinical trials have shown that lowering elevated LDL [low-density lipoprotein] cholesterol levels prevents both first and recurrent coronary events.<sup>8-11</sup> However, it has not been clear whether coronary events can be prevented by cholesterol-lowering therapy in patients who do not have hypercholesterolemia. This issue is of importance because the large majority of patients with coronary disease have cholesterol levels that are, like those of the general population,<sup>12</sup> in the average, not the elevated, range.<sup>13-16</sup>
- (MRAC\_35)

- (6.118) Large end point studies have demonstrated conclusively that effective cholesterol-lowering treatment can substantially reduce myocardial infarction and other coronary events. In the Scandinavian Simvastatin Survival Study the 3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitor simvastatin reduced total mortality in patients with CHD by 30% because of a 42% reduction in deaths from CHD.<sup>6</sup> Subsequently, pravastatin was shown to reduce fatal and nonfatal coronary events in patients with<sup>7</sup> and without<sup>8</sup> CHD. However, it is unknown whether benefit from reduction of low-density lipoprotein cholesterol (LDL-C) in patients without CHD (primary prevention) extends to individuals with average serum cholesterol levels, women, and older persons.
- (MRAC\_08)

The third phase of the Introduction states the main research purpose(s), shifting focus from “other studies” to the “present study”. This inter- to intratextual shift is marked dialogically by a specific set of [entertain] resources and a relative lack of ‘acknowledgments’ (cf. first two stages described above), with propositions grounded primarily in the subjecthood of the textual voice rather than external sources. Two articles, MRAC\_19 and MRAC\_37, formulate research purposes as closed questions (see example in (6.119)), ‘entertaining’ a potentially diverse dialogic background of alternative responses: yes, no, and everything in between (Martin and White 2005, 110).<sup>121</sup> Most MRAC articles, however, formulate research purposes as statements, with instances of [entertain] realized by

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<sup>121</sup> Although research objectives may be “more sharply focused when stated as a question” (ICMJE 2008), this option is not the default choice in MRAC, or in contemporary medical research articles in general (Webber 1994, Carter-Thomas and Rowley-Jolivet 2014).

nominal groups such as *the aim* or *the hypothesis*, or their verbal-group equivalents (*aimed*, *hypothesized*). Examples of these are provided in (6.120) and (6.121). In (6.120), the research purpose is stated as an indirect question and then as a hypothesis, both of which construe [entertain].<sup>122</sup> In (6.121), the research purpose is cast as a mental clause in which *this study*, “a product of human consciousness” directly related to the textual voice, is given the role of Senser (Halliday and Matthiessen 2014, 250). The verb *aimed*, as an expression of intention or desire, construes [entertain].

(6.119) The Diabetes Prevention Program Research Group conducted a large, randomized clinical trial involving adults in the United States who were at high risk for the development of type 2 diabetes. The study was designed to answer the following primary questions: Does a lifestyle intervention or treatment with metformin, a biguanide antihyperglycemic agent, prevent or delay the onset of diabetes? Do these two interventions differ in effectiveness? Does their effectiveness differ according to age, sex, or race or ethnic group?

(MRAC\_19)

(6.120) We therefore asked whether the extent of angiogenesis in human breast carcinoma correlated with the occurrence of metastasis. The hypothesis we wished to test was that lesions that have little angiogenesis have a relatively low rate of metastasis, whereas lesions that have entered a higher angiogenic state have an increased probability of metastasis.

(MRAC\_47)

(6.121) This study aimed to assess the safety and efficacy of two different regimens of peginterferon alfa-2b in combination with ribavirin compared with interferon alfa-2b plus ribavirin, and to identify predictors of response for peginterferon alfa-2b plus ribavirin.

(MRAC\_23)

Not all articles in MRAC mark the shift from other studies to the present study ‘heteroglossically’. Seven articles present the main research purpose ‘monoglossically’, deploying a lexicogrammatical resource that otherwise construes [heterogloss: attribute], namely *report* (see Table 6.2 and section 6.1.2.2.1). In (6.122), *report* does not ‘acknowledge’ some external source; rather, it grounds the proposition in the textual voice’s “single,

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<sup>122</sup> *Hypothesis*: “a supposition or proposed explanation made on the basis of limited evidence as a starting point for further investigation” (OED).

autonomous and isolated subjecthood” (Martin and White 2005, 99), retaining the inter- to intratextual shift characteristic of the generic stage.

- (6.122) In this article we report the results from the latest NHANES [National Health and Nutrition Examination Survey] data from 1999-2000 regarding population trends in obesity and in the frequency distribution of BMI [body-mass index].  
(MRAC\_11)

The most frequently used [engagement] resources in MRAC Introductions are superscript numerical references and the noun *risk*. As noted in section 6.1.2.1, *risk* ‘entertains’ the extent to which some outcome or endpoint is likely or unlikely. *Risk* is frequently quantified in MRAC, but only rarely in Introduction sections (see first instance in (6.123)). In MRAC Introductions, *risk* is found in all three phases of the section (see (6.123), (6.124), and (6.125), respectively) and is central to the overall purpose or macro-Theme of those articles.

- (6.123) Critically ill patients who require intensive care for more than five days have a 20 percent risk of death and substantial morbidity.<sup>1</sup> Critical-illness polyneuropathy and skeletal-muscle wasting prolong the need for mechanical ventilation.<sup>2-5</sup> Moreover, increased susceptibility to severe infections and failure of vital organs amplify the risk of an adverse outcome.  
(MRAC\_46)

- (6.124) Laboratory and pathological data support the idea that inflammation has a role in both the initiation and the progression of atherosclerosis, and antiinflammatory agents may have a role in the prevention of cardiovascular disease.<sup>2-5</sup> However, there are few data to indicate whether inflammation increases the risk of first myocardial infarction, stroke, and venous thrombosis or whether antiinflammatory therapy decreases that risk.  
(MRAC\_32)

- (6.125) The objective of this study was to estimate the effects of air pollution on mortality, with control for individual smoking status, sex, age, and other risk factors.  
(MRAC\_07)

The [engagement] resources deployed in MRAC Introductions suggest dialogic spaces in which the textual voice and reader are construed as sharing “the same belief or attitude or ‘knowledge’” (White 2003, 269). Although the potential for disalignment is minimal, there are instances in

which writer–reader solidarity could be threatened. For example, in (6.98)—reproduced below as (6.126)—‘distance’, ‘counter’, ‘deny’, and ‘entertain’ resources (underlined) combine in such a way as to potentially disalign readers for whom the J-shaped relation might be an important or real issue.

(6.126) In addition, concerns have been expressed that too vigorous reduction in blood pressure may be associated with increased cardiovascular risk—the so-called J-curve concept.<sup>9, 10, 11 and 12</sup> The issue of how far blood pressure should be lowered to achieve the greatest benefit, in terms of reduced cardiovascular morbidity and mortality, has been a matter of scientific debate.<sup>13</sup> The real issue is not whether the relation between achieved blood pressure and cardiovascular events is J-shaped (it must be), but whether there are additional benefits, or risks, in lowering blood pressure of patients with hypertension to fully normotensive levels—ie, between 70 mm Hg and 85 mm Hg diastolic blood pressure—or whether there is little further benefit in lowering diastolic blood pressure much below 90 mm Hg.<sup>14</sup> This issue needed to be addressed in a randomised and prospective trial and this was one of the reasons for doing the present study.

(MRAC\_16)

In summary, the Introduction sections of MRAC are characterized by high frequencies of [engagement] compared with MRAC as a whole. Moreover, the kinds and degrees of [engagement] in MRAC Introductions change as the generic stage unfolds. The phase that describes the field of study is characterized by dialogically expansive ‘acknowledgments’ to and ‘endorsements’ of other researchers’ work; the phase that identifies a gap in the field is characterized by dialogically contractive ‘counters’ and ‘denials’; and the phase that states the main research purpose is characterized by ‘entertain’ and ‘monogloss’. Overall, in terms of [engagement], MRAC Introductions represent a dialogic narrowing that resembles the general-to-particular funnelling effect described by Hill, Soppelsa, and West (1982, 335–336), Swales (1990, 133–134), and Atkinson (1992, 341) for research article introductions and that mirrors an inter- to intratextual shift in the text.

### 6.2.2 Methods Sections

The main phases of the Methods section in contemporary medical research articles include describing the study material and recounting the

experimental and data-analysis procedures (see section 4.1.1). There are 4782 instances of [engagement] in the Methods sections of MRAC (RF 68.51 instances per 1000 words; range across individual RAs 42.48–109.87 per 1000 words). Compared with MRAC as a whole, there are notably larger relative frequencies for [monogloss] and [justify] and lower relative frequencies for [counter], [pronounce], and [acknowledge] in MRAC Methods (see Figure 6.14). Table 6.3 summarizes global selection probabilities, relative frequencies, and the most common realizations of [engagement] in MRAC Methods and includes comparison with MRAC as a whole. ‘Entertain’ and ‘deny’ are the most frequently instantiated ‘engagement’ features, followed by ‘acknowledge’, ‘justify’, ‘endorse’, and ‘counter’, although there is considerable variation among individual RAs, as can be seen from the ranges of relative frequencies (Table 6.3).

Table 6.3. Summary of global selection probabilities, relative frequencies, and most common realizations of [engagement] in MRAC Methods.

Feature	Global selection prob., GSP	Rel. freq./1000 words (range/RA)	MRAC as a whole: GSP, rel. freq.	Most common realizations (most frequent first, max. five)
Monogloss	8.45%	5.79 (0.00-12.24)	6.06%, 3.82	bare assertions: material (84.51%), relational (9.43%)
Heterogloss	91.55%	62.72 (25.95-92.24)	93.94%, 59.27	numerical references, <i>if, to (inf), not, non-</i>
Contract	35.63%	24.41 (7.04-45.10)	36.00%, 22.71	<i>to (inf), not, non-, un-, no</i>
Deny	18.24%	12.49 (3.52-22.74)	16.93%, 10.68	<i>not, non-, un-, no, failure</i>
Counter	4.66%	3.19 (0.00-7.82)	6.98%, 4.41	<i>but, only, however, except, other than</i>
Affirm	0.27%	0.19 (0.00-2.31)	0.32%, 0.20	<i>clearly, clear, obvious, inevitably</i>
Concede	0.00%	0.00	0.00, 0.00%	—
Pronounce	0.10%	0.07 (0.00-0.88)	0.36%, 0.23	<i>the fact that, pivotal, note, in fact</i>
Endorse	6.09%	4.17 (0.00-11.61)	6.24%, 3.94	<i>approve, confirm, indicate, evidence (n), determine</i>

Feature	Global selection prob., GSP	Rel. freq./1000 words (range/RA)	MRAC as a whole: GSP, rel. freq.	Most common realizations (most frequent first, max. five)
Justify	6.27%	4.30 (0.00-10.48)	5.15%, 3.25	<i>to (inf), because, since (conj), on the basis of, so</i>
<b>Expand</b>	<b>55.92%</b>	<b>38.31 (7.98-64.76)</b>	<b>57.94%, 36.56</b>	<b>numerical references, if, primary, include, risk (n)</b>
Entertain	41.41%	28.37 (5.99-51.66)	46.76%, 29.50	<i>if, primary, include, risk (n), at least</i>
Acknowledge	14.03%	9.61 (0.82-20.30)	10.87%, 6.86	<i>numerical references, report (v), informed consent, describe, approve</i>
Distance	0.46%	0.32 (0.00-4.24)	0.30%, 0.19	<i>quotation marks</i>
<b>Engagement, total</b>	<b>100%</b>	<b>68.51 (42.48-109.87)</b>	<b>100%, 63.09</b>	<b>numerical references, if, to, not, non-</b>

The first phase in the Methods section, describing the study material, variously describes the type of study, the size of the study sample, the selection of study groups (including an explanation of inclusion and exclusion criteria), the study location, and/or length of study period. The phase is typified by instances of [monogloss], [deny], and [justify], and by a relative lack of ‘expansive’ resources.

Descriptions of the type of study, the size of the study sample, the study location, and the study period are often characterized by ‘monoglossic’ statements. In (6.127), the textual voice makes no overt reference to other voices or viewpoints in the discourse. The study type, study size, and study groups are presented as bare assertions, as statements of fact that do not need to recognize or invoke some dialogic background. Here, the “autonomous subjecthood” of the textual voice and its presumed role in collecting study material can be taken as given.

- (6.127) The double-blind, two-by-two factorial, randomized Heart Outcomes Prevention Evaluation study evaluated ramipril and vitamin E in 9541 patients. A substudy compared a low dose of ramipril (2.5 mg per day) with a full dose (10 mg per day) or placebo; there were 244 patients in each group. The results of the placebo-controlled study of full-dose ramipril are given here.



(MRAC\_50)

Many of the studies in MRAC are direct follow-up or continuation studies of previous or ongoing research and thus elaborate upon previously published work. In such instances (see (6.128) below), the Methods section opens with a reference or references to previously published research, offering the reader a more comprehensive description of some or all of the methods used and providing ‘acknowledgments’ and possible ‘endorsements’ of those methods.<sup>123</sup>

- (6.128) A full description of the methods of the study has been published elsewhere.<sup>19</sup>  
The key features of the conduct of the trial were as follows.

(MRAC\_41)

In describing and explaining the selection of study groups, certain propositions are rejected or ‘denied’, especially with regard to the exclusion of different patients or patient groups.<sup>124</sup> That ‘denial’ can be expressed at the level of clause or clause-complex, or further down the rank scale, within phrases, groups, or words, as shown in examples (6.129) and (6.130), respectively. In both cases, ‘justifications’ (*since...* and *because...*) are given for those ‘denials’.

- (6.129) Silent myocardial infarctions were not included, since they could not be dated accurately.

(MRAC\_32)

- (6.130) We declared 481 households ineligible because respondents did not speak English or because of cognitive or physical incapacity.

(MRAC\_09)

In some Methods sections, conditions for inclusion or exclusion are signalled by [entertain] resources like *if* and *when* (see section 6.1.2.1). An example of this is provided in (6.131).

<sup>123</sup> Reference to more detailed methods published elsewhere is made in 19 of 50 RAs in MRAC. In one RA, MRAC\_45, the previously published material is itself part of the corpus (MRAC\_44).

<sup>124</sup> *Exclude* and *exclusion* are instances of ‘semantic negation’ (Fairclough 1992, 122). See section 6.1.1.1.1 for discussion of the role of semantic negation in construing [deny].

(6.131) Patients were excluded if they had bilateral breast cancer, untreated brain metastases, osteoblastic bone metastases, pleural effusion or ascites as the only evidence of disease, a second type of primary cancer, or a Karnofsky score of less than 60. Patients were also excluded if they were pregnant or had received any type of investigational agent within 30 days before the study began.

(MRAC\_39)

Statements regarding study approval and informed consent are sometimes considered a separate phase in the Methods (Davis 2015) or a sub-phase of describing the study material (Fryer 2012). In terms of [engagement], study approval represents an ‘acknowledgment’ of an ‘endorsement’, i.e. “we, the authors, acknowledge that this study was approved [endorsed] by a local ethics committee”. Similarly, informed consent suggests a double ‘acknowledgment’ (see section 6.1.2.2.1) in which the textual voice ‘acknowledges’ the patient or patients as the source of consent and the study or researchers as the source of information. Together, study approval and informed consent constitute a research article’s “ethics statement” (Davis 2015, 90–92), which, interpersonally, is an important part of asserting credibility for the research. See example (6.92), reproduced below as (6.132).

(6.132) The institutional review board at each center approved the protocol, and written informed consent was obtained from all participants or their authorized representatives.

(MRAC\_01)

A second phase in the Methods section is recounting the experimental procedure. This phase, like the previous phase, is characterized by ‘monoglossic’ statements. In (6.101)—reproduced here as (6.133)—those statements describe a step-by-step experimental study protocol. As discussed in section 6.1.3, all seven matrix clauses construe [monogloss] and recount what was done. All clauses are material, i.e. clauses of doing or happening, and there are no instances of [heterogloss].<sup>125</sup>

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<sup>125</sup> The high frequency of material clauses in ‘monoglossic’ statements and in propositions in general in MRAC Methods reflects the “doings and happenings” characteristic of the stage and characteristic of the activity of “doing” research. Processes typical of these

(6.133) The first treatment group received peginterferon alfa-2b (PEG-Intron, Schering Corp, Kenilworth, NJ, USA) at a dose of 1.5 ( $\mu\text{g}/\text{kg}$ ) each week subcutaneously plus oral ribavirin (Rebetol, Schering Corp) at a dose of 800 mg/day for 48 weeks ( $n=511$ ). The second group received peginterferon alfa-2b subcutaneously at a dose of 1.5 ( $\mu\text{g}/\text{kg}$ ) each week for the first 4 weeks followed by 0.5 ( $\mu\text{g}/\text{kg}$ ) per week for the next 44 weeks plus 1000–1200 mg/day of ribavirin orally for 48 weeks ( $n=514$ ). The third group received interferon alfa-2b (Intron A, Schering Corp), 3 million units subcutaneously three times per week, plus ribavirin 1000–1200 mg/day orally, both for 48 weeks ( $n=505$ ). In the two groups receiving 1000–1200 mg ribavirin, the dose was adjusted according to bodyweight (1000 mg for weight below 75 kg, and 1200 mg for weight 75 kg or more). For all groups, ribavirin was administered in two divided doses per day. Peginterferon alfa-2b was administered subcutaneously once per week according to weight. Both drugs were started and stopped at the same time. Patients were followed up for 24 weeks after treatment.

(MRAC\_23)

A similar series of ‘monoglossic’ statements can be seen in (6.134). Like (6.133), the text recounts what was done. However, (6.134) also includes instances of [heterogloss] that [acknowledge] previous work and [justify] certain methodological choices (highlighted below).

(6.134) Base-line plasma samples from each woman with an event and each control subject were thawed and assayed for hs-CRP, serum amyloid A, and Lp(a) lipoprotein with use of latex-enhanced immunonephelometric assays on a BN II analyzer (Dade Behring, Newark, Del.). Apolipoprotein A-I and apolipoprotein B-100 were simultaneously measured with this device by immunoassay. Total cholesterol, HDL cholesterol, and directly obtained LDL cholesterol levels were measured on a Hitachi 911 analyzer (Roche Diagnostics, Indianapolis) with reagents from Roche Diagnostics and Genzyme (Cambridge, Mass.). Plasma levels of sICAM-1 and interleukin-6 were measured by enzyme-linked immunosorbent assay (R & D Systems, Minneapolis), and the total plasma homocysteine level was measured with an IMx homocysteine assay (Abbott Laboratories, Abbott Park, Ill.) as previously reported.<sup>16</sup> Samples were handled in identical and in blinded fashion throughout the study. Samples were analyzed in triplicate and in random order so as to reduce systematic bias and interassay variation.

(MRAC\_33)

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material clauses include the verbs *measure, give, take, receive, use, record, administer, and perform*.

A related phase, recounting the data-analysis procedure, has a similar function to recounting the experimental procedure.<sup>126</sup> However, in accounting for the statistical tests and software used in the study, this phase contains fewer instances of [monogloss] and more instances of [heterogloss], particularly in the form of references and mathematical expressions of probability ([acknowledge] and [entertain], respectively).<sup>127</sup> Instances of [justify] are also characteristic of the phase. See highlighted examples in (6.135)–(6.137) below.

(6.135) After the serum analysis, epidemiologic, pathological, and serologic data were entered and analyzed with the EpiInfo (Centers for Disease Control, Atlanta) and Egret (Statistics and Epidemiology Research Corporation, Seattle) computer programs. Pairs of patients and control subjects were excluded from analysis if serum was not available from both members of the pair. Matched analysis was done with McNemar's chi-square test with 95 percent confidence intervals as described previously,<sup>34</sup> the paired t-test, and conditional logistic regression. Unmatched analyses among case patients were done with the chi-square test, the t-test, and logistic regression.

(MRAC\_29)

(6.136) At the outset of the study, the size of the required sample (428 patients) was based on an assumed rate of clinical events of 30 percent in the angioplasty group and a reduction of that rate by 40 percent in the stent group (by a two-sided test with an alpha error of 0.05 and a power of 0.80). To compensate for unsuccessful interventions and losses to follow-up, the sample was enlarged by 10 percent (to 470 patients). In addition, to adjust for a loss of power due to a planned interim analysis, the sample was increased by another 10 percent, reaching a final size of 520 patients<sup>11</sup>.

(MRAC\_36)

(6.137) The study was designed to have 220 patients per group in order to have a power of 89 percent to detect a difference of 15 percentage points between the rates of sustained virologic response (30 percent vs. 45 percent), at a 5 percent level of significance (with two-sided tests). The treatment responses were compared with the use of Fisher's exact test.<sup>21</sup> Changes in the liver-biopsy score within each group were compared with the use of Student's t-tests.<sup>21</sup> The

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<sup>126</sup> Davis (2015, 96) argues that recounting experimental procedures and recounting data-analysis procedures are similar in “rhetorical intent” and might therefore be considered a single, combined generic phase.

<sup>127</sup> Although the statistical tests described in Methods sections usually involve some measure of probability (e.g. the extent to which a particular outcome may be due to chance), simply stating that a particular test was performed does not necessarily encode [entertain].

relation between pretreatment variables and treatment response was examined by stepwise logistic-regression analysis.<sup>22</sup> All P values are two-tailed.  
(MRAC\_25)

None of the examples discussed in this section seem to imply disalignment between the textual voice and the reader or a third party. Any potential disalignment, for example with regard to choice of methods, is likely avoided through the use of ‘justification’, ‘acknowledgment’, and/or ‘entertain’. A possible example of this can be seen in (6.138), where two calculations of costs are described. Note how the reasons for recalculating costs are presented as [entertain] + [justify] pairings—*partly to...* and *primarily to...*—connected by an instance of [counter *but*]. A final [entertain] resource, *should*, helps recognize and legitimize a position that may differ from that of the textual voice, maintaining the possibility of solidarity even with someone who might hold contrary views (cf. Martin and White 2005, 109).

- (6.138) We calculated costs based on per-visit prices chosen from typical prices paid for such services by private insurers using a Resource-Based Relative Value Scale (RBRVS)<sup>16</sup> system in selected states. We then recalculated costs using a second set of prices chosen partly to reflect empirical data on the out-of-pocket costs paid by the respondents, but primarily to represent conservative estimates of the per-visit cost of alternative therapies. Total costs based on this second set of prices should represent a lower bound on true expenditures.  
(MRAC\_09)

In summary, the Methods sections of MRAC are characterized by high frequencies of [monogloss], [deny], and [justify], and low frequencies of [counter] and [entertain], relative to MRAC as a whole.<sup>128</sup> Parts of the Methods section construe a relatively narrow dialogic space, but not one that necessarily resembles Hill, Soppelsa, and West’s (1982, 335–336) narrow funnel stem. From a dialogic perspective, the experimental procedure phase is arguably narrower than the study material and data-analysis phases that precede and succeed it, suggesting a generic stage that

<sup>128</sup> The number of instantiations of [entertain] in MRAC Methods is only slightly lower than that for MRAC as a whole (see Table 6.3). However, the number of realization-types is greatly reduced, with [entertain] encoded primarily by conditional clauses and mathematical-symbolic or mathematical-verbal resources.

more closely resembles that of an hourglass, as phases open, close, then open the dialogic space for alternatives.

### 6.2.3 Results Sections

The Results section typically comprises three or four interrelated generic phases: reporting findings, presenting data in the form of tables and graphs, describing and reporting the results of any adjustments made to the data or data analysis, and explaining or evaluating selected findings (see section 4.1.1). There are 5411 instances of [engagement] in the Results sections of MRAC (RF 57.06 instances per 1000 words; range across individual RAs 25.16–95.09 instances per 1000 words). Compared with MRAC as a whole, MRAC Results generally have fewer instantiations of [engagement], especially [endorse] and [acknowledge], but a relatively high frequency of [monogloss] and [deny]. ‘Entertain’ and ‘deny’ are the most frequently instantiated [engagement] features in MRAC Results, followed by [counter], [monogloss], and [justify], although there is considerable variation among individual RAs (see Table 6.4).

Table 6.4. Summary of global selection probabilities, relative frequencies, and most common realizations of [engagement] in MRAC Results.

Feature	Global selection prob., GSP	Rel. freq./1000 words (range)	MRAC as a whole: GSP, rel. freq.	Most common realizations (most frequent first, max. five)
Monogloss	7.36%	4.20 (0.88-13.67)	6.06%, 3.82	bare assertions: material (58.54%), relational (31.71%), existential (6.97%)
Heterogloss	92.63%	52.85 (23.27-85.82)	93.94%, 59.27	<i>p</i> (p-value), <i>risk</i> (n), <i>not</i> , <i>non-</i> , <i>no</i>
Contract	36.26%	20.69 (6.86-46.39)	36.00%, 22.71	<i>not</i> , <i>non-</i> , <i>no</i> , <i>but</i> , <i>because</i>
Deny	20.37%	11.62 (3.28-36.63)	16.93%, 10.68	<i>not</i> , <i>non-</i> , <i>no</i> , <i>un-</i> , <i>failure</i>
Counter	7.85%	4.48 (0.77-11.49)	6.98%, 4.41	<i>but</i> , <i>however</i> , <i>only</i> , <i>although</i> , <i>whereas</i>
Affirm	0.20%	0.12 (0.00-1.36)	0.32%, 0.20	<i>evident</i> , <i>clear</i> , <i>obvious</i> , <i>clearly</i>
Concede	0.00%	0.00	0.00, 0.00%	—

Feature	Global selection prob., GSP	Rel. freq./1000 words (range)	MRAC as a whole: GSP, rel. freq.	Most common realizations (most frequent first, max. five)
Pronounce	0.30%	0.17 (0.00-2.05)	0.36%, 0.23	<i>indeed, remarkably, the fact that, noteworthy, of note</i>
Endorse	3.44%	1.96 (0.00-9.84)	6.24%, 3.94	<i>show, find, indicate, know, finding (n)</i>
Justify	4.10%	2.34 (0.00-12.35)	5.15%, 3.25	<i>because, to (inf), due to, reason, since</i>
<b>Expand</b>	<b>56.37%</b>	<b>32.16 (14.10-56.40)</b>	<b>57.94%, 36.56</b>	<b><i>p (p-value), risk (n), confidence interval, mean, median</i></b>
Entertain	52.87%	30.17 (14.10-52.25)	46.76%, 29.50	<i>p (p-value), risk (n), confidence interval, mean, median</i>
Acknowledge	3.29%	1.88 (0.00-10.38)	10.87%, 6.86	<i>numerical references, report (v), report (n), note (v), recommend</i>
Distance	0.18%	0.11 (0.00-1.85)	0.30%, 0.19	<i>quotation marks</i>
<b>Engagement, total</b>	<b>100%</b>	<b>57.06 (25.16-95.09)</b>	<b>100%, 63.09</b>	<b><i>p (p-value), risk (n), not, non-, no</i></b>

Some Results sections begin by reporting patient enrolment or baseline characteristics, which variably includes how many patients entered the study, how many were considered (in)eligible, how many were randomized, how many were lost to follow-up, and possible reasons for dropping out of or discontinuing the study. Other RAs in MRAC present this information as part of the Methods section (see section 6.2.2). An example of this phase in the Results section is given in (6.139). A variety of [engagement] features are instantiated. These include [monogloss] and [deny], in asserting polar-positive or polar-negative facts about patients; [entertain], in speculating on eligibility and compliance, and in making approximations; [acknowledge], in referring to previous studies or to patients' own reports of their conditions; and [counter] and [deny], at the end of the paragraph, to make clear that, despite indications to the contrary, two patients were not excluded from the study.

(6.139) 63 603 people attended the initial screening clinic visit, and 32 145 were potentially eligible and agreed to enter the prerandomisation run-in phase of the study (figure 1).<sup>23</sup> Of those who entered run-in, 36% were not subsequently randomised: 26% chose not to enter the trial or did not seem likely to be compliant for 5 years, 5% were considered by their own doctors to have a clear indication for (or, rarely, contraindication to) statin therapy, 3% had elevated concentrations of liver enzymes, creatinine, or creatine kinase in their pretreatment screening blood sample, 2% attributed various problems to the run-in treatment (with about half doing so before starting any simvastatin), 1% had non-fasting screening total cholesterol below 3.5 mmol/L, 0.3% reported having myocardial infarction, stroke, or hospitalisation for angina during run-in, and two (0.01%) developed myopathy. Nobody was excluded because of elevations in liver enzymes during run-in: central laboratory assay of blood collected at the randomisation visit did subsequently identify alanine aminotransferase >4XULN in two people who had been randomised, but both continued in the study and those elevations were not persistent.

(MRAC\_03)

Not all opening phases of MRAC Results sections are as dialogically diverse as (6.139). In (6.140), for example, the opening paragraph on baseline characteristics starts with a series of ‘monoglossic’ statements (underlined) before recognizing or invoking other voices in the discourse.

(6.140) Between December 4, 1989, and December 31, 1991, 4159 patients were randomly assigned to study groups, 2078 to the placebo group and 2081 to the pravastatin group. The characteristics of the patients before randomization were similar in the two groups (Table 1). In the last year of follow-up, 86 percent of the placebo group and 94 percent of the treatment group were taking their study medication. This included the 6 percent of patients in each treatment group who were taking cholestyramine according to the protocol. Of the patients, 8 percent in the placebo group and 2 percent in the treatment group discontinued the study medication and started treatment to lower lipid levels with open-label drug therapy, as prescribed by their personal physicians. The final study visit was between January 1 and February 14, 1996, at which time the median duration of follow-up was 5.0 years (range, 4.0 to 6.2). Data were obtained to classify myocardial infarctions as confirmed or unconfirmed for all patients in whom a myocardial infarction was reported. Vital status was ascertained for the first four years for all patients and, at the end, for all but one patient.

(MRAC\_35)



'Monoglossic' statements are commonly used for reporting study findings.<sup>129</sup> In MRAC\_39, for example, several instances of [monogloss] are evident. In reporting on the number of adverse events (including death) in the study, the textual voice has little or no need to recognize or invoke other voices in the discourse (see examples (6.141) and (6.142)).

(6.141) As of October 1999, 314 patients had died (149 in the group given chemotherapy plus trastuzumab and 165 in the group given chemotherapy alone); 95 percent of these deaths were attributed to progressive disease. Two deaths, both in patients who had received an anthracycline, cyclophosphamide, and trastuzumab, were possibly related to trastuzumab therapy: one patient died of sepsis after 2 doses of trastuzumab, and the second died of hepatitis B-related hepatorenal syndrome after 11 doses of trastuzumab.

(MRAC\_39)

(6.142) Infection occurred in 47 percent of patients who were given chemotherapy plus trastuzumab and in 29 percent of those treated with chemotherapy alone (Table 4). These infections consisted of mild-to-moderate infections of the upper respiratory tract in 72 percent of cases, catheter-related infections in 9 percent, a viral syndrome in 3 percent, and other types of infections in 16 percent. Of the 14 catheter-related infections among patients who received trastuzumab, 3 were severe, 13 required treatment, and 4 required surgical removal of the catheter. The incidence of sepsis was low and evenly distributed among the four subgroups. The addition of trastuzumab to the chemotherapy regimen increased the frequency of leukopenia and anemia (Table 4). These cases of cytopenia were mild to moderate in severity and did not necessitate the discontinuation of trastuzumab or withdrawal from the study.

(MRAC\_39)

When the textual voice does recognize or invoke a dialogic background, it typically does so through negation or modality (see instances in (6.141) and (6.142) above). The Results section of MRAC\_39, to continue with the same example, concludes with two instances of [deny] (see (6.143)).

<sup>129</sup> 'Monoglossia' in MRAC Results differs from that in MRAC Introductions and Methods, in that a higher percentage of 'monoglossic' statements are realized by relational and existential clauses (see Table 6.4). Results sections focus less on what was done and more on what was observed and how those observations are characterized. Examples include *there were 142 and 209 acute major coronary events in participants treated with lovastatin and placebo, respectively* (MRAC\_08) and *the incidence of thrombotic events was similar in the two groups* (MRAC\_01). Note how the embedded clause in the first example is material, referring to what was done as part of the study methods.

However, what is ‘denied’ or rejected in (6.143) is not some commonly held “misunderstanding or misconception”; the rejection is not “corrective” (Martin and White 2005, 120). Rather, the rejected propositions are based on prior, text-internal utterances, set up in the Abstract, Introduction, and Methods, as part of the study aims. Those aims are reproduced in (6.144), taken from the Introduction of MRAC\_39. This use of [deny], as rejecting some prior, text-internal proposition, is a common feature of MRAC Results and differs from the text-external ‘denials’ instantiated in MRAC Introductions.

(6.143) Adding trastuzumab to the chemotherapy regimen did not increase the risk of other adverse events related to chemotherapy, and in no patient were antibodies against trastuzumab detected.

(MRAC\_39)

(6.144) We report the results of a phase 3 trial in which women with cancers that overexpressed HER2 who had not previously received chemotherapy for metastatic disease were randomly assigned to receive either chemotherapy alone or chemotherapy plus trastuzumab. The primary end points of the study were the time to disease progression and the incidence of adverse effects. Secondary end points were the rates and the duration of responses, the time to treatment failure, and overall survival.

(MRAC\_39)

Instances of [entertain] are also characteristic of the dialogic functionality of MRAC Results, especially in statistical analyses. Unlike the verbal [entertain] resources typical of the Introduction and Discussion sections (see sections 6.2.1 and 6.2.4), [entertain] in MRAC Results is generally realized by mathematical resources such as *p-values* and *relative risk* (see (6.145) below for examples of the former). Indeed, the relative frequency of mathematical [entertain] is higher in MRAC Results than in any other MRAC section. These mathematical [entertain] resources are often combined with instances of [deny], as in (6.146), where what is ‘denied’ is a projected assumption or anticipation of statistical significance.<sup>130</sup> These [deny] + [entertain] pairings are also common in generic phases that report adjusted analyses (see example (6.147)).

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<sup>130</sup> Example (6.145) also includes instances of local negation, i.e. *non-significant* and *non-vascular* (see section 6.1.1.1.1).

(6.145) All-cause mortality was significantly reduced (1328 [12.9%] deaths among 10 269 allocated simvastatin versus 1507 [14.7%] among 10 267 allocated placebo;  $p=0.0003$ ), due to a highly significant 18% (SE 5) proportional reduction in the coronary death rate (587 [5.7%] vs 707 [6.9%];  $p=0.0005$ ), a marginally significant reduction in other vascular deaths (194 [1.9%] vs 230 [2.2%];  $p=0.07$ ), and a non-significant reduction in non-vascular deaths (547 [5.3%] vs 570 [5.6%];  $p=0.4$ ).

(MRAC\_03)

(6.146) Among men, the increase in obesity was not significant ( $P = .0503$ ).

(MRAC\_26)

(6.147) The age- and sex-adjusted hazard ratio was not significantly different from 1.0 (hazard ratio, 1.4; 95 percent confidence interval, 0.7 to 2.6), suggesting that these groups have similar mortality rates. Further adjustment for LDL cholesterol, HDL cholesterol, triglyceride, smoking, and hypertension did not significantly change the results.

(MRAC\_14)

References to nonverbal or multimodal material in tables and graphs usually take one of three forms. Most commonly, they are given as parenthetical additions, as in (6.148), but occasionally they take the form of ‘monoglossic’ directives (see (6.149)).<sup>131</sup> Less frequently, references to tables and graphs are an integral part of the clause (cf. Swales 1990, 148, Fløttum 2003a, 102–105, Fløttum, Dahl, and Kinn 2006, 227), appearing in Subject position or as part of a circumstantial Adjunct, e.g. *Table 3 shows...* (MRAC\_06) or *... are shown in Figure 2* (MRAC\_16, MRAC\_23).<sup>132</sup> In both examples, *show* is used in the sense of “be, allow, or cause to be visible” rather than “demonstrate or prove” (OED; cf. [endorse *show*], section 6.1.1.2.3).

<sup>131</sup> Although the parenthetical addition in (6.149) is encoded as a command or directive, it is unlikely that such an instruction, in this instance, would not allow for the possibility of alternative actions, as Martin and White (2005, 111) seem to suggest.

<sup>132</sup> Swales (1990, 148) uses the terms “integral” and “non-integral” to refer to citations, where “[a]n integral citation is one in which the name of the researcher occurs in the actual citing sentence as some sentence-element; in a non-integral citation, the researcher occurs either in parenthesis or is referred to elsewhere by a superscript number or via some other device” (see review and discussion in section 4.2.2.2). Similar descriptors might be usefully applied to the way texts refer to tables and figures.

(6.148) Enrolment began in March, 1998, and the trial was completed in October, 2000. A total of 2316 patients were screened, and 1530 were enrolled and treated (figure 1).

(MRAC\_23)

(6.149) The proportional reduction in LDL cholesterol produced by actual use of 40 mg simvastatin daily is approximately independent of the presenting cholesterol concentration (see table 4 footnote).

(MRAC\_03)

None of the Results sections in MRAC include a specific generic phase that explains or evaluates selected findings. However, as some of the examples above show, interpretations of selected findings are offered at various points in the section. In (6.147), for example, the statistical analysis *suggests* (to the authors) that mortality rates in two groups are similar. Similar explanations or evaluations are given in (6.150) and (6.151), in which clusters or syndromes of verbal and mathematical [entertain] are deployed as authors speculate on the significance of their findings.

(6.150) No mutations were detected, suggesting that only a subgroup of cancers, in which EGFR signaling may play a critical role in tumorigenesis, harbor EGFR mutations.

(MRAC\_22)

(6.151) Few women with a history of VTE were enrolled, but these data suggest a possibility that these women may be at greater risk of future VTE events when taking estrogen plus progestin (7 vs 1; HR, 4.90; 95% CI, 0.58-41.06) than those without a history of VTE (144 vs 66; HR, 2.06; 95% CI, 1.54-2.76).

(MRAC\_34)

It seems that Results sections, perhaps more than any other section in MRAC, are grounded in the (often autonomous) subjecthood of the textual voice rather than some external source. While this may imply a generic stage in which the relation between writer and reader is at greater risk of disalignment, there seem to be few if any examples of this in MRAC. Instances of [monogloss] are likely to be 'taken for granted', and dialogic features that may imply a certain interpersonal risk—those construing [concur], [pronounce], and [endorse], for example—are relatively scarce (see Table 6.4). In instances where there may be a threat to writer–reader solidarity, for example in interpreting or evaluating selected findings,

combinations of [entertain] and [justify] ensure that, even in the case of disagreement, disalignment between the writer and reader (or some other third party) is unlikely.

In summary, the Results section of MRAC has relatively few instances of [engagement] compared with MRAC as a whole. From a more fine-grained, feature-by-feature perspective, the section is characterized by high relative frequencies of [monogloss] and [deny], and low relative frequencies of [acknowledge] and [endorse]. The section as a whole maintains a relatively narrow dialogic space for alternatives, particularly the phase that presents study findings. The statistical analyses and interpretation of selected findings in some Results sections, however, contain instances of mathematical and verbal [entertain] that suggest a broadening of the dialogic space as the section unfolds.

#### **6.2.4 Discussion Sections**

Discussion sections comprise several generic phases. They include reporting main findings (a reiteration of part of the Results section), exploring connections with the literature, explaining or discussing possible mechanisms or causes, discussing limitations, recommending possible applications and future research, and summarizing or concluding (see section 4.1.1).

There are 5674 instances of [engagement] in the Discussion sections of MRAC (RF 103.57 instances per 1000 words; range across individual RAs 69.05–141.34 per 1000 words). Compared with MRAC as a whole, MRAC Discussions have considerably more instantiations of [engagement], especially of [counter], [affirm], [pronounce], [endorse], and [distance], all of which are at least double that of MRAC as a whole (see Table 6.5). Only [monogloss] has fewer instantiations, approximately one-third of that in MRAC as a whole. ‘Entertain’ and ‘deny’ are the most frequently instantiated [engagement] features in MRAC Discussions, followed by ‘acknowledge’, ‘endorse’, ‘counter’, and ‘justify’, but there is considerable variation across individual RAs, as can be seen in Table 6.5.

Table 6.5. Summary of global selection probabilities, relative frequencies, and most common realizations of [engagement] in MRAC Discussions.

Feature	Global selection prob., GSP	Rel. freq./1000 words (range)	MRAC as a whole: GSP, rel. freq.	Most common realizations (most frequent first, max. five)
<b>Monogloss</b>	<b>1.20%</b>	<b>1.24 (0.00-8.14)</b>	<b>6.06%, 3.82</b>	<b>bare assertions: material (55.32%), relational (42.55%)</b>
<b>Heterogloss</b>	<b>98.80%</b>	<b>102.33 (65.55-140.43)</b>	<b>93.94%, 59.27</b>	<b>numerical references, <i>risk</i> (n), <i>not</i>, <i>may</i>, <i>failure</i></b>
<b>Contract</b>	<b>39.39%</b>	<b>40.80 (21.52-61.22)</b>	<b>36.00%, 22.71</b>	<b><i>not</i>, <i>failure</i>, <i>un-</i>, <i>but</i>, <i>no</i></b>
Deny	14.47%	14.99 (4.60-28.31)	16.93%, 10.68	<i>not</i> , <i>failure</i> , <i>un-</i> , <i>no</i> , <i>non-</i>
Counter	8.60%	8.91 (1.16-15.08)	6.98%, 4.41	<i>but</i> , <i>only</i> , <i>however</i> , <i>although</i> , <i>even</i>
Affirm	0.46%	0.47 (0.00-2.76)	0.32%, 0.20	<i>clear</i> , <i>clearly</i> , <i>evident</i> , <i>logical</i> , <i>obvious</i>
Concede	0.00%	0.00	0.00, 0.00%	—
Pronounce	0.85%	0.88 (0.00-3.05)	0.36%, 0.23	<i>indeed</i> , <i>the fact that</i> , <i>note</i> , <i>true</i> , <i>merit</i>
Endorse	9.24%	9.57 (1.93-17.00)	6.24%, 3.94	<i>finding</i> (n), <i>find</i> , <i>show</i> , <i>indicate</i> , <i>evidence</i>
Justify	5.76%	5.97 (0.00-13.05)	5.15%, 3.25	<i>because</i> , <i>to</i> (inf), <i>since</i> , <i>thus</i> , <i>due to</i>
<b>Expand</b>	<b>59.41%</b>	<b>61.53 (38.36-92.37)</b>	<b>57.94%, 36.56</b>	<b>numerical references, <i>risk</i> (n), <i>may</i>, <i>can</i>, <i>would</i></b>
Entertain	46.11%	47.75 (26.22-78.23)	46.76%, 29.50	<i>risk</i> (n), <i>may</i> , <i>can</i> , <i>would</i> , <i>should</i>
Acknowledge	13.01%	13.47 (3.59-24.69)	10.87%, 6.86	numerical references, <i>report</i> (v), <i>report</i> (n), <i>guideline</i> , <i>recommendation</i>
Distance	0.30%	0.31 (0.00-3.31)	0.30%, 0.19	quotation marks, <i>argue</i> , <i>as if</i> , <i>purport</i> , <i>think</i>
<b>Engagement, total</b>	<b>100%</b>	<b>103.57 (69.05-141.34)</b>	<b>100%, 63.09</b>	<b>numerical references, <i>risk</i> (n), <i>not</i>, <i>may</i>, <i>failure</i></b>

For articles that open with a summary or reminder of the main findings, propositions are generally of two types. Some (n=4) are ‘monoglossic’—

see (6.152) and (6.153)—restating, in categorical and undialogized terms, specific relationships uncovered by the study.<sup>133</sup> More commonly (n=27), the phase appears to start as an ‘endorsement’—see (6.154)–(6.156)—in which typical [endorse] resources like *find*, *show*, and *demonstrate* frame the projected proposition as being “correct, valid, undeniable or otherwise maximally warrantable” (Martin and White 2005, 126). However, unlike the ‘endorsements’ typical of Introductions (see section 6.2.1), the ‘endorsements’ in MRAC Discussions, and especially in this phase of the Discussion, are directed primarily towards propositions within the text rather than those external to it, with the researchers or the study itself positioned as framer (see section 6.1.1.2.3). In MRAC as a whole, text-internal ‘endorsements’ account for approximately one-third of all ‘endorsements’; in MRAC Discussions, text-internal ‘endorsements’ like those in (6.154)–(6.156) account for approximately half of all ‘endorsements’.

(6.152) The angiotensin-II–receptor antagonist irbesartan was associated with better renal outcomes than the other agents (amlodipine, placebo, and antihypertensive agents) we used.

(MRAC\_21)

(6.153) Peginterferon alfa-2a plus ribavirin was significantly more effective than interferon alfa-2b plus ribavirin or peginterferon alfa-2a alone for the treatment of chronic hepatitis C.

(MRAC\_12)

(6.154) We found that captopril significantly retarded the rate of loss of renal function in this group of patients with diabetic nephropathy.

(MRAC\_20)

(6.155) Our findings show that ramipril, an angiotensin-converting–enzyme inhibitor, is beneficial in a broad range of patients without evidence of left ventricular systolic dysfunction or heart failure who are at high risk for cardiovascular events.

(MRAC\_50)

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<sup>133</sup> Unlike ‘monoglossic’ statements in the Introduction, Methods, and Results sections of MRAC, those in Discussion sections are more frequently realized by relational clauses, i.e. clauses of being and having. ‘Monoglossia’ in MRAC Discussions relates more often to characterizing research findings and less often to describing what was done or what happened than other sections of MRAC. The main clauses in (6.152) and (6.153) are both relational.

(6.156) This study demonstrated a significant reduction in mortality and hospitalizations for congestive heart failure in patients treated with an angiotensin-converting-enzyme inhibitor, enalapril, in addition to conventional therapy for heart failure.

(MRAC\_49)

‘Endorsements’ become text-external again in the generic phase that explores connections with the literature, as the textual voice makes comparisons with studies it considers highly warrantable. This phase is also characterized by integral and non-integral ‘acknowledgments’ of other researchers’ work, to provide support and substantiation for study findings. Examples are given in (6.157)–(6.159).

(6.157) Previous epidemiological studies have shown an association between hypertension and albuminuria in patients with type 2 diabetes who do not have renal failure.<sup>11 12</sup>

(MRAC\_40)

(6.158) Clinical trials have demonstrated that a structured lifestyle intervention including dietary change, weight loss, and increased physical activity can reduce the risk of progressing to diabetes mellitus from impaired glucose tolerance.<sup>21-22</sup>

(MRAC\_11)

(6.159) Excess bleeding was not higher in the patients in our study than reported with the same dose of acetylsalicylic acid in secondary prevention,<sup>16</sup> where the use of acetylsalicylic acid is now considered standard therapy. The advantages of using acetylsalicylic acid in hypertension have been shown in extremely well treated patients with hypertension, such as those in our study, and do not necessarily extend to less well treated patients with hypertension.

(MRAC\_16)

In exploring connections with the literature, the textual voice sometimes ‘counters’ and ‘denies’ and/or ‘distances’ itself from certain aspects of previous work, setting itself apart from, though not necessarily at odds with, other studies. ‘Affirm’ and ‘pronounce’ also make appearances in this phase, as the textual voice seeks to substantiate and validate its own position. Examples of these are shown and highlighted in (6.160) and (6.161).



(6.160) This finding [endorse, text-internal] in patients without clinical heart failure at base line accords well with findings [endorse, text-external] from the Studies of Left Ventricular Dysfunction Prevention study.<sup>31</sup> That study, however [counter], did not [deny] include patients with impaired renal function. The Heart Outcomes Prevention Evaluation (HOPE) Study<sup>32</sup> and its substudy of patients with diabetes, MICRO-HOPE,<sup>20</sup> showed [endorse, text-external] benefits of angiotensin-I–converting enzyme inhibition in terms of the signs and symptoms of heart failure but [counter] failed [deny] to show [endorse, text-external] significant differences in hospitalizations for heart failure. Furthermore, the evaluation of a subgroup of the HOPE population with renal insufficiency<sup>5</sup> did not [deny] show [endorse, text-external] a significant effect on this outcome. Our findings [endorse, text-internal] suggest [entertain] that angiotensin II blockade in patients with renal disease decreases the risk of overt heart failure resulting in hospitalization.

(MRAC\_02)

(6.161) The beneficial actions of captopril may [entertain] also result in part [entertain] from the direct inhibition of the proposed deleterious effects of neurohumoral activation.<sup>33</sup> The renin-angiotensin system can [entertain] be activated after an acute myocardial infarction.<sup>34</sup> In patients with severe chronic heart failure, the degree of activation is a powerful determinant of survival.<sup>33</sup> A recent experimental study demonstrated [endorse] that the myocytolysis produced by endogenous angiotensin II could [entertain] be prevented by captopril therapy.<sup>35</sup> These purported [distance/acknowledge] mechanisms by which captopril exerts its beneficial effects (i.e., the attenuation of ventricular remodeling and the inhibition of neurohumoral activation) are not [deny] mutually exclusive. Indeed [pronounce], in this study the combination of ventricular enlargement and elevated plasma levels of neurohormones at base line was associated with a higher risk of death than that found [endorse, text-external] for either of these adverse prognostic indicators alone.<sup>36</sup>

(MRAC\_30)

The generic phase that discusses possible mechanisms or causes is characterized, dialogically, by instances of [entertain], [acknowledge], and [justify]. In (6.162), for example, [entertain] combines with [acknowledge] to ground speculation on causality in both the subjectivity of the textual voice and the subjectivity of several external sources. ‘Justification’ for this particular line of reasoning is then signalled by the conjunction *since*, and further support for the ‘justification’ is indicated by an additional set of ‘acknowledgments’.

(6.162) Spironolactone may prevent myocardial fibrosis by blocking the effects of aldosterone on the formation of collagen,<sup>5,35,36</sup> which in turn could play a part in reducing the risk of sudden death from cardiac causes, since myocardial

fibrosis could predispose patients to variations in ventricular-conduction times and, hence, to reentry ventricular arrhythmias.<sup>32,35-37</sup>

(MRAC\_31)

Discussions of study limitations—or strengths and weaknesses—often refer to the extent to which study material and study findings can be generalized and how the study might be improved. In (6.163)–(6.165), a variety of [entertain], [counter], and [justify] resources are deployed in order to present possible limitations and to argue for the study’s relevance despite those limitations.

(6.163) Although the frequency with which follow-up angiography was performed was relatively high in both groups, there was a higher rate of angiographic follow-up in the stent group (92 percent vs. 83 percent,  $P = 0.008$ ). This difference, which may bias the rate of restenosis in favor of stent placement, is a limitation of the study.

(MRAC\_10)

(6.164) One potential limitation of the current study is that the rates of mortality from coronary heart disease in Finland are among the highest in the world.<sup>23</sup> However, for a number of reasons, we believe our data are likely to be generalizable to countries with lower rates of coronary heart disease. Within Finland, rates of coronary heart disease vary widely,<sup>23</sup> ranging from very high in eastern Finland (Kuopio) to lower in western Finland (Turku). In Turku, the rate of coronary heart disease in men is somewhat higher than that in men in the United States, whereas the rate of coronary heart disease in women in Turku is actually lower than that in women in the United States.<sup>23</sup> Furthermore, in this population, the relation between type 2 diabetes and both the prevalence<sup>18</sup> and incidence<sup>24</sup> of coronary heart disease is similar in both high-risk areas (eastern Finland) and moderate-risk areas (western Finland).

(MRAC\_14)

(6.165) The relatively high rates of discontinuation in the active treatment arm (42%) and crossover to active treatment in the placebo arm (10.7%) are a limitation of the study; however, the lack of adherence would tend to decrease the observed treatment effects. Thus, the results presented here may underestimate the magnitude of both adverse effects on cardiovascular disease and breast cancer and the beneficial effects on fractures and colorectal cancer among women who adhere to treatment.

(MRAC\_34)

Discussion sections typically conclude with a brief restatement of the main findings and remarks on the possible implications or applications of those

findings. One of the characteristics of this phase is its instantiation of [entertain]. As examples (6.166)–(6.169) show, modalizing resources such as *suggest*, *could*, *may*, *probably*, *possibility*, and *likely* are deployed to make claims about the study’s relevance and application, and modulating resources such as *should* and *must* are used to make proposals for future work (see section 6.1.2.1 on dialogical functionality of deontic modality). The phase also includes instances of text-internal and text-external ‘endorsements’, as well as ‘acknowledgments’, ‘denials’, and ‘counters’ (see examples below).

(6.166) In summary, the addition of bevacizumab to bolus IFL conferred a clinically meaningful and statistically significant improvement in overall survival, progression-free survival, and response rate. These results suggest that bevacizumab plus fluorouracil-based chemotherapy should be considered a new option for the treatment of metastatic colorectal cancer.

(MRAC\_18)

(6.167) Our data suggest that an intensive combination drug-therapy regimen that includes a protease inhibitor should be considered the standard of care for patients with advanced HIV infection.<sup>27</sup>

(MRAC\_28)

(6.168) In conclusion, we have shown that patients with type 2 diabetes who have not had a myocardial infarction have a risk of infarction similar to that among nondiabetic patients who have had a prior myocardial infarction. This observation, combined with the results of previous studies showing the efficacy of lipid-lowering therapy in diabetic patients with coronary heart disease<sup>12,13</sup> and the high mortality (including prehospital mortality) after myocardial infarction,<sup>14-16</sup> suggests that all persons with diabetes could be treated as if they had prior coronary heart disease. The best way to answer this question more definitively would be to conduct a clinical trial comparing the effect of different levels of lipid-lowering therapy on coronary heart disease in diabetic subjects. Clinical trials, however, are very expensive and take many years to complete. In the short term, further confirmation of our findings may come from other observational studies.

(MRAC\_14)

(6.169) We draw four main conclusions from these data. First, among apparently healthy men, the base-line level of inflammation as assessed by the plasma concentration of C-reactive protein predicts the risk of a first myocardial infarction and ischemic stroke, independently of other risk factors. Second, the base-line concentration of C-reactive protein is not associated with the risk of venous thrombosis, a vascular event generally not associated with atherosclerosis. Third, C-reactive protein is not simply a short-term marker of

risk, as has previously been demonstrated in patients with unstable angina,<sup>9</sup> but is also a long-term marker of risk, even for events occurring six or more years later. This observation suggests that the effects of inflammation are probably mediated through a chronic process and excludes the possibility that undetected acute illness at base line is responsible for the observed effects. Finally, the benefits of aspirin appear to be modified by underlying inflammation — an observation that raises the possibility of antiinflammatory as well as antiplatelet effects of this agent. The latter observation also suggests the possibility that other antiinflammatory agents may have a role in preventing cardiovascular disease. Moreover, these data suggest that inflammatory markers such as C-reactive protein may provide a method of identifying people for whom aspirin is likely to be more or less effective — a hypothesis requiring direct testing in randomized trials.

(MRAC\_32)

In terms of intersubjective positioning, MRAC Discussions generally work to maintain alignment between the textual voice and reader. Features like [entertain] and [justify]—and, to a lesser extent, [acknowledge]—are deployed throughout the section, as the textual voice attempts to keep the reader “on side”. However, the high relative frequencies of [pronounce], [affirm], and text-internal [endorse] can convey “heightened personal involvement” (White 2003, 269) and may imply a certain amount of interpersonal risk. Examples of this can be seen in (6.160) and (6.161), in which the textual voice appears to reject the methodologies or findings of certain studies, while vouching for its own position. The risk to writer–reader solidarity, while arguably low, seems to be greater in MRAC Discussions than in other sections.

In summary, the Discussion sections of MRAC are characterized by high relative frequencies of [heterogloss] and low relative frequencies of [monogloss]. The deployment of these [engagement] features and their more fine-grained sub-features changes as the section unfolds. The phase that restates main findings is characterized by text-internal ‘endorsements’; the phase that explores connections with the literature is characterized by text-external ‘endorsements’ and ‘acknowledgments’; the phase that discusses possible mechanisms or causes is characterized by ‘entertain’, ‘acknowledge’, and ‘justify’; the phase that discusses study limitations is characterized by ‘entertain’, ‘counter’, and ‘justify’; and the concluding phase of the section is characterized by ‘entertain’. The dialogic space in MRAC Discussions variously expands and contracts as the text

unfolds, beginning relatively narrow before opening up the space to a variety of alternative voices and positions in the discourse.

### 6.2.5 Abstracts

The generic phases of medical research article Abstracts closely resemble the four main stages of the medical research article (see section 4.1.2). In MRAC Abstracts, these phases are typically labelled *Background* or *Context*, *Methods*, *Results* or *Findings*, and *Conclusions* or *Interpretations*.

There are 1380 instances of [engagement] in the combined MRAC Abstracts (RF 68.22 instances per 1000 words; range across individual RAs 31.79–114.38 instances per 1000 words). Compared with MRAC as a whole, MRAC Abstracts have a slightly higher relative frequency of [engagement]. A feature-by-feature comparison shows that MRAC Abstracts have considerably more instances of [monogloss] and [entertain] and considerably fewer instances of [counter], [affirm], [pronounce], [justify], and [acknowledge] per 1000 words than MRAC as a whole. ‘Entertain’ and ‘deny’ are the most frequently instantiated [engagement] features in MRAC Abstracts, followed by ‘monogloss’, ‘counter’, and ‘endorse’, but there is variation among individual RAs (see Table 6.6).

Table 6.6. Summary of global selection probabilities, relative frequencies, and most common realizations of [engagement] in MRAC Abstracts.

Feature	Global selection prob., GSP	Rel. freq./1000 words (range)	MRAC as a whole: GSP, rel. freq.	Most common realizations (most frequent first, max. five)
Monogloss	7.97%	5.44 (0.00-20.23)	6.06%, 3.82	bare assertions: material (67.49%), relational (21.76%)
Heterogloss	92.03%	62.78 (11.56-114.38)	93.94%, 59.27	<i>p</i> (p-value), <i>risk</i> (n), <i>confidence interval</i> , <i>non-</i> , <i>not</i>
Contract	28.33%	19.33 (0.00-52.29)	36.00%, 22.71	<i>non-</i> , <i>not</i> , <i>failure</i> , <i>no</i> , <i>but</i>
Deny	16.09%	10.97 (0.00-22.04)	16.93%, 10.68	<i>non-</i> , <i>not</i> , <i>failure</i> , <i>no</i> , <i>un-</i>
Counter	4.71%	3.21 (0.00-11.58)	6.98%, 4.41	<i>but</i> , <i>although</i> , <i>only</i> , <i>despite</i> , <i>however</i>

Feature	Global selection prob., GSP	Rel. freq./1000 words (range)	MRAC as a whole: GSP, rel. freq.	Most common realizations (most frequent first, max. five)
Affirm	0.14%	0.10 (0.00-3.03)	0.32%, 0.20	<i>clear, evident</i>
Concede	0.00%	0.00	0.00, 0.00%	—
Pronounce	0.00%	0.00	0.36%, 0.23	—
Endorse	4.49%	3.06 (0.00-8.35)	6.24%, 3.94	<i>finding (n), know, show, determine, find</i>
Justify	2.90%	1.98 (0.00-6.54)	5.15%, 3.25	<i>to (inf), because, due to, purpose, since</i>
<b>Expand</b>	<b>63.70%</b>	<b>43.45 (10.75-75.47)</b>	<b>57.94%, 36.56</b>	<b><i>p (p-value), risk (n), confidence interval, mean, conclusion</i></b>
Entertain	62.10%	42.36 (10.75-72.78)	46.76%, 29.50	<i>p (p-value), risk (n), confidence interval, mean, conclusion</i>
Acknowledge	1.45%	0.99 (0.00-9.29)	10.87%, 6.86	<i>report (v), report (n), disclosure, recommend, observe</i>
Distance	0.14%	0.10 (0.00-3.86)	0.30%, 0.19	<i>criticize, quotation marks</i>
<b>Engagement, total</b>	<b>100%</b>	<b>68.22 (31.79-114.38)</b>	<b>100%, 63.09</b>	<b><i>p (p-value), risk (n), confidence interval, non-, not</i></b>

With regard to [engagement], the first generic phase of the Abstract—presenting the background or context for the study—is characterized by [monogloss] and [endorse] (see (6.170) and (6.171), respectively). Some instances of [endorse] in (6.171) and (6.172) are ‘denied’ (e.g. *not been determined* and *not been confirmed*) or ‘countered’ (e.g. *but*) and highlight a potential gap in the field (cf. Introductions, section 6.2.1). The aim or objective of the study is to fill this perceived gap. Unlike Introduction sections, this background or context phase and MRAC Abstracts in general contain few if any ‘acknowledgments’, and none in the form of numerical references.

(6.170) Treatment with peginterferon alfa-2a alone produces significantly higher sustained virologic responses than treatment with interferon alfa-2a alone in

patients with chronic hepatitis C virus (HCV) infection. We compared the efficacy and safety of peginterferon alfa-2a plus ribavirin, interferon alfa-2b plus ribavirin, and peginterferon alfa-2a alone in the initial treatment of chronic hepatitis C.

(MRAC\_12)

- (6.171) Controlled clinical trials have shown that beta-blockers can produce hemodynamic and symptomatic improvement in chronic heart failure, but the effect of these drugs on survival has not been determined.

(MRAC\_27)

- (6.172) Context.— Observational studies have found lower rates of coronary heart disease (CHD) in postmenopausal women who take estrogen than in women who do not, but this potential benefit has not been confirmed in clinical trials. Objective.— To determine if estrogen plus progestin therapy alters the risk for CHD events in postmenopausal women with established coronary disease.

(MRAC\_17)

In the second phase of MRAC Abstracts, [monogloss] predominates (see (6.173)) as the textual voice describes the study material and recounts the main experimental and data-analysis procedures (cf. Methods, section 6.2.2). In (6.174), the latter part of the phase, the last sentence, includes a cluster of [engagement] resources that construe [acknowledge], [justify], and [endorse]. Mathematical-verbal [entertain], realized by *mean*, *median*, and *risk (factor)*, is also a common feature of the methods phase of MRAC Abstracts (see example in (6.175)).

- (6.173) We randomly assigned 410 patients with symptomatic coronary disease to elective placement of a Palmaz-Schatz stent or to standard balloon angioplasty. Coronary angiography was performed at base line, immediately after the procedure, and six months later.

(MRAC\_10)

- (6.174) From a cohort of 128,992 persons followed since the mid-1960s at a health maintenance organization, 186 patients with gastric carcinoma were selected as case patients and were matched according to age, sex, and race with 186 control subjects without gastric carcinoma. Stored serum samples collected during the 1960s were tested for IgG antibodies to *H. pylori* by enzyme-linked immunosorbent assay. Data on cigarette use, blood group, ulcer disease, and gastric surgery were obtained from questionnaires administered at enrollment. Tissue sections and pathology reports were reviewed to confirm the histologic results.

(MRAC\_29)

- (6.175) Participants.—A total of 2763 women with coronary disease, younger than 80 years, and postmenopausal with an intact uterus. Mean age was 66.7 years.  
(MRAC\_17)

In the results or findings phase, mathematical [entertain] is a common feature: primarily *p* (*p*-values), *confidence intervals*, and (*relative*) *risk*. Examples of some of these realizations are shown in (6.176) and (6.177). ‘Deny’ is also frequently instantiated (cf. Results, section 6.2.3). At the end of (6.177), for example, any assumption or anticipation of *differences* is rejected or ‘denied’ by the textual voice.

- (6.176) The men in the quartile with the highest C-reactive protein values had three times the risk of myocardial infarction (*relative risk*, 2.9;  $P < 0.001$ ) and two times the risk of ischemic stroke (*relative risk*, 1.9;  $P = 0.02$ ) of the men in the lowest quartile.  
(MRAC\_32)

- (6.177) Results.— After an average follow-up of 5.2 years, lovastatin reduced the incidence of first acute major coronary events (183 vs 116 first events; relative risk [RR], 0.63; 95% confidence interval [CI], 0.50-0.79;  $P < .001$ ), myocardial infarction (95 vs 57 myocardial infarctions; RR, 0.60; 95% CI, 0.43-0.83;  $P = .002$ ), unstable angina (87 vs 60 first unstable angina events; RR, 0.68; 95% CI, 0.49-0.95;  $P = .02$ ), coronary revascularization procedures (157 vs 106 procedures; RR, 0.67; 95% CI, 0.52-0.85;  $P = .001$ ), coronary events (215 vs 163 coronary events; RR, 0.75; 95% CI, 0.61-0.92;  $P = .006$ ), and cardiovascular events (255 vs 194 cardiovascular events; RR, 0.75; 95% CI, 0.62-0.91;  $P = .003$ ). Lovastatin (20-40 mg daily) reduced LDL-C by 25% to 2.96 mmol/L (115 mg/dL) and increased HDL-C by 6% to 1.02 mmol/L (39 mg/dL). There were no clinically relevant differences in safety parameters between treatment groups.  
(MRAC\_08)

The conclusions or interpretations phase of MRAC Abstracts is relatively short, usually a single sentence. (The examples in (6.178)–(6.181) each show the phase in its entirety.) Like the concluding remarks in MRAC Discussions (see section 6.2.4), the conclusions phase of MRAC Abstracts is characterized by [entertain] resources, e.g. *may*, *suggest*, *seem*, *should*. The phase also features [monogloss], [deny], and text-internal [endorse].

- (6.178) The number of microvessels per 200× field in the areas of most intensive neovascularization in an invasive breast carcinoma may be an independent predictor of metastatic disease either in axillary lymph nodes or at distant sites



(or both). Assessment of tumor angiogenesis may therefore prove valuable in selecting patients with early breast carcinoma for aggressive therapy.

(MRAC\_47)

(6.179) Although the effects of other, unmeasured risk factors cannot be excluded with certainty, these results suggest that fine-particulate air pollution, or a more complex pollution mixture associated with fine particulate matter, contributes to excess mortality in certain U.S. cities.

(MRAC\_07)

(6.180) Losartan prevents more cardiovascular morbidity and death than atenolol for a similar reduction in blood pressure and is better tolerated. Losartan seems to confer benefits beyond reduction in blood pressure.

(MRAC\_06)

(6.181) In patients with chronic hepatitis C, initial therapy with interferon and ribavirin was more effective than treatment with interferon alone.

(MRAC\_25)

Abstracts are an integral part of medical research articles, but they often appear as standalone texts in databases and on journal websites. Their basic function is to summarize and promote research (see section 4.1.2). Generically, abstracts closely resemble the four main stages of the research article. With regard to [engagement] and dialogic positioning, there are some important similarities and differences between MRAC Abstracts and the Introduction, Methods, Results, and Discussion sections. For example, the background phase of MRAC Abstracts construes a text that, like MRAC Introductions, is dialogically expansive, but that, unlike MRAC Introductions, only rarely ‘acknowledges’ external sources. The methods phase of MRAC Abstracts, like MRAC Methods, construes a relatively narrow dialogic space, but one in which, compared with MRAC Methods, other voices are rarely invoked. The results phase of MRAC Abstracts, like MRAC Results, is often ‘monoglossic’, but it contains a considerably higher relative frequency of mathematical [entertain], as statistical analyses are presented in relatively short text segments (see (6.177) for an example of this). Similarly, the conclusion phase of MRAC Abstracts resembles the first and final phases of MRAC Discussions, in terms of its use of [monogloss] and [entertain] to summarize main findings and to speculate on their relevance. However, compared with MRAC Discussions, there are relatively few instances of text-external [endorse];

and [counter], [deny], and [justify] are rarely used to comment on study limitations. More generally, MRAC Abstracts instantiate few if any [engagement] features that are likely to construe disalignment between the textual voice and reader; there are, for example, no instances of [pronounce] and comparatively few instances of [affirm] in MRAC Abstracts (see Table 6.6).

Space, it seems, is a crucial factor in how and when [engagement] is construed in MRAC Abstracts, and how that construal compares with [engagement] in the Introduction, Methods, Results, and Discussion sections. The relative brevity and semantic density of the Abstract (see León and Divasson 2006) means that, in comparison to the rest of the research article, something is inevitably lost in translation or summarization. What is lost is both ideational (Pitkin, Branagan, and Burmeister 1999) and interpersonal (Adams Smith 1984, Hyland 1998b, 78), and [engagement] is no exception.

In summary, MRAC Abstracts are characterized by a relative frequency of [engagement] that is similar to MRAC as a whole. The type and realization of [engagement] varies according to generic phase. The background phase is characterized by [monogloss] and [endorse]; the methods phase is characterized by [monogloss] and mathematical [entertain]; the results phase is characterized by mathematical [entertain] and [deny]; and the conclusion is characterized by [monogloss], text-internal [endorse], and verbal [entertain]. The dialogic space created by each of those Abstract phases is similar to, but generally narrower than, that construed by each of the four main sections, with the first and the last phases of the Abstract potentially more dialogic 'expansive' than the second and third phases.

## **6.2.6 Other Stages of the Medical Research Article**

### **6.2.6.1 Titles**

All of the titles in MRAC are of the nominal-group type, with nine being of the compound nominal-group subtype (see Soler 2007 and section 4.1.2). There are no clausal or full-sentence titles in MRAC, despite their relative prevalence in medicine, biology, and biochemistry research articles (Soler 2007). The few instances of [engagement] in MRAC Titles are realized by

morphologic negation (*non-*) and mathematical-verbal probability (*risk*, *prediction*), expressing [deny] and [entertain], respectively. Examples of these ‘heteroglossic’ and ‘non-heteroglossic’ titles are given in (6.182) and (6.183), respectively.<sup>134</sup>

(6.182) *HELICOBACTER PYLORI* INFECTION AND THE RISK OF GASTRIC CARCINOMA  
(MRAC\_29)

(6.183) EFFICACY AND SAFETY OF RECOMBINANT HUMAN ACTIVATED PROTEIN C FOR SEVERE SEPSIS  
(MRAC\_01)

### 6.2.6.2 Acknowledgments

MRAC Acknowledgments contain the highest relative frequency of [monogloss] in MRAC (6.49 instances per 1000 words). The section also includes instances of [acknowledge] and [entertain] (1.30 and 1.47 instances per 1000 words, respectively).

Acknowledgements in MRAC typically express gratitude to those involved in the research, particularly those with technical, administrative, or financial roles. The section also includes a series of statements regarding potential conflicts of interest between the authors and funding bodies involved in the research (see also section 6.2.6.5). In (6.184) and

<sup>134</sup> The extent to which titles in MRAC can be described as ‘heteroglossic’ or ‘monoglossic’ is debatable. The main unit of analysis in this study is the clause/proposition. It is difficult to say how standalone nominal groups like those in MRAC Titles construe [engagement], since such units in isolation are not normally associated with “language as exchange” (see Halliday and Matthiessen 2014, chapter 4). While the decision to mark titles as ‘heteroglossic’ may be relatively straightforward—the mathematical and verbal resources used (e.g. *risk* and *non-*) are the same as those used elsewhere in MRAC—‘monoglossic’ elements are more difficult to identify. The default method I have used for clauses (i.e. no heterogloss = monogloss) may be applicable to nominal-group titles, especially if one thinks of titles as representing the autonomous subjecthood of the textual voice, but their role in language as exchange is unclear. A title like EFFICACY AND SAFETY OF RECOMBINANT HUMAN ACTIVATED PROTEIN C FOR SEVERE SEPSIS could be represented clausally as “recombinant human activated protein C is efficacious and safe for severe sepsis”. On the other hand, it could just as easily be reformulated as “How efficacious and safe is recombinant human activated protein C for severe sepsis?” or “Recombinant human activated protein C may be efficacious and safe”. For these reasons, I have chosen to use the term ‘non-heteroglossic’ rather than ‘monoglossic’ to refer to titles that do not contain typical [heterogloss] resources.

(6.185), acknowledgments are presented in ‘monoglossic’ terms, primarily realized by unmodulated, polar-positive relational clauses that identify and characterize participants.

(6.184) Funding was provided by Merck & Co Inc. Drs Shapiro and Beere and Ms Langendorfer are employees of Merck & Co Inc. Dr Stein is a consultant, speaker, and funded researcher for Merck & Co Inc. Dr Gotto is a consultant and speaker for Merck & Co Inc.

(MRAC\_08)

(6.185) We are indebted to Elizabeth Hawkins (protocol specialist), Bethann Cunningham (data manager), Lynn Morrow (data manager), Michael Wulfson, M.D. (statistician), and John Modlin, M.D. (protocol team member), for their critical contributions; to the women who participated in the trial; and to the many AIDS Clinical Trials Group investigators and personnel who contributed to the successful conduct of the study.

(MRAC\_04)

That MRAC Acknowledgments are primarily ‘monoglossic’ may seem counterintuitive, considering the title of the section (*acknowledgments*) and its function as an “academic thank-you note” (Salager-Meyer, Ariza, and Berbesí 2009, Salager-Meyer et al. 2011). As Salager-Meyer et al. (2006, 425) note, acknowledgements are “the only place where science is portrayed as a dialogic process that reveals the complex web of interpersonal debts implicit in the construction of knowledge”. Yet this dialogic process is not made explicit through choices in the ENGAGEMENT system. The *presence* of different participants is manifested through personal pronouns and determiners (*we, our*) and the names of colleagues and pharmaceutical companies (see (6.184) and (6.185)), but the *voices* of those participants are rarely recognized or invoked.

The few explicit instances of [heterogloss] in MRAC Acknowledgments are typically realized by the resources of projection and modality (e.g. *report, may, in part*). In (6.186), the textual voice creates a dialogic space in which a potential conflict of interest is construed as one among a number of possible alternatives. In terms of dialogic positioning, this can lead to disalignment between the textual voice and reader if the reader considers the multi- or other-voicedness of the proposition to be deliberately obfuscating some relation that ought to be made clearer. For

instances of ‘heteroglossia’ that likely confer less or no interpersonal risk, see (6.187) and (6.188).

(6.186) Drs. Snapinn, Zhang, and Shahinfar are employees of Merck and may own stock or hold stock options in Merck.

(MRAC\_02)

(6.187) Dr. Hurwitz was supported in part by a Career Development Grant (K23 CA085582–04).

(MRAC\_18)

(6.188) The opinions stated in the article are those of the authors and do not represent those of the Department of Defense or the US Air Force.

(MRAC\_08)

### 6.2.6.3 Appendices

Appendices in MRAC generally provide lists of research participants and sometimes comment on the roles and responsibilities of the main authors. Examples of these are given in (6.189) and (6.190), respectively.

(6.189) The following institutions and investigators participated in the STRESS trial: Arizona Heart Institute, Phoenix (E. Davis, W. Catran, and K. Waters); Beth Israel Hospital, Boston (D.J. Diver, J. Carrozza, and C. Senerchia); [list continues]

(MRAC\_10)

(6.190) The members of the writing committee were Salim Yusuf, Bertram Pitt, Clarence E. Davis, William B. Hood, and Jay N. Cohn.

(MRAC\_49)

In one article, MRAC\_22, the Appendix is an extension of the Methods section (see section 6.2.2), describing and recounting parts of the experimental procedure in more detail. Reference to the Appendix appears in the Methods section of the paper, PDF, and HTML versions of the article, but the Appendix itself is only available in HTML (see (6.191)). An abridged extract of the Appendix is given in (6.192).

(6.191) Primer sequences and amplification conditions are explained in the Supplementary Appendix, available with the full text of this article at [www.nejm.org](http://www.nejm.org). *EGFR* mutations in exons 19 and 21 were also sought in primary tumors of the breast (15 specimens), colon (20 specimens), kidney (16 specimens), pancreas (40 specimens), and brain (4 specimens), along with a

panel of 108 cancer-derived cell lines representing diverse histologic types (listed in the Supplementary Appendix).

(MRAC\_22)

(6.192) This appendix has been provided by the authors to give readers additional information about their work. Mutational Analysis. The polymerase chain reaction was used to amplify the 28 exons comprising the EGFR gene using DNA isolated from primary tumor tissue or tumor-derived cell-lines. Primer pairs used were: Exon 1, CAGATTTGGCTCGACCTGGACATAG (sense) and CAGCTGATCTCAAGGAAACAGG (antisense); [list continues]. Nested PCR amplification of DNA extracted from archival tumor tissue was performed as follows. An initial PCR for exons 2, 5, 6, 7, 11, 12, 14, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, and 27 was generated using primers and conditions described above. Subsequently, 2  $\mu$ l of this reaction was amplified in a secondary PCR using the following internal primer pairs [...]

(MRAC\_22)

In terms of [engagement], MRAC Appendices are characterized by [monogloss] (see examples above). Occasional instances of [acknowledge] and [justify] are also present. See, for example, the opening sentence of (6.192) for an instance of ‘justification’.

There is nothing to suggest that the [monogloss] characteristic of MRAC Appendices should be interpreted as anything other than ‘taken for granted’, as factual statements about who was involved and what they did; the propositions express no overt value-positions in terms of [affect], [judgment], or [appreciation] (see section 3.1). ‘Heteroglossic’ resources are few and far between in MRAC Appendices, implying a generic stage that is primarily grounded in “the textual voice’s single, autonomous and isolated subjecthood” and that is “not in tension with, or contradistinction to, any alternative position or positions” in the discourse (White 2003, 263).

Before concluding this section, the instance of [justify] in (6.192) may be worth further explication, particularly with regard to generic staging. Unlike other ‘justifications’ in MRAC (see section 6.1.1.2.4), the ‘justification’ in the opening sentence of (6.192)—*This appendix has been provided by the authors to give readers additional information about their work*—refers to the text itself, the Appendix, rather than to reasons why particular activities were carried out as part of experimental or data-analysis procedures (see examples in section 6.2.2). The ‘justification’ in

(6.192) is discursual or textual rather than real-world or research-process oriented, to paraphrase the terminologies of Thomas and Hawes (1994), Fløttum (2003a, b), and others (see section 4.2.2). It overtly signals a reason for including in the Appendix something that may otherwise be reserved for the Methods section, and which, in this case, is not included in any other MRAC articles. Although appendices, by their very name (“a section or table of subsidiary matter at the end of a book or document”, OED), can include anything considered supplementary or extrinsic to the main article, the fact that the Appendix in MRAC\_22 is justified in these text-discursual terms suggests a generic stage that is somehow unusual or marked. As noted in section 6.1.2.1, MRAC\_22 investigates a specific genetic mutation among patients with non-small-cell lung cancer. The methods of relatively small-scale gene-based studies like this may be less familiar to readers of a general medical journal like NEJM than other types of studies such as largescale randomized controlled trials (37 articles are of this type in MRAC; see section 5.2.1). The general lack of space given to Methods sections in MRAC (see chapter 7, section 7.3.2) may further account for the need for this supplementary information. The article thus retains what seems to be the generic expectation of a short Methods section while also maintaining a sense of methodological transparency. As ICMJE (2008, 13) puts it: “Extra or supplementary materials and technical detail can be placed in an appendix where they will be accessible but will not interrupt the flow of the text, or they can be published solely in the electronic version of the journal”.

#### **6.2.6.4 References**

The referencing system used in MRAC is Vancouver, a numerical endnote citation system in which superscript numbers in the main body of the text refer to a list of numbered references at the end of the article (BMJ 2018b). References are not organized chronologically but based upon first mention. The basic structure for standard journal references in MRAC is author names (or study group name), article title, journal name, year of publication, volume number, and page numbers. An example of the first three entries in the References section of MRAC\_24 is shown in (6.193); the reference list contains 31 entries in total. In its current guidelines for

authors, NEJM recommends up to 40 references (NEJM 2018). LAN recommends no more than 30 references (LAN 2018b). JAMA and BMJ do not specify a maximum or minimum number of references.

(6.193) References

1. Division of Chronic Disease Control and Community Intervention. Cardiovascular disease surveillance: stroke, 1980-1989. Atlanta: Centers for Disease Control and Prevention, 1994.
2. Fieschi C, Argentino C, Lenzi GL, Sacchetti ML, Toni D, Bozzao L. Clinical and instrumental evaluation of patients with ischemic stroke within the first six hours. *J Neuro Sci* 1989;91:311-22.
3. del Zoppo GJ, Poeck K, Pessin MS, et al. Recombinant tissue plasminogen activator in acute thrombotic and embolic stroke. *Ann Neurol* 1992;32:78- 86.

(MRAC\_24)

Although references were not annotated as part of the corpus analysis of [engagement] (see section 5.2.1), the dialogic resources in MRAC References are similar to those found in MRAC Titles (e.g. *non-*, *un-*, *risk*, *prediction*), and are similarly scarce (see section 6.2.6.1). However, the dialogic functionality of references needs to be considered in light of the kinds of intra- and intertextual relations they construe. Superscript numbers in the main text direct the reader to the relevant numbered entries in the References section, which in turn direct the reader to various external sources.<sup>135</sup> These resources act ostensibly to ‘acknowledge’ other voices in the discourse, but they may also serve to ‘endorse’ and ‘justify’ certain text-internal or text-external positions (see section 6.1.2.2.1).

References are not only one of the defining characteristics of scientific discourse of this kind; they are also a defining characteristic of [engagement]. References are the most frequently occurring dialogic resource in MRAC (see section 6.1.5), and, more generally, they are one of

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<sup>135</sup> The structure of entries in Reference sections is arguably a form of projection (see, for example, Hood 2010, 180–182), in which references, using entry 3 in (6.193) as an example, might be understood as “del Zoppo et al. report on recombinant tissue plasminogen activator in acute thrombotic and embolic stroke in this particular issue of *Annals of Neurology*”. Indeed, in some referencing systems, such as the one I use in this thesis, article titles are set in quotation marks suggestive of direct speech, e.g. del Zoppo et al. “Recombinant tissue plasminogen activator in acute thrombotic and embolic stroke”.



the most conspicuous resources of ‘heteroglossia’ as intertextuality in written science (cf. Bakhtin 1981 [1935], Kristeva 1984).

#### **6.2.6.5 Conflict of Interest and Role of the Funding Source**

Although typically part of the Acknowledgments section (see section 6.2.6.2), statements declaring potential conflicts of interest are presented as separate sections in two MRAC articles (both LAN, published in 2002). These Conflict-of-Interest sections are reproduced in their entirety in (6.194) and (6.195). Both articles also include a section headed Role of the Funding Source, which appears as a subsection or phase of the Methods section, reproduced below as (6.196) and (6.197).

(6.194) Conflict of interest statement

The Clinical Trial Service Unit has a staff policy of not accepting honoraria or other payments from the pharmaceutical industry, except for the reimbursement of costs to participate in scientific meetings. Coordinating centre members of the writing committee (R Collins, J Armitage, S Parish, R Peto) have, therefore, only had such costs reimbursed. P Sleight has received honoraria and costs for participating in meetings.

(MRAC\_03)

(6.195) Conflict of interest statement

K Kristiansson is a Merck employee and was a non-voting member of the steering committee.

(MRAC\_06)

(6.196) Role of the funding source

The study was designed, conducted, analysed, and interpreted by the investigators entirely independently of all funding sources.

(MRAC\_03)

(6.197) Role of the funding source

Study data are in a Merck database. Merck provided the study steering committee with free access to all data. The steering committee was free to interpret data and write the paper and the outcome was validated independently by the steering committee statistician.

(MRAC\_06)

The examples above are primarily ‘monoglossic’, but also include ‘heteroglossic’ resources that [deny] and [counter] alternative propositions. Like MRAC Acknowledgments, these generic stages or

phases are only likely to disalign the textual voice and reader if the reader is unconvinced that the research presented is not affected or biased in some way by the role of funding bodies. The ‘countering’ statement in (6.194), for example, may lead a potential reader to question the relationship between researchers and funding bodies, particularly if those funding bodies have commercial interests in the research (cf. example (6.186) in section 6.2.6.2). This does not necessarily imply disalignment, but it could lead to a more sceptical reading of the article. The primary intention of such statements, of course, is to make medical research as transparent as possible and to avoid or make clear any potential conflicts of interest.

### **6.2.7 Summary**

The dialogic space created as MRAC texts unfold resembles somewhat the general–particular, particular–general structure proposed by Hill, Soppelsa, and West (1982), Swales (1990), and Atkinson (1992), with Introductions and Discussions construing relatively open dialogic spaces and Methods and Results construing relatively closed dialogic spaces. This also accords with other genre-based studies that generally consider Introduction and Discussion sections to be relatively argumentative and Methods and Results sections to be largely descriptive stages of the (medical) research article (e.g. Skelton 1994, Nwogu 1997, MacDonald 2002, Hyland 2005, Li and Ge 2009, Fryer 2012, Davis 2015). However, closer inspection of the phases within those four main stages, as well as other stages and phases not typically included in genre analyses of medical research articles, suggests a dialogic space that differs somewhat from the schematized hourglass figure offered by Hill and others (Hill, Soppelsa, and West 1982, 335, Swales 1990, 134, Atkinson 1992, 341, Swales and Feak 2012). Introductions usually begin by construing a wide dialogic space that gradually narrows as the textual voice identifies gaps in the research field and states the aims of the study. Methods construe a considerably narrower space for dialogic alternatives, one which is most constrained in the experimental-procedure phase and less so in the material and data-analysis phases. The dialogic space in Results sections remains relatively narrow—narrower in general than that construed by

the Methods section—but gradually widens in the statistical analysis and evaluation phases. Discussion sections begin, in the main findings phase, by construing a relatively narrow dialogic space, but gradually expand the space for alternative voices as they discuss possible mechanisms or causes and draw conclusions. To this, we can add that Titles are relatively ‘non-heteroglossic’; Abstracts more or less mirror the hourglass-like dialogic space of IMRaD, albeit against a somewhat narrower multivoiced background; Acknowledgments, Appendices, and Conflict-of-Interest Statements are relatively ‘monoglossic’; and References, on the one hand, open up dialogic space by ‘acknowledging’ an explicit set of external voices and, on the other, ‘contract’ that space by ‘endorsing’ or ‘justifying’ various text-internal and text-external positionings. The resulting effect is a medical research article (idealized, of course) in which different voices in the discourse are in varying ways and to varying degrees ignored or not recognized, accommodated, exploited, or challenged. While MRAC articles overall seem to be more ‘heteroglossic’ than ‘monoglossic’, and more dialogically ‘expansive’ than ‘contractive’ (see section 6.1), a closer inspection of generic stages and phases shows that the dialogic space changes according to generic function. The extent to which this might be “a direct reflection of the process of scientific discovery” (ICMJE 2008, 11) is explored in section 6.4.

As we have seen, the instantiation of [engagement] differs across generic stages and phases. So, too, does the realization of [engagement]. For example, in the construal of [entertain], MRAC Introductions frequently deploy modalizing resources like *may* and *can* as well as mathematical-verbal *risk* and the conjunction *whether* indicating doubt or choice (see Table 6.2). In Methods sections, where the instantiation of [entertain] is less common, conditional clauses marked by the conjunction *if* are the most frequent realization-type (see Table 6.3). In Results sections, mathematical-verbal resources predominate, e.g. *p*, *risk*, and *confidence interval* (see Table 6.4). Realization-types in Discussions, however, more closely resemble those of the Introduction sections, with the addition of modulating resources such as *should* and *must* (see Table 6.5). These different realization-types—and their differing scopes and

weights—can be accounted for ‘from above’, by considering their function in relation to the stages or phases in which they appear.

Other differences in realization-type include *not* as the most common realization of [deny] in all four main stages, but *non-* as the most common realization in Abstracts (compare Tables 6.2–6.6). In the semantically dense Abstract, where space is generally at a premium, the choice of local or morphologic negation rather than clausal negation may be conditioned by the relative lack of space. Among ‘monoglossic’ statements in MRAC, a higher percentage are realized by relational and existential clauses in the Results section (see Table 6.4) compared with the other three main stages of the RA. Again, these differences can be explained in large part by looking ‘from above’, from the perspective of genre, where Results sections focus less on what was done and more on what was observed and how those observations were characterized.

Although very few instances of [engagement] in MRAC are likely to disalign the textual voice and the reader, there are two generic stages or phases in which the potential for disalignment seems greatest. Discussions and Acknowledgments—or, more specifically, Conflict-of-Interest statements in Acknowledgments—are generic stages in which the textual voice expresses heightened levels of personal involvement (White 2003, 269), either through instances of [pronounce], [affirm], and text-internal [endorse] in the case of Discussions or through open-for-discussion [monogloss] and [entertain] in the case of Conflict-of-Interest statements. Writer–reader solidarity may be threatened in these generic stages if the reader is unconvinced by the subjectivized position of the textual voice.

### **6.3 Contextual Variables**

Several contextual parameters were annotated in MRAC (see section 5.2.1). In this section, I discuss the potential effects of those parameters on choices of [engagement].

#### **6.3.1 Year of Publication**

Articles in MRAC were published in the years 1991–2006. The highest relative frequency of [engagement] features (92.28 instances per 1000

words) is found in 1997, and the lowest relative frequency in 1992 (50.89 instances per 1000 words).<sup>136</sup> Despite differences in relative frequencies of [engagement], there are no discernible patterns of general increase or decrease over time (see Figure 6.15). The same is true of more delicate suboptions of [engagement]; there are no notable time-dependent changes.

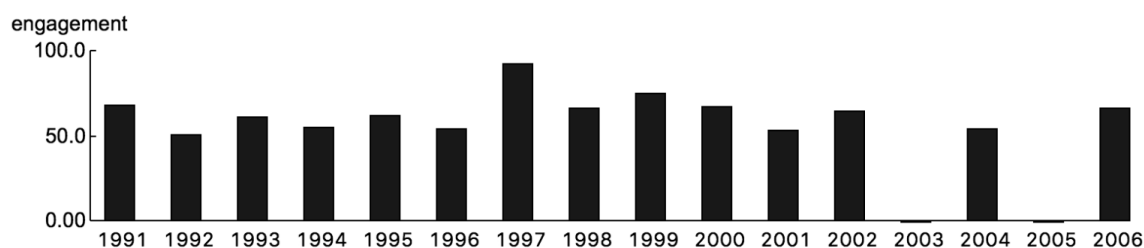


Figure 6.15. Instantiation of [engagement] (relative frequency) by year of publication.

### 6.3.2 Source Journal

MRAC contains 36 RAs from NEJM, seven from LAN, six from JAMA, and one from BMJ (see section 5.1 and Table A1 in the Appendix). The highest relative frequency of [engagement] is found among JAMA articles (79.48 instances per 1000 words), and the lowest among LAN articles (56.98 instances per 1000 words) (see Figure 6.16). Upon closer inspection, the high relative frequency of [engagement] among JAMA articles can be accounted for by high relative frequencies of dialogically expansive [entertain] and [acknowledge] (39.13 and 9.86 instances per 1000 words, respectively; cf. 29.50 and 6.86 for MRAC as a whole), and particularly by ‘acknowledgments’ realized by reporting verbs such as *report* and *ask*. (One of the JAMA articles, MRAC\_09, investigates the uses and costs of alternative medicine, and presents patients’ responses to surveys conducted by telephone.)

<sup>136</sup> No MRAC articles were published in the years 2003 and 2005.

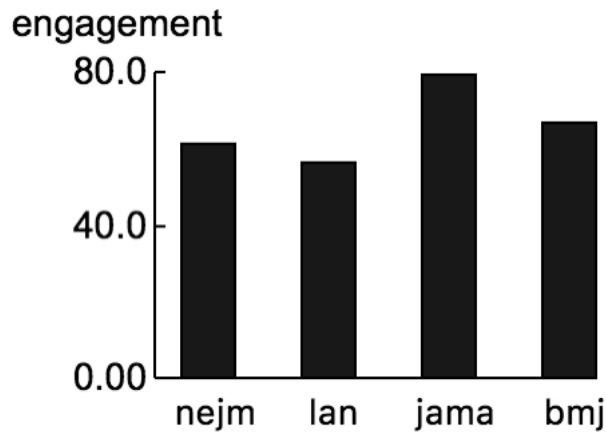


Figure 6.16. Instantiation of [engagement] (relative frequency) by source journal.

### 6.3.3 Author Affiliation

Thirty-one MRAC articles were authored by researchers based primarily in the United States, six by transnational research teams, five by authors based in the United Kingdom, two from Canada, and one each from Australia, Belgium, Finland, France, the Netherlands, and Sweden (see section 5.2.1). The relative frequency of [engagement] was highest among articles authored by researchers based in the United Kingdom (72.16 instances per 1000 words) and lowest in the article authored by researchers based in Sweden (29.37 instances per 1000 words) (see Figure 6.17). The Sweden article, MRAC\_06, compares the effects of two antihypertensive drugs in treating hypertension (abnormally high blood pressure). The relatively low number of instances of [engagement] in MRAC\_06, especially of [counter] and [deny], may be due to the generally high level of agreement between the study's hypotheses and its findings (see comments in section 6.1.1.1). Levels of [acknowledge] and [entertain] are also relatively low, implying a text that generally offers fewer comparisons and fewer explanations or speculations for findings compared with other texts in MRAC.

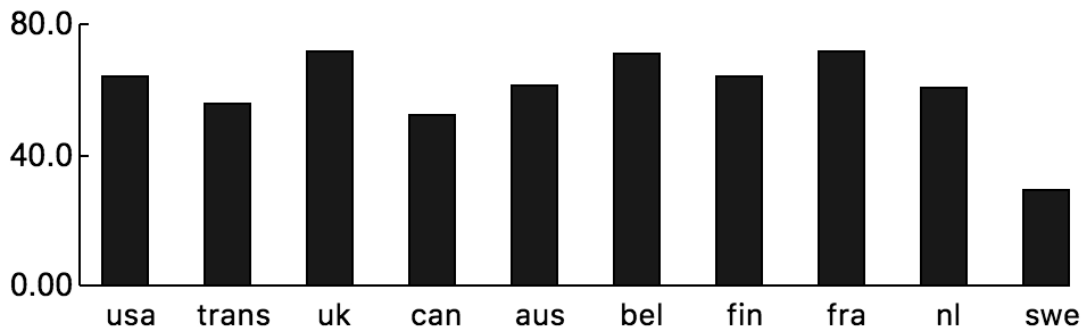


Figure 6.17. Instantiation of [engagement] (relative frequency) by author affiliation.

Other notable affiliation-related differences include the high relative frequencies of [monogloss], text-external [endorse], and [pronounce] in the France and Netherlands articles (see Figures 6.18, 6.19, and 6.20, respectively), as well as the high relative frequency of text-internal [endorse] in the Australia article (see Figure 6.21). Other [engagement] features had relatively even distributions across affiliations.

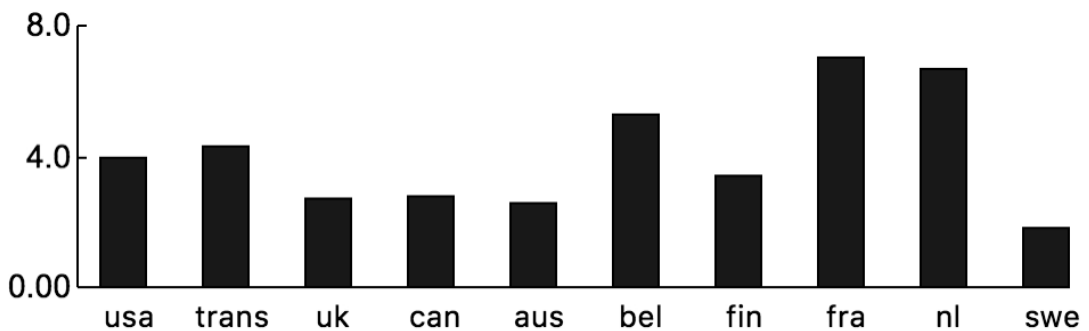


Figure 6.18. Instantiation of [monogloss] (relative frequency) by author affiliation.

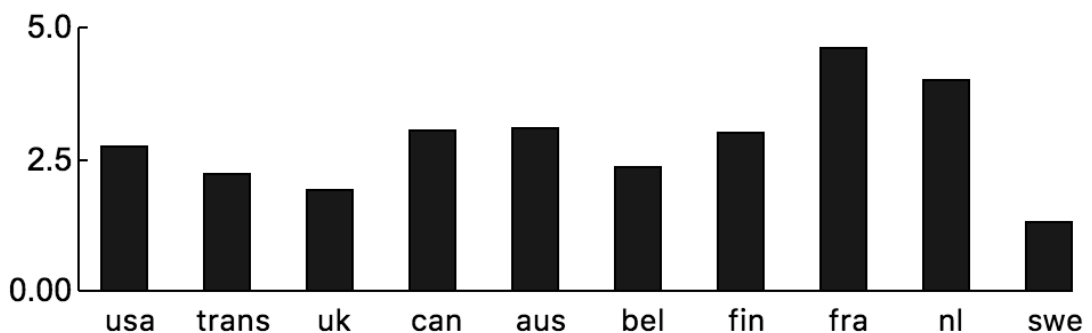


Figure 6.19. Instantiation of text-external [endorse] (relative frequency) by author affiliation.

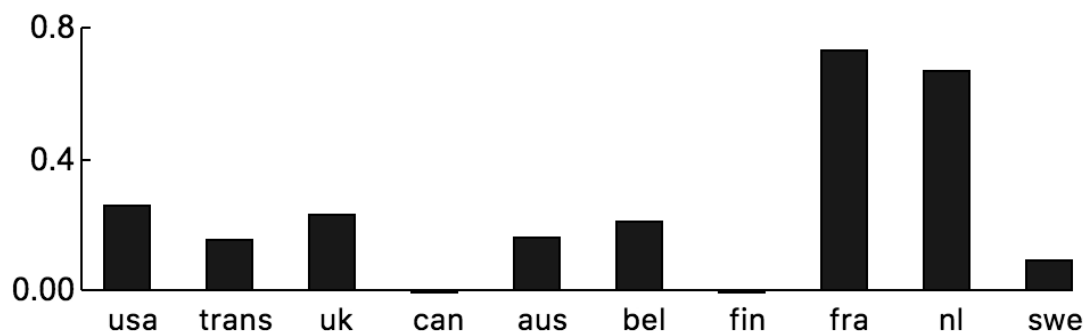


Figure 6.20. Instantiation of [pronounce] (relative frequency) by author affiliation.

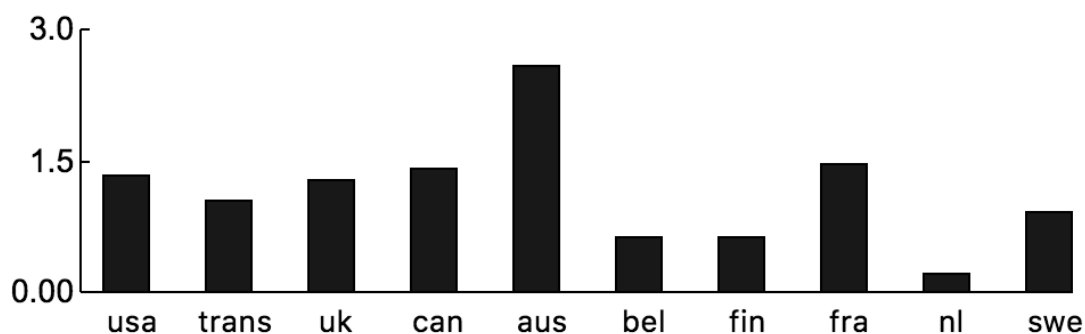


Figure 6.21. Instantiation of text-internal [endorse] (relative frequency) by author affiliation.

### 6.3.4 MeSH Major Topic Key Words

There are 150 MeSH Major Topic Key Words covered by MRAC (see section 5.2.1 and Table A2 in the Appendix). Based on the frequency of occurrence of those key words, major topic areas are heart failure/disease, hypertension, diabetes mellitus (especially type 2), obesity/overweight, and HIV/AIDS.

Table 6.7 shows the instantiation of [engagement] across each of the major topic areas and MRAC as a whole. Several notable comparisons can be made. For example, HIV/AIDS articles generally contain fewer instances of [engagement] than MRAC as a whole, but higher relative frequencies of [monogloss]. While dialogically ‘contractive’ features are generally lower in HIV/AIDS articles, occurrences of [counter] are higher than in MRAC as a whole. For MRAC articles dealing with obesity/overweight, the instantiation of [engagement] is slightly lower than for MRAC as a whole, especially with regard to dialogically contractive [heterogloss]. There are considerably more instances of



[monogloss] and [acknowledge] in obesity/overweight articles than in MRAC as a whole. Diabetes-related articles have lower relative frequencies of [engagement], especially [heterogloss: contract], than MRAC as whole. Like obesity/overweight articles, diabetes articles contain relatively high frequencies of [acknowledge] compared with MRAC as a whole. Hypertension articles contain fewer instances of [engagement] than MRAC as a whole, but a higher relative frequency of [deny]. Heart failure/disease articles, the most common major topic area in MRAC, are characterized by more instances of [engagement] than MRAC as a whole, with considerably higher relative frequencies of dialogically 'contractive' [deny], [endorse], and [justify] and dialogically 'expansive' [entertain].

Table 6.7. Instantiation of [engagement] (relative frequency per 1000 words) across major topic areas covered by MRAC.

Feature	MRAC as a whole	Major topic areas				
		HIV/AIDS	Obesity/overweight	Diabetes mellitus	Hypertension	Heart failure/disease
<b>Monogloss</b>	<b>3.82</b>	<b>6.55</b>	<b>4.39</b>	<b>3.77</b>	<b>3.44</b>	<b>2.91</b>
<b>Heterogloss</b>	<b>59.27</b>	<b>45.24</b>	<b>55.92</b>	<b>55.82</b>	<b>51.93</b>	<b>63.51</b>
<b>Contract</b>	<b>22.71</b>	<b>19.48</b>	<b>19.51</b>	<b>18.99</b>	<b>17.84</b>	<b>24.92</b>
Deny	10.68	8.73	9.11	9.64	9.51	11.83
Counter	4.41	5.07	4.11	3.40	2.77	4.62
Affirm	0.20	0.26	0.11	0.06	0.12	0.21
Concede	0.00	0	0	0	0	0
Pronounce	0.23	0.26	0.07	0.11	0.21	0.26
Endorse	3.94	2.45	2.86	3.02	3.55	4.52
Justify	3.25	2.71	3.25	2.77	1.67	3.48
<b>Expand</b>	<b>36.56</b>	<b>25.77</b>	<b>36.41</b>	<b>36.83</b>	<b>34.09</b>	<b>38.58</b>
Entertain	29.50	21.4	28.91	29.48	27.26	31.78
Acknowledge	6.86	4.37	7.43	7.29	6.74	6.61
Distance	0.19	0	0.07	0.05	0.07	0.19

Feature	MRAC as a whole	Major topic areas				
		HIV/ AIDS	Obesity/ overweight	Diabetes mellitus	Hypertension	Heart failure/ disease
Engagement, total	63.09	51.88	60.31	59.59	55.37	66.41

Among the major topic areas presented in Table 6.7, heart failure/disease articles are the most multi- or other-voiced, ‘expanding’ and ‘contracting’ the dialogic space more often it would seem than articles from other major topic areas. In contrast, HIV/AIDS articles are relatively more single-voiced, containing generally fewer instances of [heterogloss] and more instances of [monogloss] than other major topic areas.

The relative frequencies of [engagement] in most of these major topic areas are lower than MRAC as a whole, suggesting that some articles outside of these major topics have considerably higher relative frequencies of [engagement]. The MRAC article with the highest relative frequency of [engagement] (MRAC\_29; 106.38 instances per 1000 words), for example, investigates the risk of gastric carcinoma (a type of stomach cancer) associated with *Helicobacter pylori* infection. It is not part of the major topic areas discussed here. The lowest relative frequency of [engagement], on the other hand, is found in MRAC\_06 (49.22 instances per 1000 words), which is part of the hypertension topic area.

### 6.3.5 Publication Type

Publication type, a term used by the National Library of Medicine database, refers to the type of study conducted (see section 5.2.1). Most MRAC articles (n=37) are clinical randomized controlled trials, some of which (n=29) are conducted across multiple study sites. Eight RAs are categorized as comparative studies.

Clinical randomized controlled trials have fewer relative instances of [engagement] than MRAC as a whole (60.75 and 63.09 instances per 1000 words, respectively), as do multicentre studies (60.71 vs. 63.09 instances per 1000 words) and comparative studies (55.70 vs. 63.09 instances per 1000 words). Choices at more delicate levels of the ENGAGEMENT system are consistently of lower relative frequency for articles

categorized as clinical randomized controlled trials, multicentre, and/or comparative.

Notable differences in realization-type include higher relative frequencies of [entertain *p*] and [endorse *demonstrate*] in clinical randomized controlled trials compared with MRAC as a whole. Multicentre studies show the same tendency for [endorse *demonstrate*], as do comparative studies for [entertain *should*]. The two most frequently deployed [engagement] resources in MRAC—numerical references and mathematical-verbal *risk*—are more frequent in MRAC as a whole than in articles categorized as clinical randomized controlled trials, multicentre studies, and/or comparative studies.

### 6.3.6 On the Possible Effects of Contextual Variables

The relatively small size of MRAC (50 RAs, 298,152 words) makes it difficult to determine the potential effects of contextual variables on [engagement]. Moreover, it is not clear to what extent (if at all) these variables might intersect or interact. No factor analysis was carried out as part of the study. However, based on the rudimentary analyses in sections 6.3.1–6.3.5, and bearing in mind the small sample size, it seems that year of publication has little or no effect on the construal of [engagement] in MRAC. Source journal may matter, with JAMA articles containing considerably more instances of [engagement] than other MRAC articles, especially LAN articles. The effect of affiliation is less clear, although the single article written by researchers based primarily in Sweden has considerably fewer instances of [engagement] than those written by researchers with other affiliations. With regard to topic, heart failure/disease articles contained considerably more instances of [engagement] than other major topic areas. Publication type seems to have a negative effect on the deployment of [engagement], with all three main types—comparative, multicentre, and/or clinical RCT—associated with fewer instances of [engagement] than other MRAC articles.

The article containing the highest relative frequency of verbal and mathematical [engagement] in MRAC, MRAC\_29, was published in 1991 in NEJM by researchers based primarily in the United States. The article investigates the relation between gastric carcinoma and *Helicobacter*

*pylori* infection. It is not a comparative, multicentre, or clinical RCT study. The article containing fewest instances of verbal and mathematical [engagement] in MRAC, MRAC\_06, was published in 2002 in LAN by researchers based primarily in Sweden. The article compares the effects of two antihypertensive treatments on cardiovascular morbidity and mortality. It deals with the topic of hypertension, and its publication type is categorized as a comparative (non-multicentre) clinical RCT.

## 6.4 Disciplinarity and Ideology

[T]he specific text is but a transformation of the specialized interactional practice; the text is the form of the social relationships made visible, palpable, material. It should be possible to recover the original specialized interactional practice from an analysis of its text(s) in its context. Further, the selective creation, production, and changing of texts is the means whereby the positioning of subjects is revealed, reproduced, and changed.

Bernstein (1981, 329)

Although the ability to read context through text may be limited (see Fairclough 1992, 88–89), “the interpersonal resources of language [...] play an important role in the negotiation of scientific knowledge and in the creation and maintenance of scholarly communities” (Matthiessen, Teruya, and Lam 2010, 12), and an analysis of the instantiation and realization of [engagement] may provide valuable insights into the discipline and ideology of medical research. The above analyses show, for example, that MRAC articles are primarily ‘heteroglossic’, even if that [heterogloss] is often realized or instantiated at levels below the clause or proposition; there is relatively little [monogloss]. Propositions in MRAC are generally supported by evidence and argumentation (cf. [acknowledge], [endorse], [justify]) or grounded in the (un)certainty of the textual voice ([entertain]), regardless of whether those propositions challenge other voices or viewpoints in the communicative context. Choices of [engagement] in MRAC articles imply a discourse that primarily attempts to build alliances and seek consensus and alignment. There is very little opposition or disalignment (cf. mass-communicative texts examined in White 1998, 2003, 2012, Martin and White 2005, *inter alia*). If propositions do risk challenging the values, beliefs, or positions of

readers, they tend to be so carefully negotiated, usually with additional [engagement] resources, as to make disalignment unlikely.

Differences in the instantiation and realization of [engagement] across different generic stages and phases of the medical research article seem to imply an epistemology and writer–reader relation that evolves as the text unfolds. The relative [monogloss] and mathematical [entertain] of the Methods and Results sections, for example, may be more indicative of an objectivist ideal and an empirical, positivist epistemology than the Introduction and Discussion sections (cf. Dahl 2004, Arsenault, Smith, and Beauchamp 2006, Fløttum, Dahl, and Kinn 2006, Hiltunen 2010, Hu and Wang 2014, among others). The dialogically ‘expansive’ Introduction and Discussion sections construe a more intersubjective position than the Methods and Results sections, emphasizing the presence of other voices and connecting the study to a wider medico-scientific context (see Rowley-Jolivet 2002, 2004, Herrando-Rodrigo 2010, Lafuente Millán 2010, Yang, Zheng, and Ge 2015, *inter alia*). Adams Smith (1984) and MacDonald (2002) note that the bracketing of the relatively objective Methods and Results sections by the more subjective Introduction and Discussion sections is part of what makes the medical research article “a particularly hybrid text” (MacDonald 2002, 458). This hybridity can be seen through patterns of [engagement] choices and demonstrates how certain stages and phases of the medical research article might be considered relatively harder (Methods, Results) or softer (Introduction, Discussion), more singular (Methods, Results) or more regional (Introduction, Discussion).

ICMJE (2008, 11) describes the IMRaD structure of the medical research article as “a direct reflection of the process of scientific discovery”. This point is not elaborated further by ICMJE (2008), but it might be formulated, in a somewhat simplified form, as follows. Based on the interests or health concerns of a particular group or groups and on current medico-scientific knowledge and on funding opportunities, a particular set of hypotheses, aims, and/or research questions are proposed. Those hypotheses, aims, and/or research questions are investigated by conducting a series of tests and analyses on a sample of said group or groups, sometimes in comparison with other (unaffected) groups. The findings based on those tests and analyses are compared with

the original hypotheses and with the literature, and possible explanations for agreement with or deviation from those hypotheses and other work are offered. The possible generalizability of the findings may be discussed, and suggestions for future research are sometimes proposed. This process is an idealized one, of course, and one that is concerned primarily with the reporting of empirical studies rather than, say, case studies or reviews. Clearly, not all empirical studies and scientific discoveries follow such a process (cf. Latour and Woolgar's 1986 anthropological study of laboratory science and the production of texts), but the verbal and mathematical [engagement] resources identified in MRAC give us little (if any) insight into the actual processes behind the research; [engagement] resources in MRAC reflect the idealized process suggested by ICMJE (2008), but an idealized process in which exchange, interaction, and negotiation are foremost.

## **6.5 Verbal and Mathematical Engagement: Summary and Discussion**

This chapter shows how [engagement], as set out in the framework of Martin and White (2005) and others, is realized and instantiated verbally and mathematically in a corpus of medical research articles (MRAC). Most instances of [engagement] are 'heteroglossic' (i.e. multi- or other-voiced), with relatively few instances of [monogloss] (i.e. single-voicedness). Of those 'heteroglossic' instances, the majority are dialogically 'expansive'; that is, they open up the dialogic space for alternative viewpoints and propositions. Dialogically 'expansive' [entertain]—i.e. propositions that are grounded in the subjectivity of the textual voice and that can be construed as one among a number of possible alternative propositions—is the most frequently instantiated [engagement] feature in MRAC. Among dialogically 'contractive' features, [deny]—i.e. propositions that acknowledge and reject actual or potential alternative propositions—is the most frequently instantiated. Only one feature in the ENGAGEMENT system proposed by Martin and White (2005), dialogically 'contractive' [concede], is not instantiated in MRAC.

The number of realization-types for [engagement] features ranges from six to 233, although most [engagement] features are realized by a relatively small set of canonical verbal and mathematical resources. The semantic scope of [engagement] resources varies, with some extending over semantic sequences (proposition-nexuses) and others restricted to semantic elements. This affects the way [engagement] features overlap and interact, creating hierarchically organized clusters or syndromes of [engagement] that affect the dialogic space in different ways.

As MRAC texts unfold, the instantiation and realization of verbal and mathematical [engagement] changes. Titles are generally 'non-heteroglossic'; Abstracts mirror somewhat the instantiation of [engagement] seen in Introductions, Methods, Results, and Discussions; Introductions tend to be dialogically 'expansive'; Methods and Results are characterized by 'monoglossic' and dialogically 'contractive' propositions; Discussions are usually dialogically 'expansive'; Acknowledgments and Appendices are generally 'monoglossic'; and References are 'heteroglossic', variably construing a dialogic background that both 'expands' and 'contracts' the space for alternative propositions. Certain realization-types vary across those different generic stages, perhaps most notably the high levels of mathematical [entertain] realized by *p* and *CI* (among others) in parts of the Results section. Patterns of [engagement] choices across different stages and phases of MRAC articles are indicative, it seems, of the hybridity of medical research texts and may reflect an epistemology that, rather than being restricted to objectivist, empiricist, or subjectivized positions, evolves throughout the text.

Among the contextual variables investigated as part of the corpus analysis, there was no noticeable pattern of change in the instantiation or realization of [engagement] over time. With regard to source journal, articles published in JAMA had a greater number of instances of [engagement] than articles published elsewhere. Articles written by researchers based primarily in the United Kingdom contained the highest number of instances of [engagement]; the lowest relative frequency of [engagement] features was found in an article written by researchers based in Sweden. Articles dealing with heart failure/disease had more instances of [engagement] than articles dealing with HIV/AIDS,

obesity/overweight, diabetes mellitus types 1 and 2, and hypertension. Articles in MRAC categorized as multicentre, comparative, and/or clinical randomized controlled trials had fewer instances of [engagement] than those not categorized as such.

Overall, the findings in this chapter suggest a collection of texts that, taken as a whole, tend to be 'heteroglossic', and especially dialogically 'expansive'. Solidarity between the textual voice and the reader is generally maintained throughout the texts, with very few instances of potential disalignment.



## 7 Visual Engagement

The texts in the Medical Research Article Corpus (MRAC) are visual documents. They include graphical, numerical, figurative, and scriptural elements (cf. Rowley-Jolivet 2002, 2004) such as diagrams, graphs, tables, mathematical formulae, and written text. In the following sections, I consider how [engagement] is construed visually in MRAC. I begin with a discussion of modal function (section 7.1) based on the work of O'Toole (1994). This is followed by a feature-by-feature account of ENGAGEMENT (section 7.2) based on the discourse semantic models presented and discussed in section 3.2 and a discussion of the scope and interaction of those features. Section 7.3 examines how, from the perspective of genre, visual [engagement] resources are distributed across MRAC. Section 7.4 looks at potential variations in visual [engagement] according to contextual variables such as source journal and publication type. Section 7.5 explores relations between visual [engagement] and the disciplines and ideologies of medical research. The chapter concludes with a summary of the main findings (section 7.6).

### 7.1 Engagement and the Modal Function of Images

According to O'Toole (1994), all interpersonal meaning is essentially a mode of engagement (see section 3.2). In addition to considering the potential sources and positions construed by texts, O'Toole (1994, 5–12) emphasizes more generally the importance of RHYTHM, GAZE, FRAME, LIGHT, PERSPECTIVE, COLOUR, and MODALITY in engaging the attention and emotional involvement of the reader.<sup>137</sup>

For MRAC, visual [engagement] is dependent to a certain extent on the site of engagement, i.e. whether the text is read on paper or on screen, and whether the digital version is in portable document format (PDF), hypertext markup language (HTML), or, in the case of individual diagrams, graphs, and tables, joint photographic experts group (JPEG) or portable

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<sup>137</sup> There may be important parallels to be drawn here with regard to verbally and mathematically construed [engagement] (chapter 6). This point is discussed further in chapter 8, on the intersemiotic relations of verbal, mathematical, and visual [engagement].

network graphics (PNG) formats. The paper and PDF versions of the MRAC texts have similar layouts, organized into double- or triple-column pages; the HTML versions are single-column texts. While the paper and PDF versions are generally immutable, the layout and style of the HTML versions are liable to change over time as the journal website is updated or revamped. Examples (7.1) and (7.2) show HTML versions of the same article—the first from 2013, the second from 2018.

(7.1)

The screenshot shows the NEJM website interface for the article "Efficacy and Safety of Recombinant Human Activated Protein C for Severe Sepsis". The page features the journal's logo, a navigation menu with options like "HOME", "ARTICLES & MULTIMEDIA", and "ISSUES", and a search bar. The article title is prominently displayed, followed by the authors' names and the journal citation: "N Engl J Med 2001; 344:699-709 | March 8, 2001 | DOI: 10.1056/NEJM200103083441001". The main content area is divided into sections: "BACKGROUND" (describing the trial's purpose and findings), "METHODS" (detailing the randomized, double-blind, placebo-controlled trial design), and "RESULTS" (summarizing the outcomes). Two figures are included: "FIGURE 1" showing "Proposed Actions of Activated Protein C" and "FIGURE 2" showing a "Kaplan-Meier Estimates of Survival among 850 Patients with Severe Sepsis". A sidebar on the right contains "TOOLS" (PDF, Print, Download Citation, E-Mail, Save, Article Alert, Reprints, Permissions, Share/Bookmark) and "RELATED ARTICLES" (including an editorial and a correspondence). The page is labeled as an "ORIGINAL ARTICLE".

(MRAC\_01)

The screenshot shows the NEJM website interface. At the top, there are navigation links for 'NEJM Group', 'Follow Us', 'Sign in', 'Create Account', and 'SUBSCRIBE'. Below this is the NEJM logo and a search bar. A horizontal banner contains three featured articles: 'EDITORIAL Escalating Inhaled Glucocorticoids to Prevent Asthma Exacerbations', 'IMAGE CHALLENGE What is the diagnosis?', and 'ORIGINAL ARTICLE Balanced Crystalloids versus Saline in Critically Ill Adults'. The main article is titled 'ORIGINAL ARTICLE Efficacy and Safety of Recombinant Human Activated Protein C for Severe Sepsis' by Gordon R. Bernard, M.D., Jean-Louis Vincent, M.D., Ph.D., Pierre-Francois Laterre, M.D., Steven P. LaRosa, M.D., Jean-Francois Dhainaut, M.D., Ph.D., Angel Lopez-Rodriguez, M.D., Jay S. Steingrub, M.D., Gary E. Garber, M.D., Jeffrey D. Helderbrand, Ph.D., E. Wesley Ely, M.D., M.P.H., and Charles J. Fisher, Jr., M.D. for the Recombinant Human Activated Protein C Worldwide Evaluation in Severe Sepsis (PROWESS) Study Group\*. The article is dated March 8, 2001, with N Engl J Med 2001; 344:699-709 and DOI: 10.1056/NEJM200103083441001. A sidebar on the left contains navigation icons for 'Article', 'Figures/Media', 'References', 'Citing Articles', and 'Letters'. The main text area shows the 'Abstract' section with the heading 'BACKGROUND' and the start of the text: 'Drotrecogin alfa (activated), or recombinant human activated protein C, has antithrombotic, antiinflammatory, and profibrinolytic properties. In a previous study, drotrecogin alfa activated produced dose-dependent reductions in the levels of markers of coagulation and inflammation in patients with severe sepsis. In this phase 3 trial, we assessed whether treatment with drotrecogin alfa activated reduced the rate of death from any cause among patients with severe sepsis.'

(7.2)

(MRAC\_01)

In MRAC, visual ‘rhythm’ or flow is generally developed and maintained by evenly distributed blocks of written text, referred to by Painter et al. (2013, 92–93) as “verbiage”. The regular ‘rhythm’ of these verbal visual units can be broken up or disrupted by section headings, verbiage of differing font type and size, and diagrams, graphs, and tables, some of which extend across the double or triple columns of the page. The example in (7.3) shows a two-page spread in which the visual ‘rhythm’ or flow of the verbiage is variously interrupted or disrupted by section and subsection headings, new paragraphs, and a 1.5-column-wide table. Note, too, that the Methods section on the left is reproduced at a smaller font size than that of the preceding and succeeding sections. At a glance, these changes or disruptions in visual ‘rhythm’ alert the reader to new stages or phases in the text (see section 7.3 on genre).

was to estimate the effects of air pollution on mortality, with control for individual smoking status, sex, age, and other risk factors.

Study Population

We selected random samples of adults from six communities... Worcester, Massachusetts (before study commencement was completed in 1974); Hartford, Tennessee, including Kington (1970) and... Boston, Massachusetts (1970); St. Louis (1970); Portland, Oregon (1970);... Tokyo, Kansas (1977). The sample was restricted to the 1811 white adults who were 70 through 79 years of age at enrollment...

Air-Pollution Data

As part of the original study design, ambient (outdoor) concentrations of several major air pollutants were measured... suspended sulfates were measured in each community as a centrally located monitoring station... particulate matter samples were placed in three sites in the last 1970s data...

Statistical Analysis

Life-table survival probabilities for each year of follow-up were estimated for each city, and differences between specific annual rates were assessed with a log-rank test... We estimated adjusted mortality-rate ratios for air pollution by simultaneously adjusting

for other risk factors in Cox proportional-hazards regression models... In the Cox proportional-hazards model, First, indicator variables for the six communities were included in the model... Second, we included an indicator variable for the year of enrollment... Third, we included an indicator variable for the year of enrollment... Fourth, we included an indicator variable for the year of enrollment...

RESULTS

Characteristics of the Cohort and Air-Pollution Data

The characteristics of the cohort and the values for air-pollution measures are summarized in Table 1... For all measured air-pollution measures, the mean level and annual acidity, ambient concentrations were highest in St. Louis and lowest in Portland or Tokyo... The mean acidity of the aerosol was highest in Hartford, but second-highest in St. Louis...

Adjusted Mortality Rates

On the basis of the proportional-hazards model, mortality was most strongly associated with cigarette smoking (Table 2). Increased mortality was also associated with having less than a high-school education...

Table 1. Characteristics of the Study Population and Mean Air-Pollution Levels in the Cities.\*

Table with 5 columns: Characteristics, Portland, Hartford, St. Louis, Boston, Tokyo. Rows include: No. of participants, Mean year of follow-up, No. of deaths, Mean 1970 average annual PM10 concentration, Annual SO2 concentration, Annual NO2 concentration, Annual CO concentration, Annual O3 concentration, Annual particulate matter concentration, Annual acidity, Annual sulfate concentration, Annual nitrate concentration, Annual ammonium concentration, Annual ammonium sulfate concentration, Annual ammonium nitrate concentration, Annual ammonium nitrate sulfate concentration, Annual ammonium sulfate nitrate concentration, Annual ammonium nitrate sulfate concentration, Annual ammonium sulfate nitrate concentration, Annual ammonium sulfate nitrate concentration.

1.08 to 1.47), and 1.26 (95 percent confidence interval, 1.08 to 1.47), respectively.

Mortality

Estimates of the association between mortality and fine-particle pollution among subjects with different smoking status, and among men and women (Table 3) showed only small and nonsignificant differences between subgroups... Associations with air pollution were somewhat stronger among subjects with occupational exposure to dust, gases, or fumes (Table 3). However, positive associations between mortality and air-pollution levels were observed in all subgroups defined by occupational exposure and sex, and differences among subgroups were not statistically significant... Although cigarette smoking and other risk factors were associated with mortality, our estimates of pollution-related mortality were not significantly affected by the inclusion or exclusion of these variables in the models (Table 4). The estimated association of air pollution and mortality was unchanged when subjects who had been treated for high blood pressure or subjects with diabetes were excluded from the analysis (Table 4). When treated survival times were excluded from the date of the last follow-up contact minus the enrollment date, or when the analysis was restricted to deaths in 1979 through 1989 (the years of the National Death Index searches), no appreciable differences in the estimated association between air pollution and mortality were observed.

Causes of Death

The estimated effects of air pollution on mortality varied among causes of death (Table 5). For comparison, rate ratios were estimated for current smokers and for former smokers with approximately the average number of pack-years of smoking an enrollment (Table 5). Smoking was most strongly associated with mortality due to lung cancer and cardiovascular disease but not with mortality from all other causes. Only 98 deaths were coded on the death certificate as due to nonmalignant respiratory disease (ICD-9 codes 485 through 496), as compared with 466 deaths due to cardiovascular disease (codes 400 through 460). An analysis restricted to deaths from nonmalignant respiratory disease but not with mortality from all other causes...

(7.3)

In some HTML versions of MRAC texts, e.g. those published in JAMA and LAN, diagrams and tables are separate from the main body of the text, placed in a media bar or column to the left or right of the main verbiage (see (7.4)).<sup>138</sup> Those images do not ostensibly affect the ‘rhythm’ of the verbiage; rather, they create parallel texts or subtexts with their own visual flow that, like the verbiage, can be maintained or disrupted, in this case by downloading and viewing individual diagrams and tables as separate, standalone files (Fryer 2016). Those images can also be accessed via hypertext links in the verbiage (see reference to Table 1 in (7.5) below).

(MRAC\_07)

<sup>138</sup> According to Kress and van Leeuwen (2006, 198), triptych layouts like that in (7.4) are a common feature of webpages. Centre panels may have higher information value than panels to the left and right, representing “the nucleus of the information to which all the other elements are in some sense subservient” (Kress and van Leeuwen 2006, 196). The left–centre–right organization of webpages may also construe a given–new information structure in which left-hand panels express “something the viewer already knows, as a familiar and agreed-upon point of departure for the message”, and right-hand panels present material that “is not yet known, or perhaps not yet agreed upon by the viewer, hence as something to which the viewer must pay special attention” (Kress and van Leeuwen 2006, 181).

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Outline  
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Table 1  
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Table 5

# THE LANCET

Volume 358, Issue 9286, 22 September 2001, Pages 958-965

Articles

## Peginterferon alfa-2b plus ribavirin compared with interferon alfa-2b plus ribavirin for initial treatment of chronic hepatitis C: a randomised trial

Prof Michael P Manns MD <sup>a, b, c</sup>, John G McHutchison MD <sup>b</sup>, Stuart C Gordon MD <sup>c</sup>, Vinod K Rustgi MD <sup>d</sup>, Mitchell Shiffman MD <sup>e</sup>, Robert Reindollar MD <sup>f</sup>, Zachary D Goodman MD <sup>g</sup>, Kenneth Koury PhD <sup>h</sup>, Mei-Hsiu Ling PhD <sup>h</sup>, Janice K Albrecht PhD <sup>h</sup>, International Hepatitis Interventional Therapy Group

[https://doi.org/10.1016/S0140-6736\(01\)06102-5](https://doi.org/10.1016/S0140-6736(01)06102-5) Get rights and content

Summary

Background

A sustained virological response (SVR) rate of 41% has been achieved with interferon alfa-2b plus ribavirin therapy of chronic hepatitis C. In this randomised trial, peginterferon alfa-2b plus ribavirin was compared with interferon alfa-2b plus ribavirin.

Methods

Recommended articles

Simeprevir plus sofosbuvir, with or without...  
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(7.4)

(MRAC\_23)

## Methods

Prevalence estimates of overweight and obesity were calculated using data from the National Health and Nutrition Examination Survey (NHANES), a complex, multistage probability sample of the US civilian, noninstitutionalized population.<sup>6</sup> Race/ethnicity was reported by survey participants. During a physical examination in a mobile examination center, height and weight were measured using standardized protocols and calibrated equipment. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters and was rounded to the nearest tenth.

The NHANES 2003-2004 overall response rate (of those originally selected for participation) was 68.6% (4742/6916) for adults aged 20 years or older and 83.2% (4105/4932) for children and adolescents aged 2 to 19 years. Less than 3% of examined children and adolescents and 7% of adults had missing data for BMI. Data for analyses were available for 3958 children and adolescents and 4431 adults in 2003-2004 (Table 1), in addition to previously published data for 1999-2000 and 2001-2002.<sup>3-5</sup>

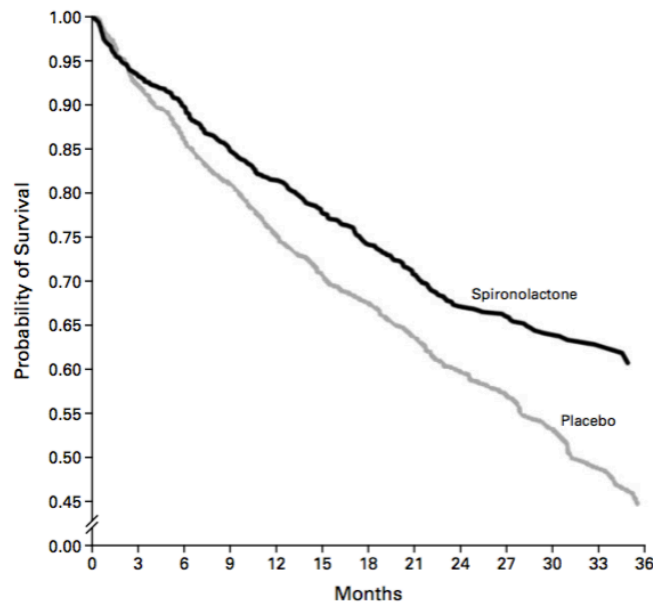
(7.5)

(MRAC\_26)

Unlike some of O'Toole's (1994) examples from fine art, none of the MRAC articles are suggestive of a "gaze", i.e. the presence of some human or human-like element that appears to look out from the text at the reader and demand that the reader engage with the text in a certain way (cf. Kress

and van Leeuwen 2006). Instead, rather than ‘demanding’ a particular response or position from the reader, texts in MRAC seem to ‘offer’ to the reader “items of information, objects of contemplation, impersonally, as though they were specimens in a display case” (Kress and van Leeuwen 2006, 119). For Kress and van Leeuwen (2006, 121), the visual ‘offer’ presented in MRAC is often representative of “objective, dispassionate knowledge, ostensibly free of emotive involvement and subjectivity”.

‘Framing’ deals with the way in which the text can be separated into its various parts, and how those parts relate to each other and the text as a whole. Frames guide or position the reader in relation to different elements of the visual text. Lines and spaces separate diagrams, tables, and verbiage, and episodes and figures (cf. O’Toole’s rank scale for images, section 2.2.2.1) within those visual elements can be identified by similarities and differences in colour, brightness, shape, and so on. ‘Perspective’ also helps determine what the reader might be encouraged to focus on and engage with in a text, based on how visual elements are foregrounded or backgrounded by the image-producer. The line-graph in (7.6), for example, contains a series of figures and episodes that can be discerned by similarities and distinctions in the shape, brightness, spacing, and labelling of visual elements. The graph represents the probability of patient survival as a function of time, and how that probability differs between two datasets. Differences in brightness, position, and labelling help distinguish those two datasets; they also serve, in the case of brightness and position, to highlight the relative importance of the active treatment group (referred to in the graph as *spironolactone*) compared with the non-active treatment group (*placebo*). (Note how, in the top left corner of the graph, where the *spironolactone* dataset overlaps the placebo dataset, the darker line of the *spironolactone* data is foregrounded by being placed over or in front of the lighter line of the *placebo* data.)



**Figure 1.** Kaplan–Meier Analysis of the Probability of Survival among Patients in the Placebo Group and Patients in the Spironolactone Group.  
The risk of death was 30 percent lower among patients in the spironolactone group than among patients in the placebo group ( $P < 0.001$ ).

(7.6)

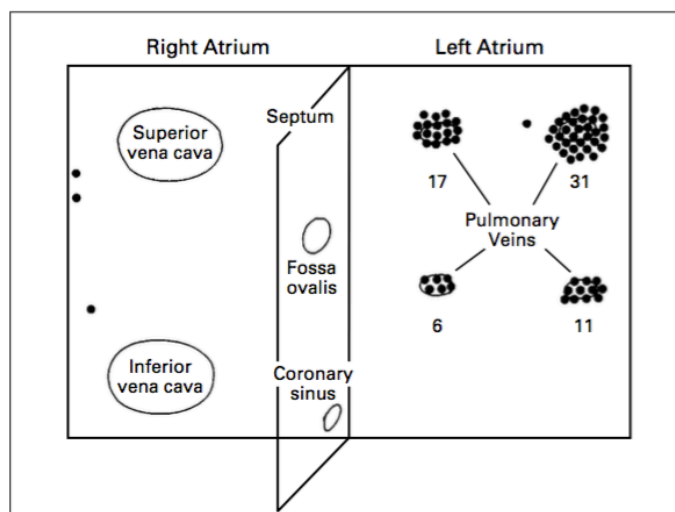
(MRAC\_31)

As discussed in sections 3.1.2.2.1 and 4.2.3, ‘modality’ or modalization is often associated with the idea of truth-value, i.e. the degree to which we might consider some statement or proposition to be true or false. For O’Toole (1994, 9)—and others (e.g. Kress and van Leeuwen 2006, Economou 2009)—the same can be said of images. Images can represent to varying degrees the world as it is, the world as it could, might, or should be, and the world as it is not. O’Toole (1994) exemplifies this in terms of the relative verisimilitude or lifelikeness of visual figures and episodes in works by Botticelli and Bruegel, among others, and Kress and van Leeuwen (2006, 160–163) propose a series of “modality markers” that, to varying degrees, indicate the “realness” or “trueness” of a particular visual representation.<sup>139</sup> Those markers include uses of and variations in colour, pictorial detail, background, and depth.

From a dialogic perspective, visual modality (like verbal modality) can be indicative of authorial subjectivity and may therefore construe for

<sup>139</sup> In Peirce’s three basic sign-categories, verisimilitude is usually referred to as “likeness” (Peirce 1894) or “icon” (Peirce 1895) (in Peirce 1998, 9, 13). What is real or true, however, is not necessarily iconic (see subsequent discussion of coding orientation).

the text a multi-voiced background of alternative representations (Economou 2009, 217–221). In MRAC, visual modality tends to be low if measured against Kress and van Leeuwen’s (2006) “naturalistic” yardstick. Pages are typically black and white, with other colours such as reds and blues reserved primarily for headings and, in the case of HTML, for advertisements and hypertext links to references, diagrams, graphs, and tables (see examples (7.1)–(7.5) above). Most diagrams, graphs, and tables are reproduced in black and white and/or greytone (see (7.3) and (7.6)), and visual representations of experimental set ups and biological material are generally nonspecific abstractions with relatively little pictorial detail and depth. In (7.7), a black-and-white line-diagram shows 69 sites of interest (indicated by black dots) in an abstract representation of part of the human heart. Rather than representing one specific heart, the diagram represents an amalgamation of how those sites of interest are distributed across the hearts of 45 different patients.<sup>140</sup>



**Figure 1.** Diagram of the Sites of 69 Foci Triggering Atrial Fibrillation in 45 Patients. Note the clustering in the pulmonary veins, particularly in both superior pulmonary veins. Numbers indicate the distribution of foci in the pulmonary veins.

(7.7)

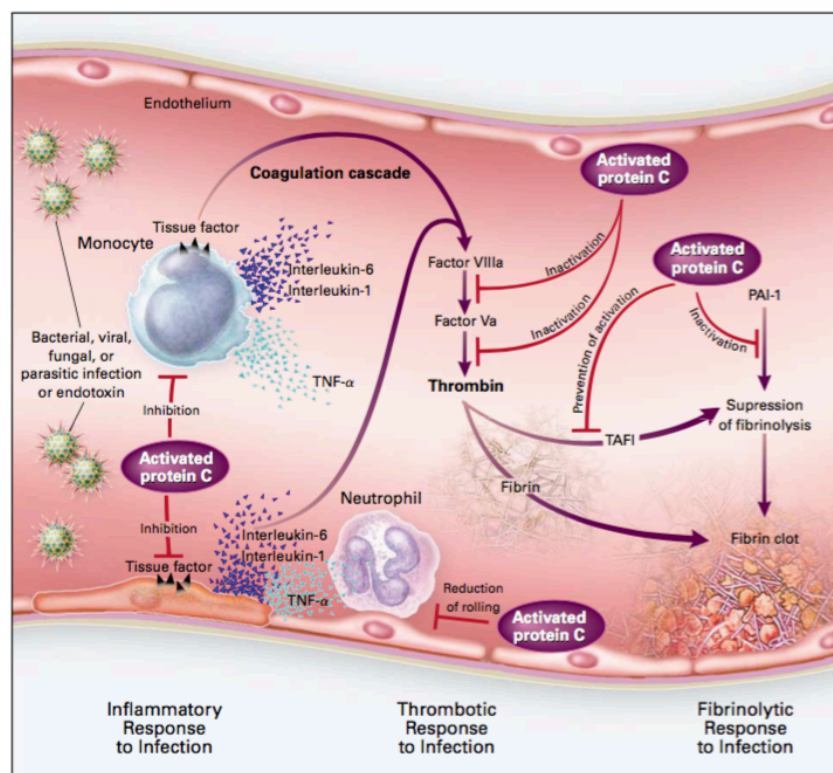
(MRAC\_15)

As the examples above show, a naturalistic yardstick is not necessarily the ideal benchmark for measuring what is “true” or “real” in MRAC. Rather than being determined by a naturalistic coding orientation, semiotic

<sup>140</sup> Note that depth, here, is suggested by the parallelogram labelled *septum*, representing the interatrial septum separating the left and right atria.



choices in MRAC seem to be regulated by a technological/abstract coding orientation that values generalizability, effectivity, and reproducibility over a naturalistic representation of reality (see Bernstein 1981, Kress and van Leeuwen 2006, and section 2.2.1.5.3 on ideology). The visuality of MRAC is characterized by a relatively limited colour palette (usually black and white or greytone), a lack of depth and pictorial detail, and a schematic rather than verisimilar form of representation. However, there are exceptions. The diagram in (7.8), for example, which is discussed at greater length in later sections, uses a combination of schematic and naturalistic elements. It also employs an extensive range of colours and a high level of pictorial detail, especially for the figures labelled *monocyte*, *neutrophil*, and *bacteria*. Such images suggest a rather different set of regulative principles from those at work in, say, (7.7). On the one hand, they imply hybridity, i.e. a possible combination of naturalistic, sensory, and technological/abstract coding orientations (van Leeuwen 1999, 182, Kress and van Leeuwen 2006, 171, Fryer 2015, 134); on the other, they highlight how varied and dynamic certain culturally determined regulative principles can be (cf. Bernstein 1981, 328 ff.).



(7.8)

(MRAC\_01)

## 7.2 Engagement Features

I move now to a more specific analysis and discussion of how [engagement] can be construed visually in terms of the interpersonal discourse-semantic system developed in section 3.2. I begin with those resources that construe for the text a ‘heteroglossic’ background, focusing first on dialogic ‘contraction’ (7.2.1) and then on dialogic ‘expansion’ (7.2.2). Section 7.2.3 discusses how visual elements in MRAC might construe a ‘monoglossic’ position, and section 7.2.4 examines how visual [engagement] features and their realizations overlap and interact (cf. section 6.1.4).

### 7.2.1 Heterogloss: Contract

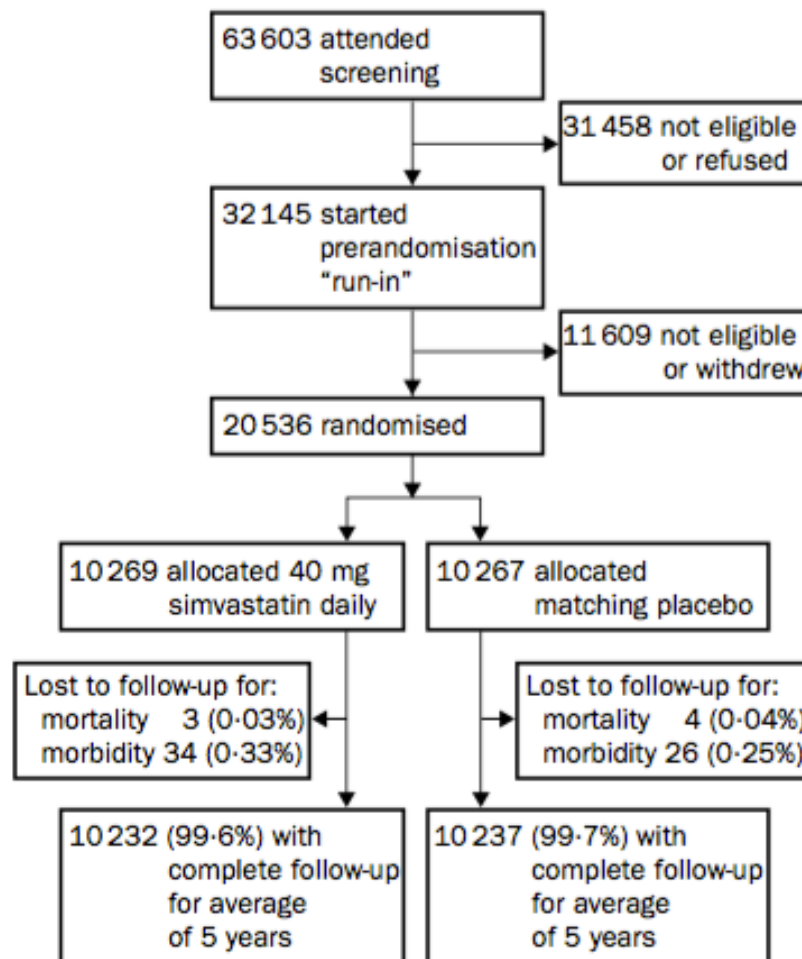
Dialogically ‘contractive’ visual resources are those resources that in some way act to challenge, block, or restrict the scope of alternative voices or positions in the discourse (cf. Martin and White 2005, 102, on verbal [engagement]). There are two basic types of dialogic contraction: [disclaim] and [proclaim]. The first rejects or counters other voices or positions in the discourse; the second emphasizes the textual voice’s own position or some other position it finds maximally warrantable.

#### 7.2.1.1 Disclaim

There are several ways in which visual elements in MRAC might reject or counter different voices, positions, or propositions in the text. In (7.8), above, for example, curved red lines connect a series of ovoid purple figures to several other figures and episodes in the image. The actions or processes suggested by those red lines, and by the verbal labels assigned to them (*inactivation, inhibition, reduction, prevention*), appear to disrupt or restrict the narrative and dialogic potential of the episodes they are directed towards and the overall left-to-right flow of the work (cf. ‘rhythm’ in section 7.1).

Similar resources are found in scriptural-graphical images like flowcharts. In (7.9)—a diagram accounting for patient enrolment in a study—horizontal arrows, and the boxes they connect, run perpendicular to the main vertical top-down temporal flow or placement of patients into

study groups. The horizontal arrows and their boxes represent patients who were excluded or *lost* during the study period. Those episodes ‘counter’ the primarily vertical episode-nexus, and their dialogically ‘contractive’ potential is complemented in some instances by verbal negation, e.g. *not eligible or refused* (see section 6.1.1.1).

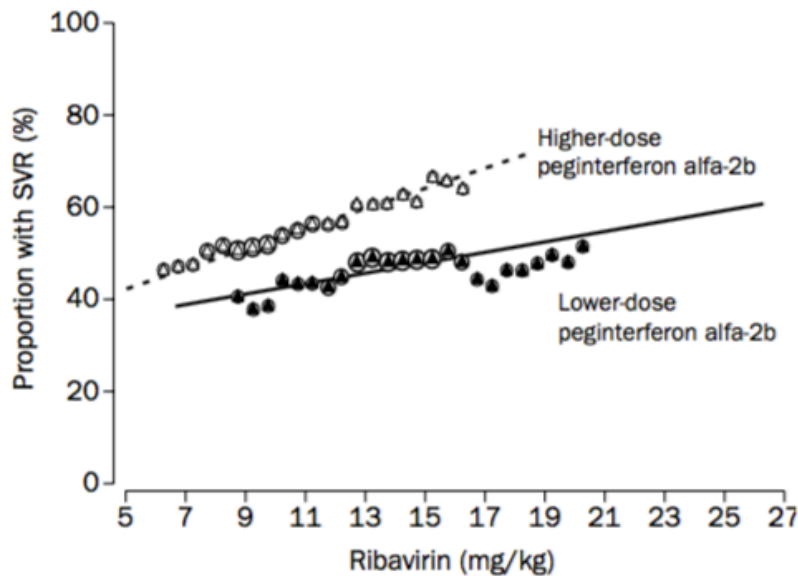


(7.9)

(MRAC\_03)

Other instances of [disclaim] in MRAC include episodes in linear regression charts like that in (7.10). Lines of best fit, or simple linear regressions, can ‘deny’ or at least discourage a particular (usually less linear) reading. In so doing, they make one reading, a specific linear interpretation, appear more valid or warrantable than another, nonlinear interpretation (cf. [proclaim], section 7.2.1.2). Moreover, those same linear regressions represent a prediction of dependent variable values as a function of some independent variable, in this case a prediction of the

proportion of patients with SVR (sustained virological response) as a function of increased or decreased ribavirin dosage.<sup>141</sup> Lines of best fit like those in (7.10) might also therefore construe mathematical-visual [entertain] (see section 7.2.2.1).



**Figure 2: Logistic regression analyses: SVR as a function of ribavirin dose (mg/kg) and dose of peginterferon alfa-2b**

SVR rates are presented as moving averages, along with the fitted regression lines. The moving average puts patients into overlapping intervals based on their ribavirin dose (mg/kg), and observed SVR rates are calculated for each interval based on all patients in the interval. Midpoints of the intervals are obtained by dividing the ribavirin dose axis into 0.5 mg/kg increments, and the (overlapping) intervals are formed by including doses within 2 mg/kg above and below the midpoints. The size of each circle represents the size of the group and the precision of these response rates.

(7.10)

(MRAC\_23)

Among numerical images in MRAC, [disclaim] can be construed visually, mathematically, and verbally. The visual construal of [disclaim] in numerical images is primarily one of omission or non-inclusion, i.e. what is not represented rather than what is represented. Two common instantiations of this 'disclaim by omission' are non-use of symbols and lack of data. In (7.11), several numerical values are marked with the symbols ¶, #, and \*\*, indicating  $p$ -values of  $\leq 0.05$ ,  $\leq 0.01$ , and  $\leq 0.001$ , respectively. Some values, however, are not marked with those symbols,

<sup>141</sup> Sustained virological response (SVR) is the absence of any detectable virus at the end of a study period.

indicating that, while there may be differences in data values between the years 1990 and 1997, those differences are *not* deemed statistically significant. There are also several instances of ellipsis ('...'), which indicate that *data [are] not applicable* (see table footnote). In (7.12), missing data are marked by a series of em-dashes, with an accompanying explanation in the table footnote. It is these kinds of omission or non-inclusion that essentially function to [disclaim], rejecting or overturning the generic expectations of what a numerical table typically includes.

Table 2.—Comparison of Prevalence and Frequency of Use of Alternative Therapies Among Adult Respondents, 1997 vs 1990\*

Type of Therapy	Used in Past 12 mo, %		Saw a Practitioner in Past 12 mo, %		Mean No. of Visits per User in Past 12 mo		No. of Visits per 1000 Population		Estimated Total No. of Visits in 1997 (in Thousands)†	Total Visits, %‡§
	1997	1990	1997	1990	1997	1990	1997	1990		
Relaxation techniques	16.3¶	13.1	15.3	9.0	20.9	18.6	521.2	219.3	103 203	16.4
Herbal medicine	12.1**	2.5	15.1	10.2	2.9	8.1	53.0	20.7	10 491	1.7
Massage	11.1**	6.9	61.6#	41.4	8.4	14.8	574.4	422.8	113 723	18.1
Chiropractic	11.0	10.1	89.9**	71.1	9.8	12.6	969.1¶	904.8	191 886	30.5
Spiritual healing by others	7.0#	4.2	...	9.2	...	14.2	...	54.9	...	...
Megavitamins	5.5**	2.4	23.7	11.8	8.6	12.6	112.1	35.7	22 196	3.5
Self-help group	4.8**	2.3	44.4	38.3	18.9	20.5	402.8	180.8	79 754	12.7
Imagery	4.5	4.2	23.1	15.1	11.0	14.2	114.3	90.1	22 640	3.6
Commercial diet	4.4	3.9	43.2	24.0	7.3	20.7	138.8	193.8	27 474	4.4
Folk remedies	4.2**	0.2	6.2	0.0	1.0	...	2.6	...	516	0.1
Lifestyle diet	4.0	3.6	8.0	12.5	2.8	8.1	9.0	36.5	1774	0.3
Energy healing	3.8**	1.3	26.3	32.2	20.2#	8.3	201.9¶	34.7	39 972	6.4
Homeopathy	3.4**	0.7	16.5	31.7	1.6	6.1	9.0	13.5	1777	0.3
Hypnosis	1.2	0.9	62.7	51.8	2.8	2.6	21.1	12.1	4171	0.7
Biofeedback	1.0	1.0	54.3	20.8	3.6	6.4	19.5	13.3	3871	0.6
Acupuncture	1.01¶	0.4	87.6	91.3	3.1	38.4	27.2	140.2	5377	0.9
≥1 of 16 alternative therapies	42.1**	33.8	46.3#	36.3	16.3	19.2	3176.0	2373.0	628 825	...
SE	1.2	1.4	1.9	2.5	1.8	4.5	378.7	599.7	74 997	...
Self-prayer	35.1**	25.2	...	...	...	...	...	...	...	...

\*Percentages are of those who used that type of therapy. Ellipses indicate data not applicable.  
 †Estimate based on 1997 population estimate of 198 million.  
 ‡Percentage of total visits of the 16 therapies (ie, excluding self-prayer).  
 §Because of rounding, percentages do not total 100.  
 ||Respondents who received spiritual healing by others were not asked for details of visits in 1997, nor were those who used self-prayer in either year.  
 ¶P=.05; #P=.01; \*\*P=.001.

(7.11)

(MRAC\_09)

TABLE 3. MORTALITY AND RATES OF PRESCRIPTION OF PROTEASE INHIBITORS AMONG PATIENTS WITH CD4+ T-LYMPHOCYTE COUNTS OF FEWER THAN 100 PER CUBIC MILLIMETER, ACCORDING TO CALENDAR QUARTER, 1994 THROUGH JUNE 1997.\*

YEAR AND QUARTER	ALL PATIENTS†		PRIVATE INSURANCE‡		MEDICARE		MEDICAID	
	PROTEASE INHIBITORS	MORTALITY	PROTEASE INHIBITORS	MORTALITY	PROTEASE INHIBITORS	MORTALITY	PROTEASE INHIBITORS	MORTALITY
	%	deaths/100 person-yr	%	deaths/100 person-yr	%	deaths/100 person-yr	%	deaths/100 person-yr
1994								
1	—	35.1 (16/237)	—	30.2 (8/129)	—	51.7 (2/20)	—	39.7 (5/70)
2	—	35.2 (19/261)	—	42.2 (13/147)	—	0 (0/16)	—	27.5 (4/70)
3	—	23.4 (14/309)	—	14.8 (5/166)	—	26.1 (1/19)	—	49.3 (8/90)
4	—	23.1 (20/429)	—	27.4 (13/236)	—	0 (0/32)	—	22.2 (5/110)
1995								
1	2.1	31.2 (34/524)	1.4	25.0 (15/279)	0	46.8 (4/41)	1.4	47.2 (13/142)
2	2.4	27.4 (34/581)	2.0	25.6 (17/307)	0	9.8 (1/47)	0.6	38.6 (13/160)
3	4.4	30.8 (41/609)	4.4	23.5 (17/317)	0	34.4 (4/60)	3.1	49.4 (17/161)
4	17.6	28.5 (40/631)	24.8	23.7 (18/335)	9.5	14.4 (2/63)	6.5	44.7 (15/154)
1996								
1	41.6	29.4 (41/645)	49.6	23.5 (18/345)	38.1	60.4 (8/53)	31.6	38.7 (13/158)
2	64.2	15.4 (22/628)	74.8	12.9 (10/330)	53.0	42.5 (6/66)	56.7	14.4 (5/157)
3	75.5	11.3 (16/608)	85.6	7.6 (6/326)	73.0	6.6 (1/63)	67.5	23.7 (8/154)
4	79.3	10.8 (15/600)	88.6	10.1 (8/336)	79.7	14.3 (2/59)	70.0	11.6 (4/150)
1997								
1	81.8	14.9 (20/583)	68.6	10.2 (8/334)	78.3	45.0 (6/60)	71.2	15.8 (5/139)
2	83.6	8.8 (12/574)	89.4	7.7 (6/329)	86.0	21.9 (3/57)	71.7	9.2 (3/138)

\*The mortality rates shown are deaths per 100 person-years in each quarter, with the numbers of deaths and numbers of patients in parentheses. Percentages for protease inhibitors are the percentages of patients who were ever prescribed a protease inhibitor during the quarter. Dashes indicate that protease inhibitors were not yet available.

†This category includes patients for whom the primary payer was not private insurance, Medicare, or Medicaid (e.g., self-payment, Ryan White Care Act, or other programs).

‡This category includes fee-for-service care, private health maintenance organizations, preferred-provider organizations, and similar programs.

(7.12)

(MRAC\_28)

Many of the tables and figures in MRAC include  $p$ -values. As discussed in section 6.1.2.1,  $p$  is a potential mathematical encoding of [entertain], since it construes and quantifies the notion of probability. In some tables,  $p$ -values are given for all data comparisons; they are not only specified for those identified as statistically significant. In (7.13), for example, an entire column of  $p$ -values is given.  $P$ -values less than or equal to 5% (0.05) are typically considered statistically significant, while those above that threshold usually indicate relations that are not statistically significant. In other words, the inclusion of high  $p$ -values in tables and graphs is a mathematical-numerical 'denial' of statistical significance, one that acknowledges and rejects the possibility or expectation of statistical significance. In (7.14), a similar example of mathematical-numerical 'denial' is shown for a graphical image, where a relatively high  $p$ -value (0.087) indicates a lack of statistically significant difference. (Note that, in these and other cases, the difference between two variables or values is not what is being 'denied'; rather, it is that there is no statistically significant difference between them.)

**Table 1. Histologic and Clinical Characteristics of 49 Patients with Breast Carcinoma, According to the Presence or Absence of Metastatic Disease.**

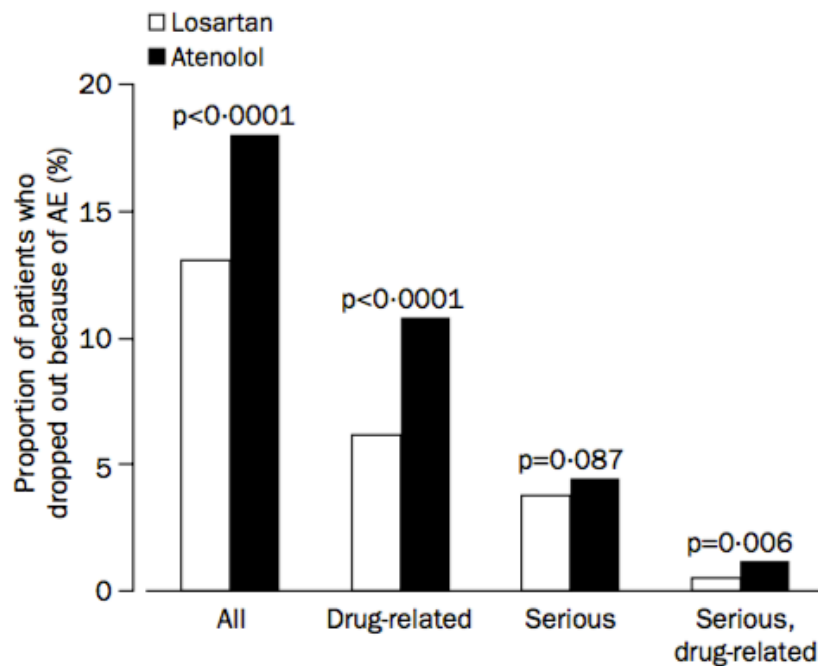
CHARACTERISTIC	METASTASES PRESENT (N = 30)	METASTASES ABSENT (N = 19)	P VALUE
	<i>mean ±SD (median, range)</i>		
Microvessel-density grade*	2.95±1.00 (3.0, 1–4)	1.38±0.82 (1.0, 1–4)	≤0.001
Microvessel count			
Per 200× field	101±49.3 (103, 16–220)	45±21.1 (41, 15–100)	0.003
Per 400× field	37±18.5 (33.5, 6–74)	17±8.0 (16, 6–33)	0.004
Tumor grade†	2.4±0.7 (2.5, 1–3)	2.3±0.7 (2.0, 1–3)	0.666
Tumor size (cm)	2.6±1.8 (2.0, 0.6–9)	2.6±1.0 (2.5, 1–5)	0.903
No. of lymph nodes examined	14.5±9.6 (15.5, 1–47)	12.6±5.0 (12, 1–23)	0.446
Age (yr)	56.6±14.6 (57, 25–84)	61.6±12.4 (63, 38–79)	0.227
Follow-up (yr)	6.03±3.45 (6.0, 1–11)	7.00±3.37 (8.0, 1–11)	0.337

\*On a scale of 1 to 4+; see Methods.

†According to the Scarff–Bloom–Richardson classification.<sup>16</sup>

(7.13)

(MRAC\_47)



**Figure 6: Adverse events (AE)**

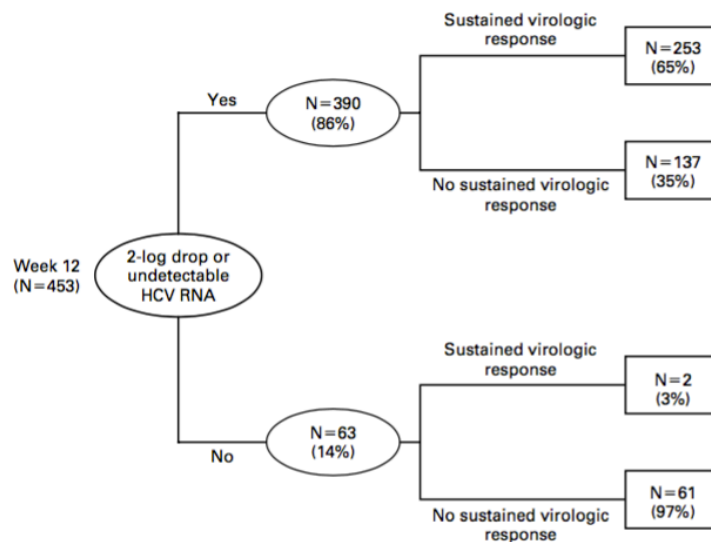
p is for between-group differences.

(7.14)

(MRAC\_06)



Several of the graphical, numerical, and figurative elements in MRAC contain instances of verbal [disclaim], most typically in the form of negation. In (7.15), the verbal resources *no* and *un-* construe [disclaim: deny] and are complemented by a visual representation that highlights the dialogic functionality of negation, i.e. that the use of such resources implies a background of one or more alternative (usually polar-positive) positions (cf. sections 3.1.2.1, 4.2.3.3, and 6.1.1.1).<sup>142</sup> Other common examples of verbal [disclaim] in diagrams, graphs, and tables (and their accompanying legends and footnotes) include *none*, *non-*, and *however* (cf. findings in section 6.1.1.1).



**Figure 2.** Predictability of Sustained Virologic Response.

At week 12, 86 percent (390 of 453) of the patients treated with peginterferon alfa-2a plus ribavirin either had a 2-log drop in HCV RNA levels or had undetectable levels of HCV RNA. Of these patients, 65 percent (253 of 390) went on to have a sustained virologic response. Of the 63 patients who did not have a 2-log drop or undetectable levels of HCV RNA at week 12, 61 (97 percent) did not have a sustained virologic response.

(7.15)

(MRAC\_12)

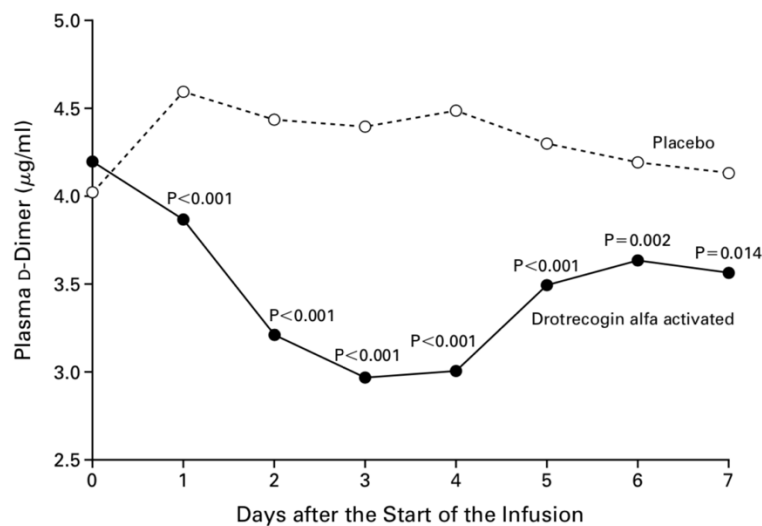
### 7.2.1.2 Proclaim

By making prominent certain figures and episodes in an image, the textual voice marks those figures and episodes as somehow important, highly valued, or attention-worthy. Visual prominence allows the textual voice to distinguish between major and minor episodes in an image (O'Halloran 2005, 140) and 'proclaim' certain episodes, figures, or figure-parts to be more highly warrantable than others.

<sup>142</sup> For more on visual-verbal relations in MRAC, see chapter 8.



Visual prominence and the potential for 'proclaiming' importance can be expressed in a number of ways in MRAC. For black-and-white or greytone images, solid or dark lines/areas and bold or italicised typeface tend to give greater prominence to figures and episodes than dashed or grey lines/areas or a regular typeface. In (7.16), the filled circles and solid line of the *drotrecogin alfa activated* dataset contrast with and are more prominent than the open circles and dashed line of the *placebo* dataset. Both datasets are important in this contrastive graphical image, but it is the former that, visually, represents the major episode in (7.16). Similarly, in (7.17), the solid bars representing patients receiving intensive therapy have more visual prominence than the hatched bars of patients receiving conventional therapy.



**Figure 3.** Changes in Median Plasma D-Dimer Levels in 770 Patients with Severe Sepsis in the Drotrecogin Alfa Activated Group and 729 Patients in the Placebo Group.

Only patients with base-line values and at least one subsequent value were included in the analysis. The P values are for the comparison with the placebo group.

(7.16)

(MRAC\_01)

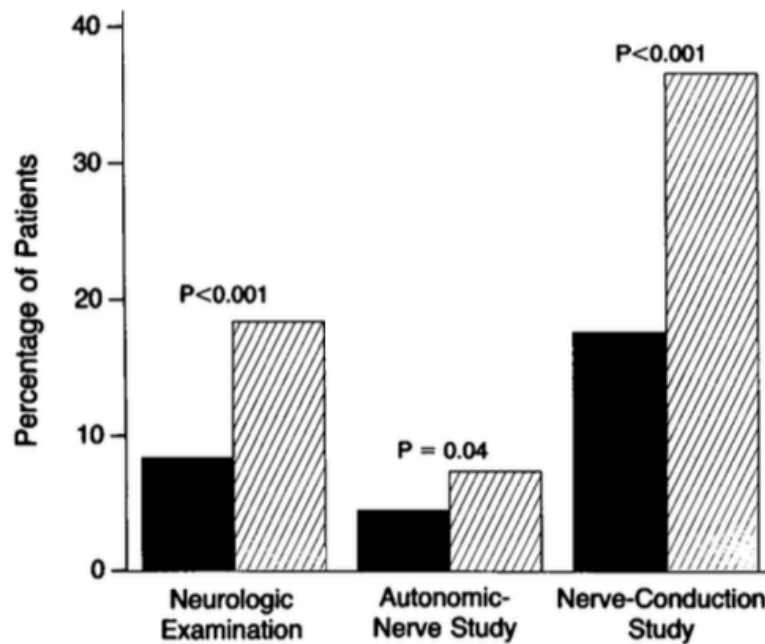


Figure 4. Prevalence of Abnormal Clinical Neurologic Examinations, Abnormal Results of Nerve-Conduction Studies, and Abnormal Autonomic-Nerve Studies at Five Years in Patients Receiving Intensive (Solid Bars) or Conventional (Hatched Bars) Therapy.

Abnormal results of nerve-conduction studies were defined as abnormal results of neurophysiologic tests in at least two peripheral nerves. The analysis included all patients from either cohort who did not have the abnormality in question at base line.

(7.17)

(MRAC\_37)

One of the reasons for distinguishing datasets in this way may be the need to ‘counter’ readings that might otherwise privilege size or position. In (7.16), filled circles and solid lines might aid a reading that focuses, thematically, on drotrecogin alfa activated rather than on placebo and its generally higher y-axis values. Similarly, the solid bars in (7.17) might encourage a reading that thematises intensive therapy rather than conventional therapy and its higher percentage of patients with adverse events. In (7.18), quantity, size, and shading combine to give prominence to the dataset marked *visits to practitioners of alternative therapies*. In all these instances, the major figures and episodes in (7.16)–(7.18) are also the main topics of the research articles from which they are taken.

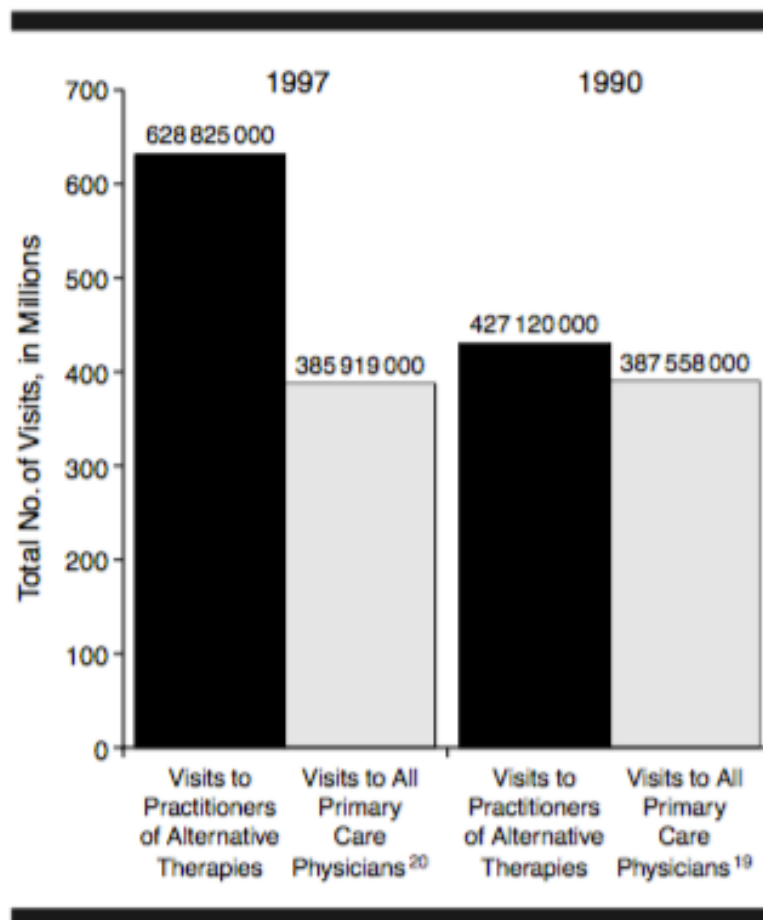


Figure 1.—Trends in annual visits to practitioners of alternative therapies vs visits to primary care physicians, United States, 1997 vs 1990. Data are from the National Ambulatory Medical Care Survey from 1996<sup>20</sup> and 1990.<sup>19</sup>

(7.18)

(MRAC\_09)

In numerical images such as tables, a number of strategies are used in order to foreground or emphasize different elements. As the example in (7.19) shows, horizontal lines and bold typeface can be used to distinguish between and categorize and taxonomize different variables. Capitalization and indentation can be used in a similar way, as in (7.12) and (7.13) above. In (7.20) below, a series of key points or messages are highlighted in a separate panel—the frame of which delineates those messages from the rest of the written text—and bullet points and reversed bold type are used for additional emphasis.

Event type	Clopidogrel	Aspirin	Total
<b>Non-fatal events</b>			
Non-fatal ischaemic stroke	472	504	976
Non-fatal MI	255	301	556
Non-fatal primary ICH	14	24	38
Amputation	52	47	99
<b>Fatal events</b>			
Fatal ischaemic stroke	37	42	79
Fatal MI	53	75	128
Haemorrhagic death	23	27	50
Other vascular death	260	261	521
Non-vascular death	187	166	353
<b>Total</b>	<b>1353</b>	<b>1447</b>	<b>2800</b>

MI=myocardial infarction; ICH=intracranial haemorrhage.

**Table 5: Validated events**

(7.19)

(MRAC\_13)

published. Intensive  
etic subgroup of the  
Follow-up Program  
tality.<sup>32</sup>  
duction in the rate of  
or more steps using  
he 47% reduction in  
by three lines using  
change from 6/6 to  
n chart) suggests that  
also prevented the  
opathy, which is the  
n type 2 diabetes.<sup>33</sup> In  
v diabetic maculopa-  
equiring retinal pho-  
opathy responds less  
ion than proliferative  
of maculopathy by  
ght provide a major  
t of blindness. To our  
n patients with type 2  
od pressure control  
cations from diabetic

(7.20)

1 of patients in the

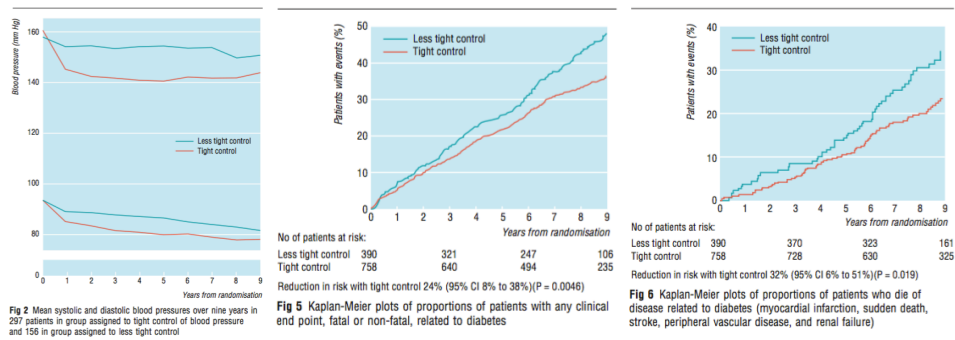
Key messages
<ul style="list-style-type: none"> <li>• This study showed that tight control of blood pressure based on captopril or atenolol as first agents and aiming for both a systolic blood pressure &lt; 150 mm Hg and diastolic pressure &lt; 85 mm Hg achieved a mean 144/82 mm Hg compared with 154/87 mm Hg in a control group</li> <li>• 29% of patients in the tight control group required three or more hypotensive treatments</li> <li>• Tight control of blood pressure reduced the risk of any non-fatal or fatal diabetic complications and of death related to diabetes; deterioration in visual acuity was also reduced</li> <li>• Reducing blood pressure needs to have high priority in caring for patients with type 2 diabetes</li> </ul>

and in patients with type 1 diabetes with microalbuminuria or established nephropathy.<sup>18 19</sup> Guidelines were formulated on the assumption that data relating to hypertensive non-diabetic subjects and

(MRAC\_40)

Although used relatively sparingly, colour (other than black, white, and greytone) plays an important role in highlighting major figures and episodes in MRAC. By using different hues and shades, the textual voice or image-producer can emphasize or ‘proclaim’ the relative importance of certain visual elements. Examples of this can be seen in (7.21), which shows three graphical images from MRAC\_40. All graphs and tables in MRAC\_40 have a light-blue background that corresponds with the colour-profile used by the source journal, BMJ. In the examples shown here, two

datasets are presented, one in dark blue, the other in orange. The orange line represents data for a group of patients assigned to a *tight control* group, while the dark-blue line represents data for patients assigned to a *less tight control* group.<sup>143</sup> The contrast between orange and light blue is arguably greater than the contrast between dark blue and light blue—especially considering the journal’s colour-profile—highlighting in these instances the relative importance of lower blood pressure and fewer adverse events in the *tight control* group compared with the *less tight control* group.



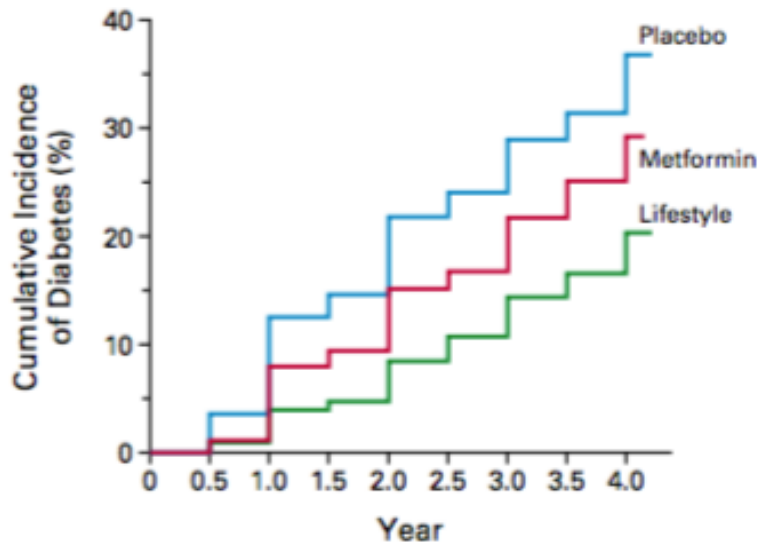
(7.21)

(MRAC\_40)

The role played by colour in (7.22) differs from that in (7.21). The blue, red, and green lines distinguish datasets for *placebo*, *metformin* (a medicine for treating type-2 diabetes), and *lifestyle*, and the image can be read in a number of ways, e.g. that the cumulative incidence of diabetes is greatest among those treated with placebo only, or that the cumulative incidence of diabetes is lowest among those who participated in a “lifestyle-modification program” (quote from MRAC\_19). However, it is not clear whether or to what extent colour emphasizes any one particular episode or reading over another. The datasets are distinct, but together they construe a major episode-nexus that, due to the use of colour, distinguishes them from other minor figures and episodes in the image such as graph-axes and the verbiage of the legend. These latter episodes are unmarked, ostensibly ‘monoglossic’ elements in the image, ones that

<sup>143</sup> The terms *tight* and *less tight* refer here to two groups of patients: those whose blood pressure was kept under 150/85 mmHg by treatment with captopril or atenolol, and those whose blood pressure was kept under 180/105 mmHg without resorting to treatment with captopril or atenolol, respectively.

the writer and reader might be expected to take for granted (see sections 3.1.1 and 3.2, as well as section 7.2.3). A similar interpretation of axes and verbiage might also apply to (7.21) and other graphical images in MRAC.



**Figure 2.** Cumulative Incidence of Diabetes According to Study Group.

The diagnosis of diabetes was based on the criteria of the American Diabetes Association.<sup>11</sup> The incidence of diabetes differed significantly among the three groups ( $P < 0.001$  for each comparison).

(7.22)

(MRAC\_19)

In addition to its use in visual inscriptions (Latour and Woolgar 1986, Latour 1990), colour is sometimes used to highlight article-type and copyright ownership. In (7.23) and (7.24), both from MRAC\_11, red is used to highlight the article as an *original contribution*. This colour is used for all JAMA papers, including case reports and editorials. Like the BMJ (see above), red is part of JAMA's colour profile, and this same shade of red is used in the copyright catchline, ©2002 American Medical Association. All rights reserved. The prominence assigned to these elements through the deployment of colour emphasizes or 'proclaims' their relative importance, in this case the overarching significance or position of the journal itself in relation to the research article and its authors.

# Prevalence and Trends in Obesity Among US Adults, 1999-2000

Katherine M. Flegal, PhD  
Margaret D. Carroll, MS  
Cynthia L. Ogden, PhD  
Clifford L. Johnson, MSPH

**Context** The prevalence of obesity and overweight increased in the United States between 1978 and 1991. More recent reports have suggested continued increases but are based on self-reported data.

**Objective** To examine trends and prevalences of overweight (body mass index [BMI]  $\geq 25$ ) and obesity (BMI  $\geq 30$ ), using measured height and weight data.

**Design, Setting, and Participants** Survey of 4115 adult men and women conducted in 1999 and 2000 as part of the National Health and Nutrition Examination Survey (NHANES), a nationally representative sample of the US population.

**Main Outcome Measure** Age-adjusted prevalence of overweight, obesity, and ex-

(7.23)

**D**ATA FROM THE THIRD National Health and Nutrition Examination Survey (NHANES III; 1988-1994)

(MRAC\_11)

## INCREASING OBESITY IN US ADULTS

veys. This report is based on data for 4115 adult men and women from the first 2 years of the continuous NHANES (1999-2000). Two or more years of data are necessary to have adequate sample sizes for subgroup analyses.

### BMI and Obesity

Weight and height were measured in a mobile examination center using standardized techniques and equipment. Body mass index was calculated as weight in kilograms divided by the square of height in meters. For adults, overweight was defined as a BMI of 25.0 or higher, obesity as a BMI of 30.0 or higher, and extreme obesity as a BMI of 40 or higher.<sup>2</sup> These definitions are consistent with those of the National Heart, Lung, and Blood Institute and the World Health Organization.<sup>11,12</sup>

### Data Analysis and Statistical Methods

Statistical analyses were carried out using SAS for Windows software (SAS Institute, Cary, NC) and SUDAAN software (RTI, Research Triangle Park, NC). For all surveys, sampling weights had been calculated that took into account unequal probabilities of selection resulting from the sample design, from nonresponse, and from planned oversampling of certain subgroups. All analyses took into account differential probabilities of selection and the complex sample design. Standard errors

were calculated with SUDAAN using Taylor series linearization for NHANES III.<sup>13</sup> For NHANES 1999-2000, SEs were calculated using the delete 1 jackknife method,<sup>13</sup> partitioning the sample into 52 sampling units and forming 52 replicates by deleting one unit at a time. Statistical hypotheses were tested univariately at the .05 level using a *t* statistic. To adjust for multiple comparisons when 3 racial/ethnic groups were compared, the Bonferroni method was used. For graphical comparison, the frequency distributions of BMI from both surveys were smoothed using a nonparametric smoothing algorithm, based on sequential calculations of running medians for groups of adjacent points.<sup>14</sup>

### RESULTS

The prevalence of obesity (BMI  $\geq 30$ ) during 1960 to 2000 in the United States by age and sex categories for those aged 20 to 74 years is shown in TABLE 1. For surveys up through NHANES II, data were available only for respondents younger than 75 years. The prevalence of obesity was relatively constant from 1960 to 1980, then increased as reported by NHANES III in 1988-1994. The most recent data, from NHANES 1999-2000, show further increases for both men and women and in all age groups. The increases from NHANES II to NHANES III were statistically significant in all sex-age groups. Statistically significant increases also occurred from

NHANES III to NHANES 1999-2000, except for the increase for men aged 40 to 59 years, which was not statistically significant but showed the same trend. The increases between NHANES III and NHANES 1999-2000 were almost as large as the increases between NHANES II and NHANES III and were not significantly different.

A more detailed examination of trends by age over a broader age range between NHANES III and NHANES 1999-2000 is possible because both surveys had no upper age limit. The prevalence of obesity for both surveys for all adults and by sex and 10-year age groups is shown in TABLE 2. Increases in the prevalence of obesity occurred for both men and women and in all age groups. Because the SEs are relatively large, particularly for NHANES 1999-2000, the differences are not always statistically significant, but the trends are similar across all subgroups.

The changes in the prevalence of obesity and extreme obesity between NHANES III and NHANES 1999-2000 by sex and racial/ethnic group for 3 groups—non-Hispanic whites, non-Hispanic blacks, and Mexican Americans—are shown in TABLE 3. In each subgroup the prevalence of both obesity and extreme obesity increased between NHANES III and NHANES 1999-2000. The increases were generally similar across all groups, although there was a nonsignificant trend for a larger

**Table 1.** Trends in the Age-Adjusted and Age-Specific Prevalence of Obesity for Adults Aged 20-74 Years, 1960-2000\*

Sex	Age, y†	Prevalence, %					Change, % (95% CI)‡	
		NHES I, 1960-1962 (n = 6126)	NHANES I, 1971-1974 (n = 12311)	NHANES II, 1976-1980 (n = 11765)	NHANES III, 1988-1994 (n = 14468)	NHANES Continuous, 1999-2000 (n = 3601)	NHANES II to NHANES III	NHANES III to NHANES 1999-2000
Both sexes	20-74	13.4	14.5	15.0	23.3	30.9	8.3 (6.6-10.0)	7.6 (4.2-11.0)
Men	20-74	10.7	12.1	12.7	20.6	27.7	7.9 (6.0-9.8)	7.1 (3.4-10.8)
	20-39	9.8	10.2	9.8	14.9	23.7	5.1 (2.9-7.2)	8.8 (4.8-12.8)
	40-59	12.6	14.7	15.4	25.4	28.8	10.0 (6.9-13.0)	3.4 (-2.8-9.6)
	60-74	8.4	10.5	13.5	23.8	35.8	10.3 (6.3-14.3)	12.0 (5.0-19.0)
Women	20-74	15.8	16.6	17.0	25.9	34.0	8.9 (6.5-11.3)	8.1 (3.7-12.5)
	20-39	9.3	11.2	12.3	20.6	28.4	8.3 (5.2-11.4)	7.8 (2.5-13.1)
	40-59	18.5	19.7	20.4	30.4	37.8	10.0 (6.1-13.9)	7.4 (0.5-14.3)
	60-74	26.2	23.4	21.3	28.6	39.6	7.3 (3.9-10.6)	11.0 (4.6-17.4)

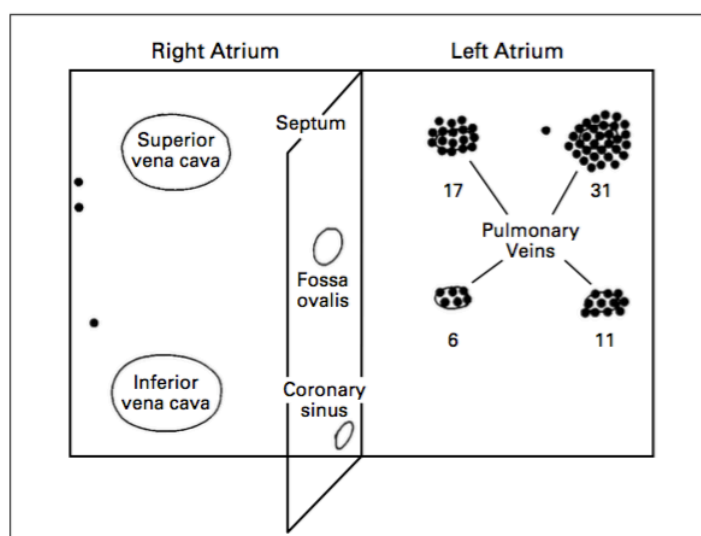
\*NHES indicates National Health Examination Survey; NHANES, National Health and Nutrition Examination Survey; and CI, confidence interval.  
†Estimated prevalences for ages 20-74 years were age-standardized by the direct method to the 2000 Census population using age groups 20-39, 40-59, and 60-74 years.  
‡Overall and within each age-sex group, the changes between 1988-1994 and 1999-2000 are not significantly different from the changes between 1976-1980 and 1988-1994.

(7.24)

(MRAC\_11)



Verbal labels allow the textual voice or image-producer to intervene in the reading of images, so as to assert a particular interpretation. In (7.7) above—reproduced below as (7.25)—most figures in the diagram are given labels, e.g. *superior vena cava* and *pulmonary veins*. Dialogically, those labels acknowledge, on the one hand, the possibility of alternative ways of seeing and interpreting the line-diagram, while, on the other, they ‘contract’ the dialogic space by anchoring the reader’s gaze and the reader’s understanding to a narrower set of possible interpretations (Barthes 1977, 39, Chen 2010, 491–493).



**Figure 1.** Diagram of the Sites of 69 Foci Triggering Atrial Fibrillation in 45 Patients.

Note the clustering in the pulmonary veins, particularly in both superior pulmonary veins. Numbers indicate the distribution of foci in the pulmonary veins.

(7.25)

(MRAC\_15)

Like verbal labels, arrows and arrowheads can also be used to guide the reader’s attention to and engagement with certain figures or episodes in a visual work. Such arrows are typically accompanied by verbal prompts. In example (7.26), the arrows in the panel labelled *A* (which may not be very clear) function firstly to highlight particular areas of interest and secondly to compare and contrast those areas of interest. The legend accompanying the image provides an additional verbal cue and explanation for what the reader should otherwise be able to see. The images on the right, labelled *B* and *C*, use an additional technique for highlighting where and how a reader should engage with the text. A higher level of magnification allows the image-producer to “zoom in” on specific areas of *A*, giving the reader a



closer look and, at the same time, guiding the reader's interpretation of the image.<sup>144</sup> This use of framing locates the reader in closer proximity to the areas of interest highlighted in *A* and may position the reader as being more directly connected to and engaged with the depicted objects (cf. Kress and van Leeuwen 2006, 127–128). A similar example of the use of labelling, arrows, and zooming to draw the reader's attention to specific sites of interest is shown in (7.27). Here, panel *C* represents a close-up of part of panel *B*. Related points of interest are highlighted in red, green, and blue. Other, less prominent figures are coloured yellow. The legend accompanying the image provides a verbal account of what the reader should be able to see.

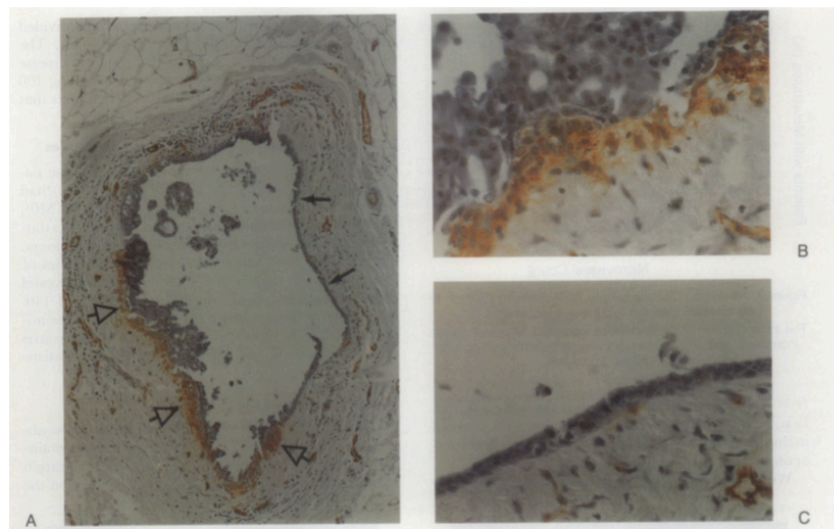


Figure 5. Large Breast Duct Partially Lined with Duct Carcinoma in Situ and Intense Angiogenesis in Immediately Adjacent Periductal Breast Stroma.

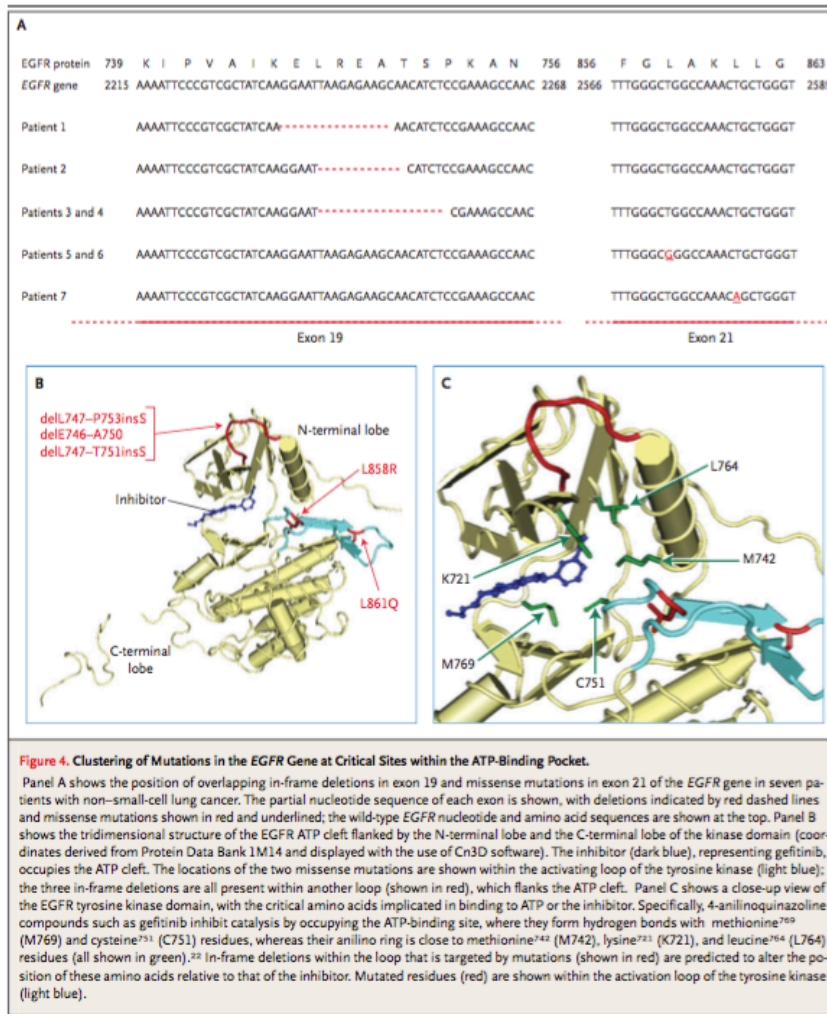
In Panel A (immunoperoxidase stain for factor VIII,  $\times 3.6$ ), brown-staining microvessels are indicated by open arrows. Note the absence of angiogenesis in the areas of breast stroma adjacent to portions of duct lined with benign duct epithelium (solid arrows).

Shown in detail are the portion of the duct lined with carcinoma in situ and adjacent angiogenesis (Panel B; immunoperoxidase stain for factor VIII,  $\times 100$ ) and the portion of the duct lined with benign duct epithelium without adjacent angiogenesis (Panel C; immunoperoxidase stain for anti-factor VIII,  $\times 72$ ).

(7.26)

(MRAC\_47)

<sup>144</sup> Rowley-Jolivet (2004, 161–162) notes a left-to-right, general-to-particular relation in multipanel images like that in (7.26). Such visual structures are typically used for “spatial focusing, or zoom-in”, where right-hand panels tend to have higher information value than left-hand panels, and where the implied relation is one of part–whole metonymy (Rowley-Jolivet 2004, 162).



(7.27)

(MRAC\_22)

Another highly conspicuous resource in MRAC is the mathematical equation. As a visual unit, equations like that in (7.28) are set apart from the main verbiage, giving them a certain prominence in the text and ‘proclaiming’ their relative value or importance. Separating equations from the rest of the verbiage like this seems to be a matter of convention in scientific discourse. Regulative principles legitimize this choice (Bernstein 1981, 328 ff.), even for relatively short equations, and emphasize the high status such resources generally have.

interim analyses. In view of these analyses, the critical Z value used at the end of the study for a one-sided test with a significance level of 0.025 was 2.11 rather than the usual 1.96. The Kaplan–Meier<sup>13</sup> method was used to construct life-table plots. The percentage reduction in mortality was reported as

$$(1 - RR) \times 100,$$

(7.28) where RR is the estimated relative risk of an event in the enalapril group as compared with the placebo group estimated from the life tables. The uniformity of treatment effects across subgroups was

(MRAC\_49)

## 7.2.2 Heterogloss: Expand

Dialogically ‘expansive’ visual resources open up or ‘expand’ in some way the scope for alternative voices or positions in the discourse. According to Economou (2009), there are three types of visual dialogic ‘expansion’: [entertain], [attribute], and [suggest]. The first construes a subjectivized position that can be understood as one among several different positions; the second indicates a position that might be considered external to that of the textual voice or image-producer; and the third alludes to semiotic choices that are characteristic of other domains or image-types.

### 7.2.2.1 Entertain

In construing for the text an overtly subjective position—one among a number of possible alternative positions or representations—visual [entertain] is typically realized by the resources of modality. As noted above (section 7.1), those resources include choices of colour, pictorial detail, background, and depth. They may also include interactive hypertext objects that set up alternative reading paths and error-bars that visualize the probability of error in graphical images (see section 3.2).

According to Economou (2009, 214), news photographs construe [entertain] through choices of “marked ideation” or “marked expression”, i.e. where depictions of people, objects, or places are represented in “atypical or unrepresentative” ways, or where certain textural or spatial choices give a sense of the unreal or surreal. As noted in section 7.1, the yardstick for what might be considered “typical” or “representative” in science, and more specifically in MRAC, is different from that of newspaper photography or fine art (cf. O’Toole 1994). Visual elements in MRAC tend

to be black and white and/or greytone, and depicted objects generally lack pictorial detail and depth. Marked ideation or expression in MRAC might therefore entail the deployment of a broad palette of colours—not just the conventional colour-coding of diagrams (Kress and van Leeuwen 2006, 165)—as well as more “naturalistic” or verisimilar representations of objects.<sup>145</sup>

While there are no standard photographic images in MRAC, there are instances of photomicrographs and radiographs (see (7.29) and (7.30)). Rowley-Jolivet (2002, 2004) treats both these image-types as figurative (see section 4.3), but distinguishes between the type-I figurative images of standard photography and the type-II figurative images of electron microscopy, x-ray imaging, ultrasound, and the like, techniques that “produce images down to the nano-scale and [...] highlight a single feature (texture, structure, etc.) of the object” of interest (Rowley-Jolivet 2004, 150). The photomicrographs and radiographs in MRAC probe beyond the naturalistic surface of objects to a different, potentially deeper, more hidden level of representation (Kress and van Leeuwen 2006, 145). That level may not be part of readers’ everyday subjective experience, but the photomicrographs and radiograph in (7.29) and (7.30), respectively, have a high degree of iconicity that, like the images produced by standard photography, refers to specific sites of interest and specific patients rather than more abstract and generalizable representations such as the heart-diagram in (7.25) above. Whether or not the images in (7.29) and (7.30) are marked ideationally and/or interpersonally is difficult to say. They are certainly marked in relation to other images in MRAC, the majority of which are graphical and numerical images such as graphs (n=112) and tables (n=194) (n=7 for figurative and graphical-figurative images in MRAC; see chapter 5). However, stain images like those in (7.29) are a mainstay of microscopy-based cytology and oncology and do not necessarily represent an overtly marked form of visual expression. For the experienced reader, such images are unlikely to be read as marked or atypical.

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<sup>145</sup> These two (potentially overlapping) uses of colour, for (semi-)naturalistic representation and for colour-coding, might usefully be described as iconic and indexical, respectively (see Peirce 1894 in Peirce 1998).

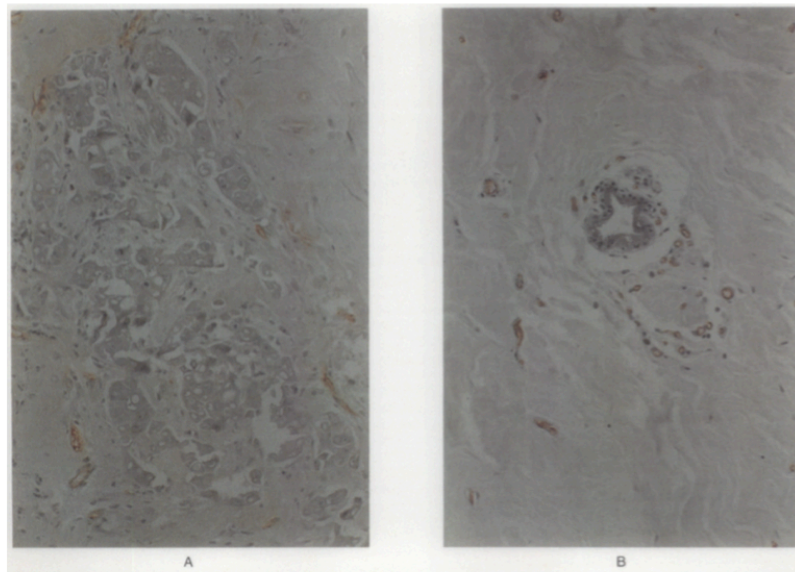


Figure 2. Representative Field of an Invasive Duct Carcinoma That Had Relatively Little Angiogenesis and Did Not Metastasize or Recur (Panel A) and a Representative Area of Benign Breast Stroma Immediately Adjacent to the Invasive Tumor (Panel B) (Immunoperoxidase Stain for Factor VIII,  $\times 36$ ).

There are approximately equal numbers of microvessels in the area of the carcinoma (12 microvessels were found in this field) and the adjacent stroma.

(7.29)

(MRAC\_47)

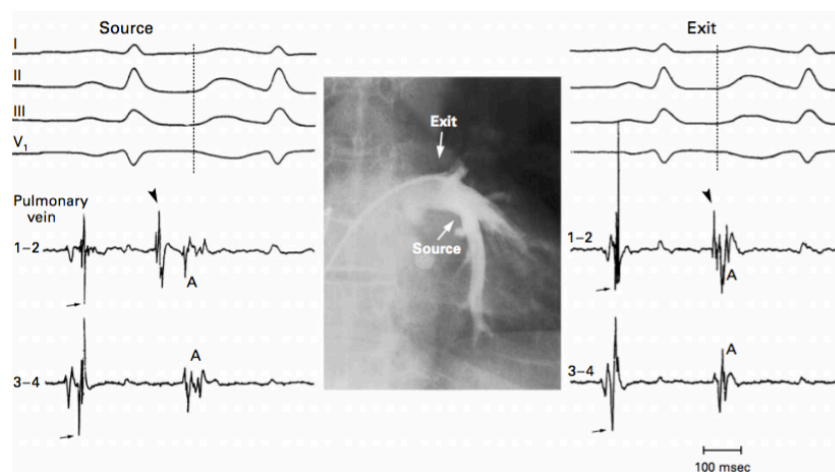


Figure 2. Angiogram of a Left Inferior Pulmonary Vein Depicting the Source and Exit of Ectopic Activity.

The electrogram showed characteristic changes in timing depending on the position of the recording catheter in the specific pulmonary vein. With an increasingly distal catheter position (toward the source), the spike was recorded progressively later during sinus rhythm (left-hand panel, arrows) and correspondingly earlier during ectopic activity (arrowhead). Conversely, in a proximal position at its exit into the left atrium (right-hand panel), the spike was not as delayed during sinus rhythm (arrows) nor as precocious during ectopic activity (arrowhead). The application of radio-frequency energy at the source of ectopic activity eliminated the local spike during sinus rhythm and ectopic beats and atrial fibrillation on a short-term basis. The dotted lines mark the onset of the ectopic P wave, and 1-2 and 3-4 are bipolar recordings from the distal and proximal poles of the mapping catheter. A indicates near-field atrial activity. The radiograph (center panel) shows the position of electrographic recordings inside the pulmonary vein at the source and exit.

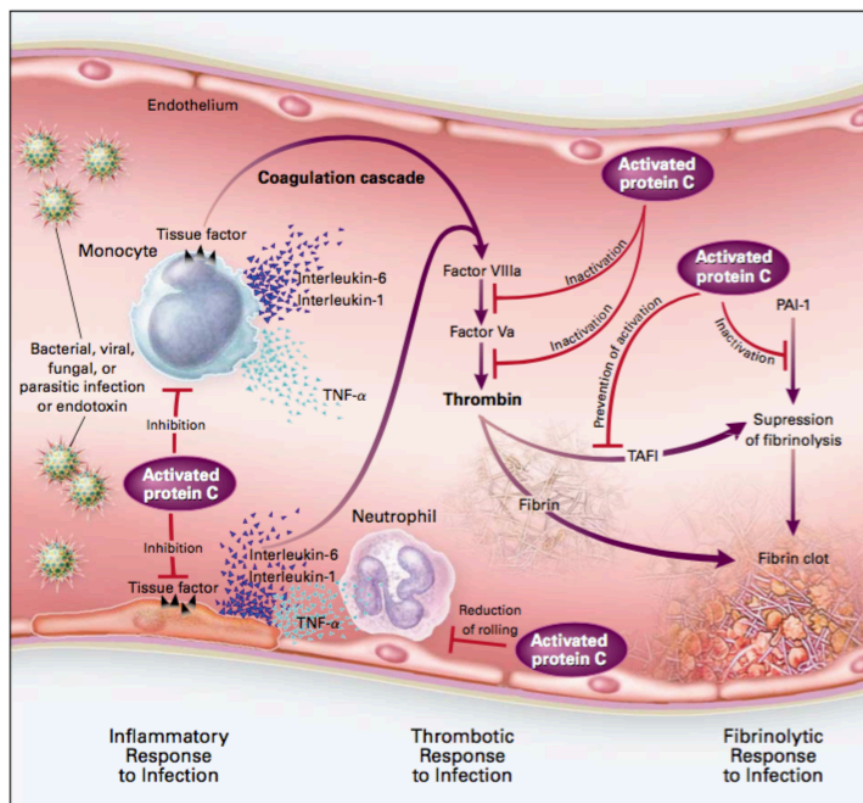
(7.30)

(MRAC\_15)

One image in MRAC that might be considered “marked” by the putative reader is the cross-section of a blood vessel in (7.31). This image, discussed above in sections 7.1 and 7.2.1.1 (example (7.8)), is a hybrid of verisimilar and schematic elements that depicts a generalized rather than individualized account of the body’s response to sepsis. The relatively wide range of colours and the naturalistic representation of certain figures



seem to be at odds with the kinds of choices typically associated with a technological-abstract coding orientation (cf. image (7.25)). To the extent that atypicality, i.e. marked ideational and interpersonal choices, construes for the text a more subjectivized position and one that implies and allows for alternative positions and representations, parts of the image in (7.31)—the figures labelled *monocyte*, *neutrophil*, *endothelium*, *bacteria*, and *fibrin clot*—might be said to instantiate [entertain].



(7.31)

(MRAC\_01)

Dotted or dashed lines can be contrasted with solid lines to give varying degrees of salience or prominence (see section 7.2.1.2). They can also be used to construe possibility or probability. In (7.32), the dashed curved lines represent confidence intervals, a mathematical expression of the likelihood of a particular future result or value falling within a certain range. In this case, 95% of all possible experimental results are estimated or expected to fall within the graphical area between the two sets of dashed curves. Dialogically, the curves ‘entertain’ the mathematical possibility of values falling within and outside of those estimation boundaries. Like the mathematical-symbolic realizations of [entertain]

discussed in section 6.1.2.1, this potential mathematical-visual construal of [entertain] is likely to carry a lower interpersonal or intersubjective risk than more subjectively oriented verbal and visual construals of [entertain].

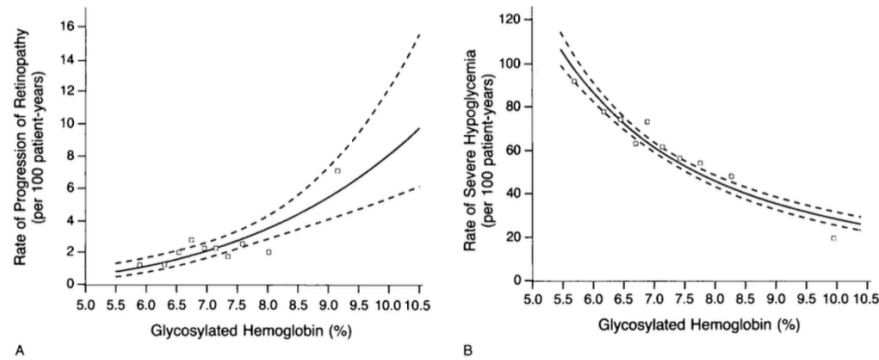


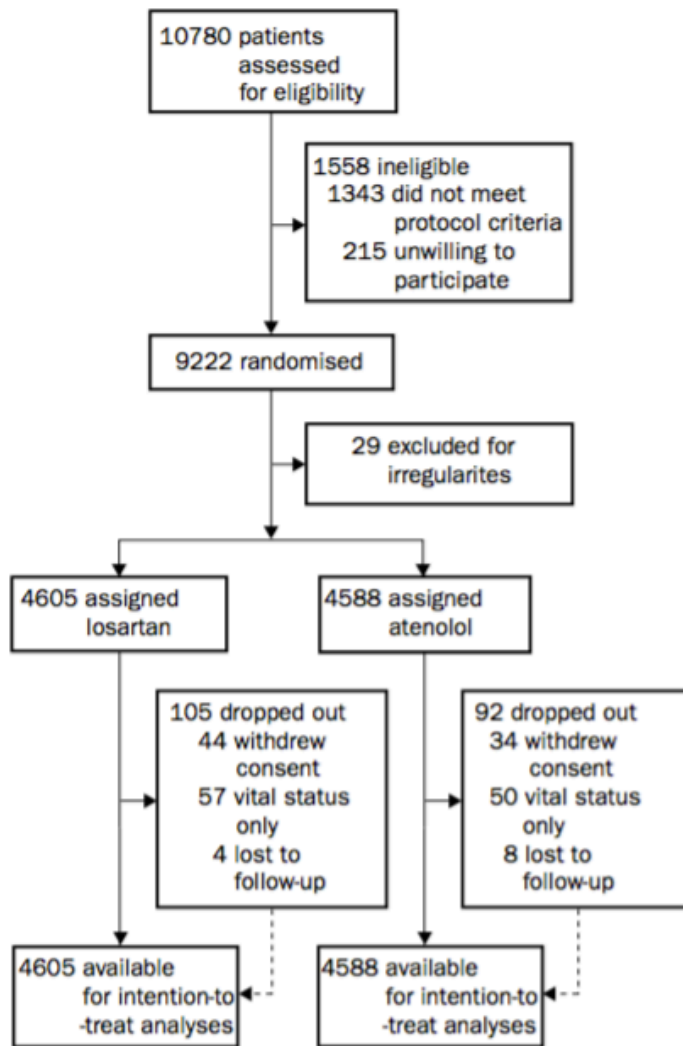
Figure 5. Risk of Sustained Progression of Retinopathy (Panel A) and Rate of Severe Hypoglycemia (Panel B) in the Patients Receiving Intensive Therapy, According to Their Mean Glycosylated Hemoglobin Values during the Trial.

Progression of retinopathy was defined as in the legend to Figure 2. In Panel A, the glycosylated hemoglobin values used were the mean of the values obtained every six months. In Panel B, the mean of the monthly values was used. Squares indicate the crude rates within deciles of the mean glycosylated hemoglobin values during the trial; each square corresponds to more than 400 patient-years. The solid lines are regression lines estimated as a function of the log of the mean glycosylated hemoglobin value in Panel A and the log of the glycosylated hemoglobin value in Panel B; the dashed lines are 95 percent confidence intervals.

(7.32)

(MRAC\_37)

In (7.33), dashed lines in the lower segment of the diagram suggest a possible or alternative pathway along which certain groups of patients can be included rather than excluded from analysis. Unlike the flowchart in (7.9) in section 7.2.1.1, the flowchart in (7.33) presents baseline data for so-called intention-to-treat analyses. Intention-to-treat analyses attempt to reduce bias in large-scale randomized controlled trials (RCTs). Unlike analyses based on actual treatment received, intention-to-treat analyses include all randomized patients regardless of “noncompliance, protocol deviations, withdrawal, and anything that happens after randomization” (Gupta 2011, 109). The dashed lines in (7.33) indicate that, despite their exclusion from treatment, “dropout” patients can still be included in the final analysis, construing what appears to be a combination of [entertain] and [disclaim: counter].



(7.33) Figure 2: Trial profile

(MRAC\_06)

According to Lemke (1998, 101), error-bars indicate “the reliability or warrantability, and so probability of error, in the data”; they are “a visual presentation of a mathematical formulation of an orientational [= interpersonal] meaning”. The graphs in (7.34) and (7.35) both contain error-bars. In the former, the error-bars are barely visible, indicating that, while one might ‘entertain’ the possibility of error and thus the possibility of alternative results, the dialogic space for those alternatives is relatively narrow. What is important in (7.34) is that, despite the margin for error indicated by the error-bars, the differences between the two study groups (note the use of shading and size) are sufficiently large for the standard error of the mean (SEM) to be of little or no consequence.



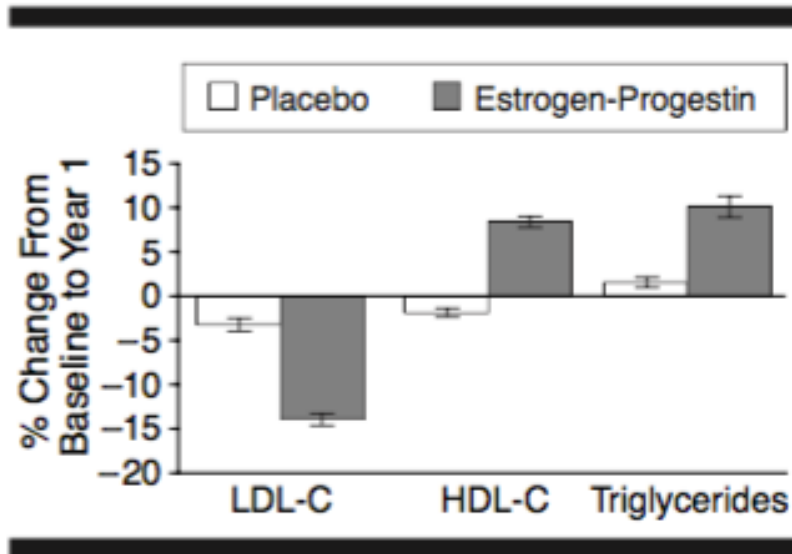


Figure 5.— Mean change in low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and triglyceride levels during the first year of the study, expressed as percent change  $\pm$  SEM.

(7.34)

(MRAC\_17)

The same cannot be said of (7.35). Here, the error-bars for the two groups, *t-PA* (tissue plasminogen activator) and *placebo*, overlap to such an extent that, at the three time-points indicated, the distinction between the two series is within a margin of error (the standard error, SE) that ‘entertains’ the possibility that, overall, there is little or no difference between the two treatment groups. This point is also made clear in the verbiage referring to the graph: “There were no significant differences in mortality between the groups (Fig. 1)” (quoted from MRAC\_24).

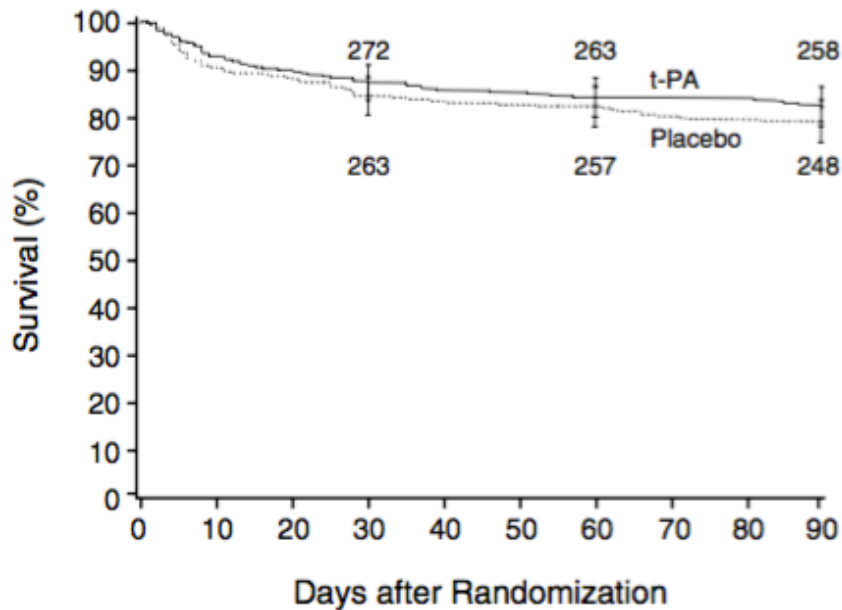


Figure 1. Mean ( $\pm$ SE) Survival at Three Months According to Treatment.

The combined results of parts 1 and 2 are shown. There were 312 patients in each group, and no patient had missing data on mortality. Error bars represent the standard errors of the point estimates of survival at 30, 60, and 90 days. The number of patients surviving at each interval is shown.

(7.35)

(MRAC\_24)

Standard deviations, like standard errors, are an integral part of the verbal-mathematical and visual construal of [engagement] in MRAC.<sup>146</sup> In (7.36), the vertical bars represent deviations from the mean and show the extent to which data from two treatment groups converge or diverge. The bars show variability within the study groups and thus construe, mathematically and visually, a dialogic space in which a range of possible values are permissible.

<sup>146</sup> Standard errors (SE) quantify the uncertainty in the estimate of a mean, while standard deviations quantify the variability or dispersion of individual observations (see Barde and Barde 2012). Although SE and SD are different statistical measurements, they may be used and/or read interchangeably in medical research articles (Barde and Barde 2012, 113).

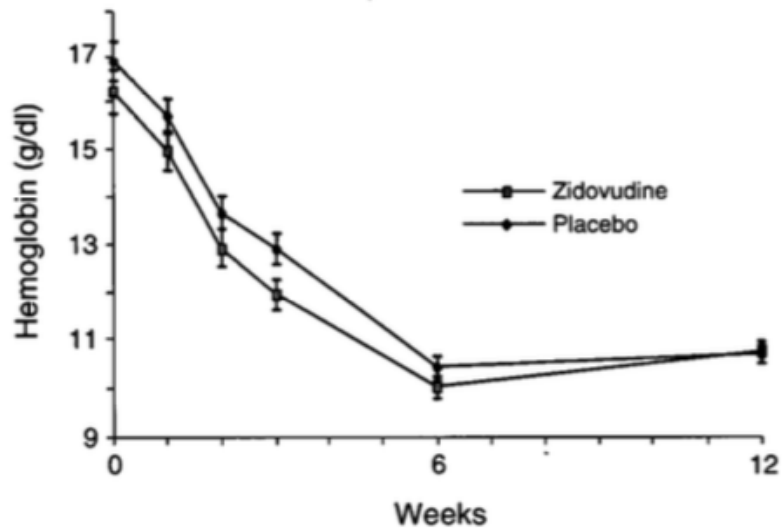


Figure 2. Mean ( $\pm$ SD) Hemoglobin Concentrations at Birth, 6 Weeks, and 12 Weeks in the Two Treatment Groups.

(7.36)

(MRAC\_04)

MRAC contains several graphical-numerical images that combine different representations of probability and likelihood. Reading from left to right, the table-graph hybrid in (7.37) presents a series of variables (*cause of death*) and their values based on two treatment groups (*simvastatin* and *placebo*). Those values and their differences are visualized as a series of geometric shapes and horizontal and vertical lines. Of particular interest with regard to [entertain] are the horizontal lines and the horizontal axes of the filled diamonds, which represent 95% confidence intervals (cf. (7.32) above) and which may construe for the text a dialogic space in which a range of alternative values (both observed and predicted) are allowed for.

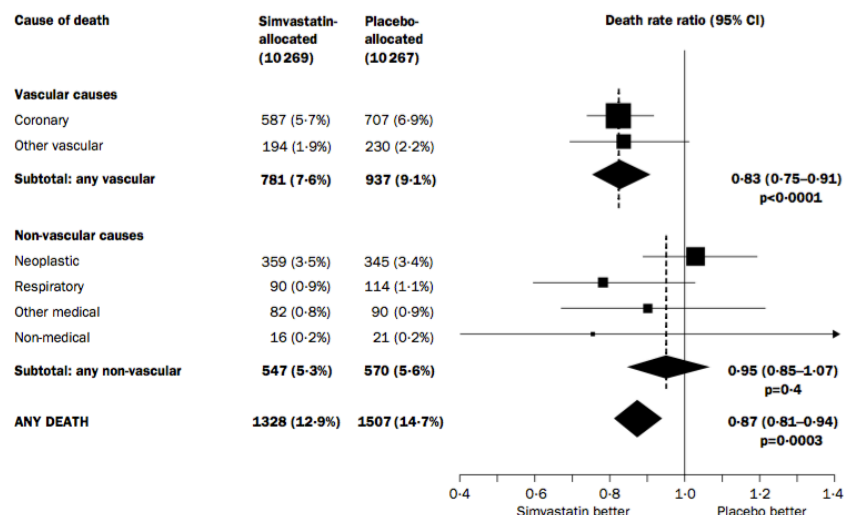


Figure 2: **Effects of simvastatin allocation on cause-specific mortality**  
 Rate ratios (RRs) are plotted (black squares with area proportional to the amount of statistical information in each subdivision) comparing outcome among participants allocated simvastatin to that among those allocated placebo, along with their 95% CIs (horizontal lines; ending with arrow head when CI extends beyond scale). For particular subtotals and totals, the result and its 95% CI are represented by a diamond, with the RR (95% CI) and its statistical significance given alongside. Squares or diamonds to the left of the solid vertical line indicate benefit with simvastatin, but this is conventionally significant ( $p < 0.05$ ) only if the horizontal line or diamond does not overlap the solid vertical line. A broken vertical line indicates the overall RR for a particular subtotal or total.

(7.37)

(MRAC\_03)

Tan (2010) proposes that certain hypertext objects or links in online advertising campaigns can construe spaces that are “maximally *heteroglossic*” in terms of their dialogic potential for reader involvement (Tan 2010, 102, emphasis in original). Hypertext links in MRAC provide possible or suggested pathways to both text-internal and text-external sites, e.g. to diagrams and tables, to a list of other studies (references), or to the cited studies themselves. Such links, like those in red in (7.5) above—reproduced here as (7.38)—open up a dialogic space that allows for alternative positions and alternative readings.<sup>147</sup>

<sup>147</sup> Although hypertext links can be considered a visual realization of [entertain], the linked text or text-element itself may ‘engage’ in different ways. For example, a link to a previous study or a table, while optional and dialogically ‘expansive’, might also seek to [justify] or [endorse] a particular position advanced in the text (see section 3.1.2).

## Methods

Prevalence estimates of overweight and obesity were calculated using data from the National Health and Nutrition Examination Survey (NHANES), a complex, multistage probability sample of the US civilian, noninstitutionalized population.<sup>6</sup> Race/ethnicity was reported by survey participants. During a physical examination in a mobile examination center, height and weight were measured using standardized protocols and calibrated equipment. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters and was rounded to the nearest tenth.

The NHANES 2003-2004 overall response rate (of those originally selected for participation) was 68.6% (4742/6916) for adults aged 20 years or older and 83.2% (4105/4932) for children and adolescents aged 2 to 19 years. Less than 3% of examined children and adolescents and 7% of adults had missing data for BMI. Data for analyses were available for 3958 children and adolescents and 4431 adults in 2003-2004 (Table 1), in addition to previously published data for 1999-2000 and 2001-2002.<sup>3-5</sup>

(7.38)

(MRAC\_26)

In the HTML versions of MRAC texts, links are activated by clicking on coloured or underlined elements (see (7.38) above). In the PDF and paper editions, those same links require scrolling or page-turning, or, in some cases, more comprehensive actions such as searching through catalogues and databases. While the links themselves may construe dialogically expansive [entertain] regardless of the site of engagement, the potential for interacting with those links is rather different.

Many of the images in MRAC contain some form of verbal and/or mathematical [engagement]. Particularly salient is the role played by mathematical probability, e.g. *p*-values, risk, odds ratios, and confidence intervals (see section 6.1.2.1), examples of which can be seen in (7.39). The role of mathematics in such instances is to help ascertain possible relations and associations (or a lack thereof) between different observations.

Table 3. Effect of Treatment on Mortality and Hospitalization for Congestive Heart Failure, and Proportion of Patients Taking Angiotensin-Converting–Enzyme Inhibitors after Various Periods.\*

MONTHS OF FOLLOW-UP	MORTALITY			DEATH OR HOSPITALIZATION FOR HEART FAILURE			PROPORTION TAKING INHIBITORS†	
	PLACEBO	ENALAPRIL	RISK REDUCTION (95% CI)	PLACEBO	ENALAPRIL	RISK REDUCTION (95% CI)	PLACEBO	ENALAPRIL
			number			percent		
3	69	47	33 (2–53)	164	92	46 (30–57)	6	91
6	126	91	29 (8–46)	259	150	45 (33–55)	10	88
12	201	159	23 (5–37)	401	262	40 (30–48)	12	86
24	344	277	23 (10–34)	559	434	30 (21–38)	20	83
36	450	396	16 (4–27)	680	555	28 (19–35)	23	82
48	504	443	17 (5–27)	731	607	27 (18–34)	30	83
Overall‡	510	452	16 (5–26)	736	613	26 (18–34)	—	—
	Z = 2.69; P = 0.0036			Z = 5.65; P < 0.0001				

\*The 95 percent confidence intervals (CI) correspond to a two-sided P value of <0.05 or a one-sided P value of <0.025. Risk reductions were calculated by the log-rank test from the data available at each specific time.

†Values shown for three and six months were based on data obtained after the visits at four and eight months, respectively. The inhibitors were angiotensin-converting–enzyme inhibitors.

‡The total numbers of deaths were 518 and 458 when deaths after January 31, 1991, but before the patients' last visits, were included. See notes to Table 2.

(7.39)

(MRAC\_49)

From an interpersonal and dialogic perspective, mathematical or numerical expressions such as those in (7.39) can, on the one hand, add to the warrantability or veracity of research findings, lending them “epistemic authority” (Jones 2013, 40) and “argumentative force” (Vihla 1999, 96) and functioning as a kind of mathematical-numerical ‘proclamation’. On the other hand, those same mathematical and numerical expressions can construe uncertainty and varying degrees of “statistical support” (Vihla 1999, 96), which also allow the textual voice to invoke and ‘entertain’ alternatives in the discourse. This dialogic duality or ambiguity is perhaps unsurprising, given that visual instantiations of [proclaim] in MRAC, like those of [entertain], are generally grounded in the subjecthood of the textual voice—they tend to ‘pronounce’ rather than ‘endorse’ (cf. verbal instantiations of [proclaim] in section 6.1.1.2).

A similar polysemy can be seen in some of the mathematical equations in MRAC. As noted above, in section 7.2.1.2, an equation like that in (7.40) is given greater conspicuity when separated from the main body of the written text. This highlights the potential importance of the equation and invites or encourages the reader to recognise that importance. At the same time, the equation as a mathematical statement or clause (see rank scale proposed by O'Halloran 2005, 98) encodes probability, in this case *estimated relative risk (RR)*, and therefore also instantiates [entertain]. The

relation between visual and mathematical instantiations of [engagement] are discussed further in chapter 8.

interim analyses. In view of these analyses, the critical Z value used at the end of the study for a one-sided test with a significance level of 0.025 was 2.11 rather than the usual 1.96. The Kaplan–Meier<sup>13</sup> method was used to construct life-table plots. The percentage reduction in mortality was reported as

$$(1 - RR) \times 100,$$

(7.40) where RR is the estimated relative risk of an event in the enalapril group as compared with the placebo group estimated from the life tables. The uniformity of treatment effects across subgroups was

(MRAC\_49)

Approximators of quantity, degree, frequency, and time (see Salager-Meyer 1994 and summary in section 4.2.3.2) are sometimes used in scriptural-numerical images to ‘entertain’ alternative variables or numerical values. In (7.41), the heading, *Most Frequent Adverse Reactions*, ‘entertains’ the possibility of other adverse reactions, and the putative reader is likely to understand that the variables listed in the leftmost column are not exhaustive. The example also highlights how the textual voice in this instance makes certain adverse events more visible than others, privileging or valuing frequency over, say, type, severity, or duration. As in (7.39) and (7.40) above, the heading and the included/excluded variables in (7.41) simultaneously encode [entertain] and [proclaim].

**Table 4. Most Frequent Adverse Reactions.\***

REACTION	PLACEBO	CARVEDILOL
	(N = 398)	(N = 696)
	<i>no. (%)</i>	
Dizziness	80 (20)	233 (33)
Fatigue	93 (23)	177 (25)
Dyspnea	101 (25)	150 (22)
Upper respiratory tract infection	74 (19)	133 (19)
Heart failure	84 (21)	111 (16)
Chest pain	61 (15)	104 (15)
Hyperglycemia	34 (9)	88 (13)
Diarrhea	24 (6)	83 (12)
Increase in weight	30 (8)	71 (10)
Cough	40 (10)	58 (8)
Pain	33 (8)	62 (9)
Headache	30 (8)	57 (8)
Nausea	18 (5)	60 (9)
Hypotension	15 (4)	60 (9)
Asthenia	27 (7)	49 (7)
Bradycardia	4 (1)	65 (9)
Worsening renal function	20 (5)	46 (7)
Vomiting	18 (5)	46 (7)

\*Patients may have had more than one adverse reaction.

(7.41)

(MRAC\_27)

### 7.2.2.2 Attribute

Unlike the examples in Economou (2009), the only instances of [attribute] in MRAC are those realized verbally, numerically, and symbolically. There are no instances of the kinds of “embodied visual attitude” or direct incorporation of other visual texts that Economou (2009) identifies in newspaper photography (see section 3.2).

Verbal and numerical ‘attributions’ in the figurative, numerical, and graphical images in MRAC are much like those expressed verbally and numerically in the rest of the text (see section 6.1.2.2). They include direct quotes and projecting/projected clauses, associated nominalizations, and superscript numbered references. Examples of these are given in (7.42)–(7.44).



Table 2. Angiographic Characteristics of the 516 Patients Included in the Intention-to-Treat Analysis and Characteristics of the Procedures They Underwent.\*

CHARACTERISTIC	ANGIOPLASTY (N = 257) STENT (N = 259)	
	number (percent)	
Artery dilated		
Right coronary	72 (28)	60 (23)
Left anterior descending	159 (62)	165 (64)
Left circumflex	26 (10)	34 (13)
Type of lesion†		
Concentric	118 (46)	130 (50)
Eccentric		
IA	33 (13)	34 (13)
IB	62 (24)	57 (22)
IIA	10 (4)	10 (4)
IIB	13 (5)	10 (4)
Tandem	0	1 (0.4)
Multiple irregularities	21 (8)	16 (6)
Occluded (TIMI 0 or 1)‡	5 (2)	9 (3)
Calcified	27 (11)	29 (11)
Length (mm)	6.96±2.57	7.06±2.56
Thrombus after procedure§	10 (4)	3 (1)
Dissection¶		
No	145 (56)	215 (83)
Type A	43 (17)	21 (8)
Type B	57 (22)	16 (6)
Type C	9 (4)	5 (2)
Type E	1 (0.4)	1 (0.4)
Type F	2 (0.8)	0
Nominal size, stent or balloon (mm)	3.29±0.38	3.31±0.34
Balloon/stent artery ratio	1.12±0.15	1.12±0.15
Largest balloon size (mm)‖	3.30±0.38	3.40±0.40
Maximal pressure (atmospheres)	9±3	10±8
Total inflation time (sec)	399±359	180±178

\*The interobserver and intraobserver variability of these morphologic measures has previously been reported by the core laboratory.<sup>13</sup> Plus-minus values are means ±SD.

†According to the classification system of Ambrose et al.<sup>14</sup>

‡According to the TIMI Study Group.<sup>10</sup>

§According to the definition of Ellis et al.<sup>15</sup>

¶According to the classification system of Dorros et al.<sup>16</sup>

‖Nominal size.

(7.42)

(MRAC\_36)

In (7.42), the symbols †, ‡, §, and ¶ are used to introduce other voices into the communicative context in order to acknowledge the sources of definitions and classifications, e.g. *Type of lesion†*. The sources themselves are then specified in the table-footnote and include superscript numbers referring to a reference list at the end of the article (cf. section 6.1.2.2). Dialogically, these resources—the symbols, the prepositional phrases (*according to...*), and the superscript numbers—together help ground propositions and semantic elements in the subjectivity of some external

voice and dissociate the textual voice from whatever position is being advanced. In terms of writer–reader alignment, the ‘attributions’ in (7.42) and similar instances are likely to maintain a relation of alliance. They are unlikely to challenge the solidarity of the writer–reader relation, unless the reader considers the positions of those external voices or the external voices themselves to be somehow unconvincing, unreliable, controversial, etc.

Direct quotes are occasionally used in scriptural-numerical images in MRAC. They play a similar dialogic role to those used elsewhere in the MRAC texts, i.e. to ground a proposition explicitly in the subjectivity of an external voice and potentially to ‘distance’ the textual voice from it (cf. section 6.1.2.2.1). In the table-footnote marked ‡ in (7.43), quotation marks and the reporting verb *reported* indicate the responses of patients.<sup>148</sup> As the table-heading makes clear, these are the patients’ own responses to questions concerning dietary and exercising habits. The role of the researcher(s), as ‘interviewer’ and ‘analyst’, appears to be minimized, and the scriptural-numerical image can in its entirety be seen as an instance of [attribute]. The textual voice essentially reports what others have reported, potentially ‘distancing’ itself from the sources of that information.<sup>149</sup>

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<sup>148</sup> Despite the quotation marks, the propositions contained within them are not direct quotes from individual patients. They represent standardized, rubric responses that are provided to patients by the researchers.

<sup>149</sup> Although only briefly mentioned in MRAC\_43, the method of self-reporting in medical research is often discussed as a source of potential bias. In another MRAC text, MRAC\_09, this issue is discussed more explicitly in terms of the accuracy of recollection in such surveys.

**TABLE 3. SELF-REPORTED CHANGE IN DIETARY AND EXERCISE HABITS DURING THE FIRST YEAR OF THE INTERVENTION, ACCORDING TO TREATMENT GROUP.\***

VARIABLE	INTERVENTION GROUP (N=253)	CONTROL GROUP (N=247)	P VALUE†
	% of subjects		
Decreased consumption of fat	87	70	0.001
Changed the quality of fat	70	39	0.001
Increased consumption of vegetables	72	62	0.01
Decreased consumption of sugar	55	40	0.001
Decreased consumption of salt	59	50	0.03
Decreased consumption of alcohol	26	23	0.43
Increased exercise‡	36	16	0.001

\*Seven subjects of 507 who remained in the study at one year had some missing data and are not included in this table.

†P values were determined by the chi-square test for the difference between the groups.

‡Subjects reported the frequency of exercise in terms of a shift to a higher category of the following four categories: (1) "I read, watch television, and work in the household at tasks that don't strain me physically"; (2) "I walk, cycle, or exercise lightly in other ways at least four hours per week"; (3) "I exercise to maintain my physical condition by running, jogging, skiing, doing gymnastics, swimming, playing ball games, etc., for at least 3 hours per week"; or (4) "I exercise competitively several times a week by running, orienteering, skiing, playing ball games, or engaging in other sports involving heavy exertion."

(7.43)

(MRAC\_43)

In the graphical image in (7.44), the heading *Proportion of Men and Women Who Reported Hypersomnolence, According to Category of Sleep-Disordered Breathing* indicates that the visualization of variables and their values in the graph is based at least in part on self-reporting (as is also specified elsewhere in MRAC\_48). Like the example above, this diagram as a whole can be understood, dialogically, as an instance of [attribute], in which the textual voice acknowledges and dissociates itself from the subjectivity of the external voices it references. Like the other examples in this section, the 'attribution' in (7.44) is unlikely to disalign the textual voice and putative reader, assuming, that is, that the reader has no reason to question the rationale or method for collecting and presenting such material.

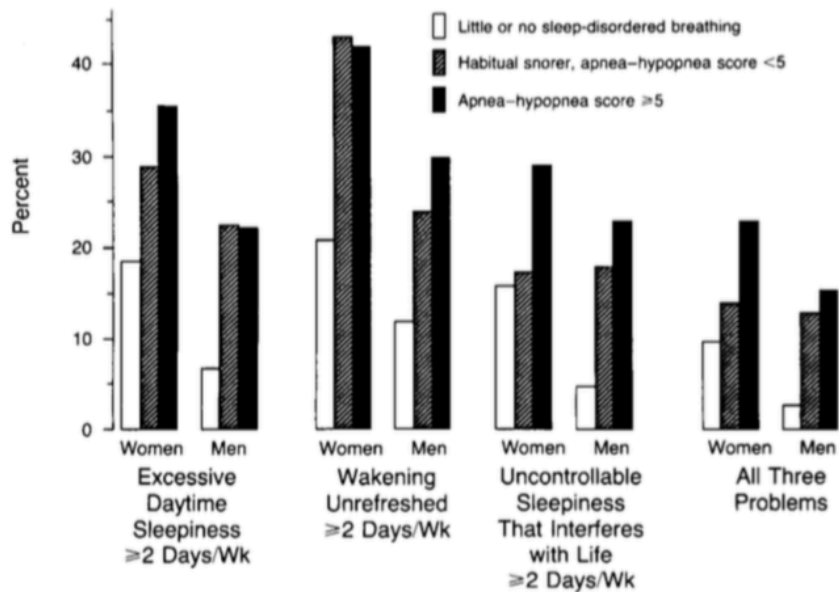


Figure 2. Proportion of Men and Women Who Reported Hypersomnolence, According to Category of Sleep-Disordered Breathing.

(7.44)

(MRAC\_48)

As with verbal and mathematical instantiations of [attribute], the dialogic function of these verbal-within-visual resources may be polysemic. While they clearly [attribute] some verbal or visual proposition to an external voice, such resources may also function to [endorse] or [justify] a particular position. In the case of (7.42) above, for example, references to *Ambrose et al.* and *the TIMI Study Group* ‘attribute’ the definitions and classifications in the table to specific sources. Depending on the perceived credibility of those sources, they might also be understood as ‘endorsing’ a particular choice of definition and, by implication, as providing a ‘justification’ for that choice, i.e. why one might choose one source or one definition over another. Understanding this dialogic potential depends to a large extent on the reader’s familiarity with those sources and a knowledge of more or less suitable alternatives.

Overall, verbal-within-visual ‘attributions’ of the kinds described above generally maintain writer–reader solidarity, although the distancing effect created by some ‘attributing’ resources may allow the textual voice to remain somewhat aloof from issues of alignment or disalignment, construing the textual voice as “an informational fair trader” (Martin and White 2005, 115). Such positioning, as noted in previous

chapters, is generally highly valued in medical-scientific discourse (cf. account of verbal and mathematical ‘attribution’ in 6.1.2.2).

### 7.2.2.3 Suggest

Economou (2009) proposes a third dialogically expansive option for the visual construal of engagement: [suggest]. The [suggest] option

[...] is called into play when a news photo alludes to, or suggests, by a certain combination of visual choices, an external visual genre or style; that is, a non-news image of some kind. This can evoke attitude associated with the non-news context and also affects viewer alignment with meanings in the photo and with the photo itself.

(Economou 2009, 222) <sup>150</sup>

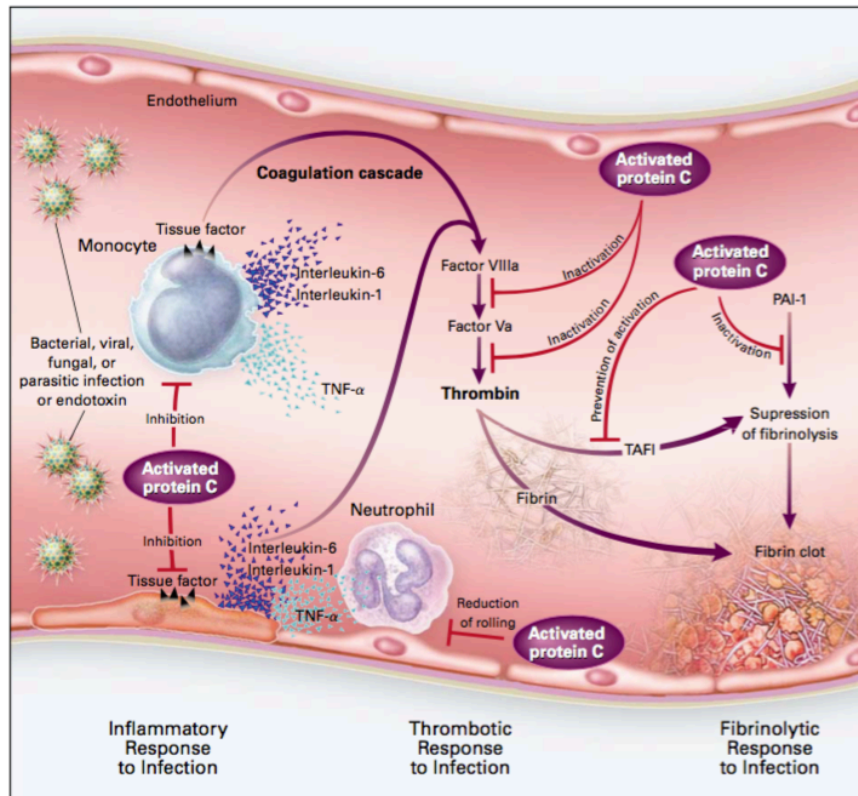
Economou’s (2009, 228 ff.) examples include the rendering of news photographs as a police investigation board, as corporate promotional material, and as a silhouette memento cut-out. All of these images are ‘suggestive’ of “non-news” domains and can extend by association the kinds of meanings typical of newspaper photography, a phenomenon Economou (2009, 222 ff., after Fairclough 1992, 124–130, *inter alia*) refers to as “interdiscursivity”.

For MRAC, several visual choices seem to be ‘suggestive’ of other “non-medical” domains. One example, which has been discussed a number of times in this chapter (as (7.8) and (7.31) above), is reproduced as (7.45) below. Here, certain ideational choices, e.g. the representations of endothelium, bacteria, monocyte, and neutrophil, are ‘suggestive’ of popular science, a field or domain in which verisimilitude may be given greater value compared with the scientific fields upon which it is often predicated (Myers 1990). The wide range of colours used in (7.45), and in other examples such as (7.5), (7.21), (7.22), and (7.27), may also be

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<sup>150</sup> The [suggest] category has no direct equivalent in the verbal ENGAGEMENT systems proposed by Martin and White (2005) and others. It could be argued that [suggest], to the extent that it can be construed visually, verbally, and mathematically, is a property of the ENGAGEMENT system as a whole. When seen from a trinocular perspective, ENGAGEMENT attempts to account for the ways in which texts refer to, respond to, and are influenced by other actual or anticipated texts. There is no reason why this would not include texts both within and across different fields or domains.

‘suggestive’ of the semiotic choices common to popular science (Herrando-Rodrigo 2010, 269), especially if one considers the use of colour to be largely unnecessary or “ornamental” in scientific visual representation (cf. Rowley-Jolivet 2004, 153). The image may also be ‘suggestive’ of the infographics sometimes used in news reporting (Dick 2014).



(7.45)

(MRAC\_01)

As Rowley-Jolivet (2002, 2004) notes (see section 4.3), medicine tends to use more colour in images than physics and geology, which may be indicative of the relative “softness” of medicine compared with the hard sciences of physics and geology.<sup>151</sup> If this is the case, and medicine is indeed a (relatively) soft science, many of the images in MRAC, i.e. graphs and tables, [suggest] a different field or domain, namely that of hard science. According to Cleveland (1984), Smith et al. (2000), and Arsenault et al. (2006), the overall number and extent of graphs, tables, and other

<sup>151</sup> Rowley-Jolivet (2002, 24, 2004, 148) describes physics and geology as “hard sciences”, “representing the two main loci of scientific investigation, namely fieldwork (geology) and the laboratory (physics [electromagnetism])”. In contrast, medicine is described as a “life sciences discipline” (Rowley-Jolivet 2002, 24, 2004, 148).

visual inscriptions (e.g. diagrams and equations) in research articles in different disciplines correlate with the perceived “hardness” of those disciplines (see section 4.3). In MRAC, there is a mean of 2.24 graphs and 3.88 tables per research article (6.56 in total, including combined graphs and tables). This compares with approximately 3.50 graphs and 2.00 tables per research article (5.50 in total) for hard science and 1.00 graphs and 2.40 tables per research article (3.40 in total) for soft science in Arsenault et al.’s (2006, 397) study.<sup>152</sup> Based on those numbers alone, the number of graphs in MRAC ‘suggests’ a relatively hard science, while the number of tables is more indicative of the soft sciences.

The key-messages box, shown above as (7.20) and reproduced below as (7.46), may also represent an instance of [suggest]. According to one set of BMJ guidelines, key messages “should contain three or four bullet points of no more than 25 words each, highlighting the main features of, and lessons from, the paper” (BMJ 2018a). Key messages do not summarize the study in the same way as abstracts do (see section 4.1.2); rather, they play a more educational role, serving as a guide or suggestion as to what the putative reader might learn from the article. Key-messages boxes like that in (7.46) are indicative of educational textbooks and longer-read newspaper articles. Their inclusion in MRAC could be ‘suggestive’ of those discursive fields.

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<sup>152</sup> The mean total number of inscriptions per research article in the hard-science journals in Arsenault et al.’s (2006, 394) study is 14.90. This is much higher than the 7.16 inscriptions per article for MRAC. The high number of inscriptions in Arsenault et al. (2006) is partly a result of the large number of mathematical equations in their physics (hard) and economics (soft) research articles. Arsenault et al. (2006, 398, 405–407) use these findings to argue that the display of equations, unlike graph use, is not necessarily indicative of hardness or the “scientificity of disciplines”.

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n chart) suggests that  
also prevented the  
pathy, which is the  
n type 2 diabetes.<sup>33</sup> In  
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(7.46) 1 of patients in the

Key messages
<ul style="list-style-type: none"> <li>● This study showed that tight control of blood pressure based on captopril or atenolol as first agents and aiming for both a systolic blood pressure &lt; 150 mm Hg and diastolic pressure &lt; 85 mm Hg achieved a mean 144/82 mm Hg compared with 154/87 mm Hg in a control group</li> <li>● 29% of patients in the tight control group required three or more hypotensive treatments</li> <li>● Tight control of blood pressure reduced the risk of any non-fatal or fatal diabetic complications and of death related to diabetes; deterioration in visual acuity was also reduced</li> <li>● Reducing blood pressure needs to have high priority in caring for patients with type 2 diabetes</li> </ul>

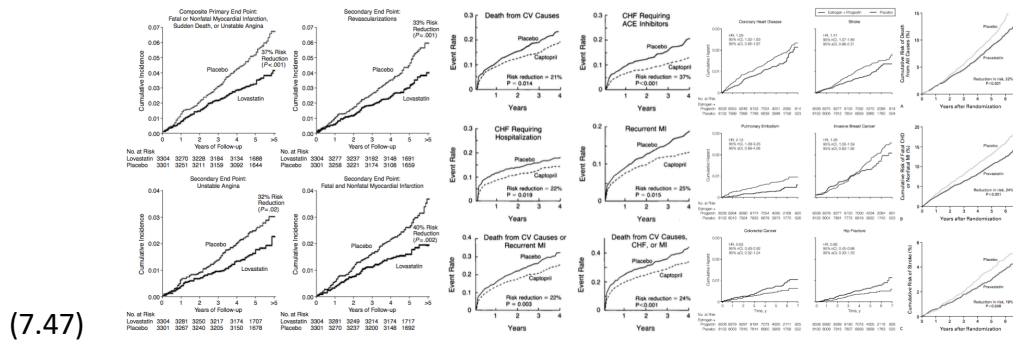
and in patients with type 1 diabetes with micro-albuminuria or established nephropathy.<sup>18 19</sup> Guidelines were formulated on the assumption that data relating to hypertensive non-diabetic subjects and

(MRAC\_40)

### 7.2.3 Monogloss

From a technological-abstract coding orientation (in contrast to a sensory or naturalistic one; see section 2.2.1.5.3), many of the diagrams, graphs, and tables in MRAC appear to be congruent, unmarked visual representations of scientific reality, ones in which the material, mental, and social worlds of the laboratory, the clinic, and other sites of observation and data collection are transformed into two-dimensional visual inscriptions (Latour 1990, 21–22, Economou 2009, 203). For the most part, those inscriptions seem to make no overt reference to an internal, subjective voice or to any external voices or positions; they are “objective and true” (Economou 2009, 203). Such visual elements are ‘monoglossic’, in that they appear to be bare assertions about some form of objective reality.





(MRAC\_08, MRAC\_30, MRAC\_34, MRAC\_42)

The examples in (7.47) demonstrate the potentially ‘monoglossic’, highly conventionalized, typical-for-science visual representations in MRAC. Detached from their original co-texts and contexts and viewed side by side like this, these graphical images seem unremarkable, displaying little or no marked ideation or marked expression (cf. Economou 2009, 214). However, as the analyses in sections 7.2.1 and 7.2.2 above suggest, it is not necessarily here, at the level of the diagram, graph, or table as a discrete whole, that all of the semiotic work is done. The extent to which an image can be described as ‘monoglossic’—or ‘heteroglossic’—depends on visual prompts and generic conventions as well as on the interests and experiences of individual readers. A cursory reading of any of the graphical images in (7.47) might imply a relatively ‘monoglossic’ interpretation: “variable Y increases over time X”. Closer readings, however, are likely to reveal a more ‘heteroglossic’ state of affairs, in which different elements of the graphical image can be seen to ‘expand’ or ‘contract’ the dialogic space for alternatives, e.g. that the differences observed between two groups are likely or unlikely to be a matter of chance.<sup>153</sup> In such cases, ‘heteroglossic’ choices realized lower down the rank scale, e.g. at the level of figure or figure-part, might be less salient than those higher up the scale, at the level of the episode, work, or beyond, allowing images to be read, at one level, as ‘monoglossic’ and, at another, as ‘heteroglossic’. Similar examples can

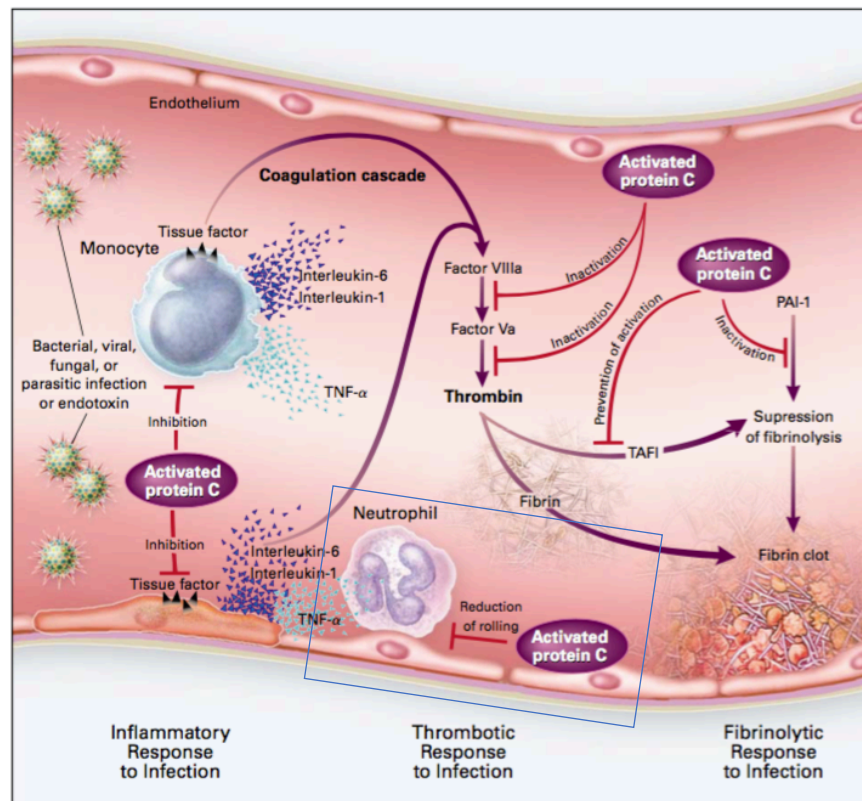
<sup>153</sup> The HTML versions of certain MRAC texts allow readers to download graphical, numerical, and figurative images as standalone files (see section 7.1). The ability to download those individual images may afford closer readings than those in print or PDF. For example, if I download a graphical image from LAN or BMJ, I might be more easily able to read off values in that image, by zooming in on specific parts of the graph, than if I view the same image in PDF or paper format.

be seen in verbal-mathematical instantiations in MRAC, where a seemingly ‘monoglossic’ utterance such as *The effect of pravastatin was greater among women than among men* can be construed as multi-voiced by the parenthetical addition ( *$P = 0.05$  for the interaction between the patient’s sex and treatment*) (see example (6.70), section 6.1.2.1).

#### **7.2.4 Scope and Interaction**

Like the written extracts in chapter 6, the images presented in this chapter often encode multiple instances of [engagement]. The degree to which those instantiations are likely to overlap and interact depends to a large extent on their realization and distribution, the kinds of reading paths prompted by a particular image, and the interests and experiences of the reader.

The blood-vessel image discussed above, and reproduced below as (7.48), includes several instances of [heterogloss]. Arrows, curves, and verbal-within-visual labels suggest dialogic ‘contraction’ (see section 7.2.1), while verisimilar representations and the relatively wide range of deployed colours imply dialogic ‘expansion’ (see section 7.2.2). Considered as a whole, from the rank of work, the putative reader is likely to engage first and foremost with the colours and the potentially subjectivized position implied by their use, i.e. [expand: entertain], noting secondarily, perhaps, which figures, episodes, and episode-nexuses are naturalistic (‘entertain’) and/or schematic (‘monogloss’).



(7.48)

(MRAC\_01)

Assuming a left-to-right (and possibly top-to-bottom) reading, in which infection on the left results in a fibrin clot on the lower right, there are certain episodes and figures-within-episodes that overlap and construe different types of [engagement]. One example of this is marked in (7.48) by a blue rectangle. The episode, which we might describe verbally as “activated protein C reduces neutrophil rolling on damaged endothelium”, counters the overall left-to-right flow or ‘rhythm’ of the work and potentially construes [contract: disclaim].<sup>154</sup> The episode contains a combination of naturalistic and schematic figures. Some, e.g. the relatively iconic *neutrophil* and *endothelium*, may [entertain] the possibility of alternative representations; others, e.g. *activated protein C* and the red line, are more likely to be considered abstract, ‘monoglossic’, standard-for-science representations. All or most of the figures in the episode are labelled, allowing the image-producer to assert or ‘proclaim’ a particular

<sup>154</sup> The name of this episode is based in part on the written description accompanying the image. For more on the intersemiotic relations between verbal and visual text, see chapter 8.

reading and thus contract the space for alternative interpretations.<sup>155</sup> From the perspective of the episode, and looking down the rank scale, we have an activity or episode that ‘disclaims’, i.e. one that counters the left-to-right narrative structure of the image, but one that also contains figures that variously ‘entertain’ and ‘proclaim’ as well as figures that represent more ‘monoglossic’ positions. If we look “round about”, in relation to other episodes in the image, several of them offer complementary [contract: disclaim] readings, i.e. all of those containing red lines and curves. Looking up the rank scale, this and other episodes are part of an image or work that, first and foremost it seems, presents a model, a guide for how the body *might* respond to infection when treated with activated protein C. That model, as discussed in the next chapter, presents one among a number of possible responses and thus construes, overall, a type of engagement that ‘entertains’ alternative responses and alternative ways of representing those responses.

In the case of English-language texts, verbal and mathematical resources are generally read linearly, from left to right, top to bottom. Visual resources need not be read in this way. Readers are not obliged to start from the left and move to the right, to go from top to bottom on a page, even if certain visual prompts suggest they should. A cursory reading of (7.48), seen as a whole, might be of a blood vessel in which some highly salient object, *activated protein C*, is performing or involved in a number of different actions, the exact details of which are provided elsewhere in the written text. A reader with a particular interest in, say, the properties and functions of neutrophils, however, might be drawn to specific figures or episodes in which those objects are implicated, without giving too much thought to the rest of the image. As discussed in the next chapter, readers are likely to return to different parts of the image, and to attend to different levels of detail, as and when they read the rest of the text.

Graphs and tables in MRAC also exhibit instances of overlapping [engagement]. At the level of the image or work, the examples in (7.49) and (7.50) might appear ‘monoglossic’. They are unmarked or congruent visual representations of scientific reality (to paraphrase Economou 2009,

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<sup>155</sup> Although *endothelium* is not labelled within this particular episode, it is labelled as such elsewhere in the image (top left corner).

203), ones that might be taken as given, generally accepted, or “authoritative” (Bakhtin 1981 [1935], 342, White 2003, 263, Martin and White 2005, 98–102), especially if read ‘at a glance’ (see section 7.2.3). On closer inspection, however, we find several instances of visually and mathematically construed ‘heteroglossia’—[proclaim], [disclaim], and [entertain]—occurring at different levels of the work.

Each column and row in (7.49) represents a major episode. The table-heading describes the overall work and is separated from the major episodes by horizontal lines. The footnotes, as minor episodes in the work, are also separated from the major episodes by a horizontal line. Two episodes, those labelled *z statistic* and *p value*, realize [entertain], since they encode, mathematically, the likelihood of certain observations for *ramipril* and *placebo* differing by chance. Within each of those vertically organized ‘entertain’ episodes, certain numerical values indicate that the relations between *ramipril* and *placebo* should *not* be treated as statistically significant. This numerically encoded negation or countering is a form of ‘disclaim’. For example, the difference in numbers of patients who were hospitalized for unstable angina in the *ramipril* and *placebo* groups is *not* statistically significant according to the high *z*-score ( $-0.41$ ) and high *p*-value ( $0.68$ ). The values thus reject or counter any expectation that the difference is, should be, or might be statistically significant.

TABLE 4. INCIDENCE OF SECONDARY AND OTHER OUTCOMES.

OUTCOME	RAMIPRIL GROUP (N=4645)	PLACEBO GROUP (N=4652)	RELATIVE RISK (95% CI)*	Z STATISTIC	P VALUE†
	no. (%)				
Secondary outcomes‡					
Revascularization	742 (16.0)	852 (18.3)	0.85 (0.77–0.94)	-3.17	0.002
Hospitalization for unstable angina	554 (11.9)	565 (12.1)	0.98 (0.87–1.10)	-0.41	0.68
Complications related to diabetes§¶	299 (6.4)	354 (7.6)	0.84 (0.72–0.98)	-2.16	0.03
Hospitalization for heart failure	141 (3.0)	160 (3.4)	0.88 (0.70–1.10)	-1.16	0.25
Other outcomes					
Heart failure§	417 (9.0)	535 (11.5)	0.77 (0.67–0.87)	-4.09	<0.001
Cardiac arrest	37 (0.8)	59 (1.3)	0.62 (0.41–0.94)	-2.28	0.02
Worsening angina§	1107 (23.8)	1220 (26.2)	0.89 (0.82–0.96)	-2.91	0.004
New diagnosis of diabetes	102 (3.6)	155 (5.4)	0.66 (0.51–0.85)	-3.31	<0.001
Unstable angina with electrocardiographic changes‡	175 (3.8)	180 (3.9)	0.97 (0.79–1.19)	-0.30	0.76

\*CI denotes confidence interval.

†P values were calculated with use of the log-rank test.

‡These events were centrally adjudicated.

§All cases are included, whether or not hospitalization was required.

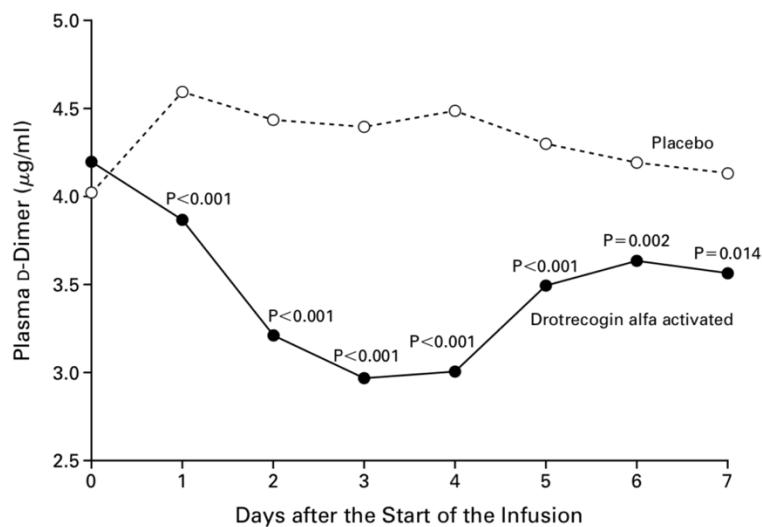
¶Complications related to diabetes include diabetic nephropathy (defined as urinary albumin excretion of at least 300 mg per day or urinary protein excretion of 500 mg per day), the need for renal dialysis, and the need for laser therapy for diabetic retinopathy.

||The denominator in the ramipril group is the 2837 patients who did not have diabetes at base line. The denominator in the placebo group is the 2883 patients who did not have diabetes at base line.

(7.49)

(MRAC\_50)

In (7.50), one major episode is contrasted with another, through the use of solid and dashed lines, and certain figures within those episodes are given greater prominence through labelling and the use of solid rather than open circles ('proclaim'). Moreover, the labels used for the solid-circle figures indicate how likely it is that differences between figures are due to chance. Some indicate low probability ( $P < 0.001$ ) (i.e. statistically significant → 'entertain'), others somewhat higher ( $P = 0.014$ ) (i.e. not statistically significant → 'disclaim', 'entertain').



**Figure 3.** Changes in Median Plasma D-Dimer Levels in 770 Patients with Severe Sepsis in the Drotrecogin Alfa Activated Group and 729 Patients in the Placebo Group. Only patients with base-line values and at least one subsequent value were included in the analysis. The P values are for the comparison with the placebo group.

(7.50)

(MRAC\_01)

In summary, visual [engagement] features in MRAC can overlap and interact to create dialogic spaces that are potentially both 'contractive' and 'expansive', and that can also construe a more authoritative single-voicedness. Like verbal and mathematical [engagement], visual [engagement] in MRAC is realized at different levels of the rank scale for visual display.

### 7.2.5 Summary

Seen from the rank-scale perspective of work, the majority of images in MRAC appear to be 'monoglossic', making no overt reference to an internal, subjective voice or to any external voices or positions. However, on closer inspection, episodes, figures, and figure-parts within those

works often construe a more ‘heteroglossic’ backdrop. Dialogically ‘contractive’ resources in MRAC include lines and arrows that stop, block, or diverge from some expected narrative flow, the omission or exclusion of otherwise expected visual, verbal, and numerical elements, the highlighting or foregrounding of certain visual elements through choices of shading, colour, size, and placement, and the use of verbal labels to assert particular interpretations. Dialogically ‘expansive’ resources include choices of marked ideation or expression (e.g. naturalistic representations), error-bars and standard deviations, hypertext objects, as well as interdiscursive borrowings such as key-messages boxes that draw upon visual resources more typical of other discursive fields. Several visual resources, e.g. the use of solid and dashed lines in diagrams and graphs, may simultaneously express dialogically ‘expansive’ and dialogically ‘contractive’ positions.

A single page or a single image in MRAC generally encodes multiple instances of [engagement]. Those instances overlap, often due to their relations across and within the rank scale for visual display. The exact interaction of [engagement] features and the overall effect they create depends on visual prompts in the image and on readers’ interests. For example, a particular episode may be dialogically ‘contractive’, while also containing figures and figure-parts that are considered dialogically ‘expansive’. The overall effect of such an example is a relatively narrow dialogic space that can be maintained or perturbed (expanded or contracted further) by choices made at different levels of the rank scale. This interactional hierarchy, however, may be overridden by a reader’s personal or professional interest in certain figures and figure-parts within the episode.

With regard to intersubjective positioning, the relative [monogloss] of most graphs and tables in MRAC is likely to be ‘taken for granted’ and is unlikely to disalign the textual voice and the reader. However, some forms of marked ideation or expression—for example, certain uses of colour and naturalistic representation—may affect intersubjective relations if the reader considers such choices unnecessary or superfluous to the construction of scientific fact (cf. Rowley-Jolivet 2004). Images or parts of images that make explicit the inclusion or exclusion of certain

measurements, observations, or interpretations may also put writer-reader solidarity at risk.

### **7.3 Genre and Generic Staging**

In the following sections, I examine how visual [engagement] resources are distributed across different generic stages and phases of MRAC articles, considering how visual [engagement] evolves as texts unfold. I begin with the four main sections of the medical research article: Introduction, Methods, Results, and Discussion. I then discuss other sections of the medical research article, including the Abstract, before concluding with an overall summary of logogenetic variability in MRAC.

#### **7.3.1 Introduction Sections**

The Introduction section of the modern medical research article has three main functions or phases: describing the field of study, identifying a gap in the field, and stating the main research purposes (see section 4.1.1). As a visual unit, the Introduction is relatively small or short compared with the other three main sections of the research article (Methods, Results, Discussion). Typically, the Introduction occupies one-third to one-half of a page in the print and PDF versions, and comprises two to three paragraphs, with each paragraph roughly corresponding to each of the three main phases in the section. See examples in (7.51).<sup>156</sup>

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<sup>156</sup> The images in (7.51) show the opening pages of two MRAC articles, MRAC\_12 and MRAC\_40.



Papers

PEGINTERFERON ALFA-2a PLUS RIBAVIRIN FOR CHRONIC HEPATITIS C VIRUS INFECTION

MICHAEL W. FRIED, M.D., MITCHELL L. SHIFFMAN, M.D., K. RAJENDER REDDY, M.D., DOUGLAS SMITH, M.D., GEORGE MARINIS, M.D., FERNANDO L. GONCALVES, JR., M.D., MOHAMED EL-SAYED, M.D., GEORGE CARRAS, M.D., DANIEL DUBREUIL, M.D., ANTONIO CRANE, M.D., AMY LIN, M.S., JOSEPH HOFFMAN, M.D., AND JIAN-YU WU, M.D., Ph.D.\*

**ABSTRACT** Treatment with peginterferon alfa-2a alone produces significantly higher sustained virologic responses than treatment with interferon alfa-2a alone in patients with chronic hepatitis C virus (HCV) infection. We compared the efficacy and safety of peginterferon alfa-2a plus ribavirin, interferon alfa-2b plus ribavirin, and peginterferon alfa-2a alone in the initial treatment of chronic hepatitis C.

**ALTHOUGH** the mechanism of action of ribavirin remains speculative, the current standard of care for patients with chronic hepatitis C is the addition of ribavirin to interferon-based therapies.<sup>1,2</sup> Unfortunately, some patients, particularly those with more resistant hepatitis C virus (HCV) genotypes, do not respond to these regimens.

**Methods.** A total of 1521 patients were randomly assigned to treatment and received at least one dose of study medication, consisting of 180 µg of peginterferon alfa-2a once weekly plus daily ribavirin (1000 or 1200 mg, depending on body weight), weekly peginterferon alfa-2a plus daily placebo, or 3 million units of interferon alfa-2b three times weekly plus daily ribavirin for 48 weeks.

**Results.** A significantly higher proportion of patients who received peginterferon alfa-2a plus ribavirin had a sustained virologic response (defined as the absence of detectable HCV RNA 24 weeks after cessation of therapy) than of patients who received interferon alfa-2a plus ribavirin (56 percent vs. 46 percent, P<0.001) or peginterferon alfa-2a alone (56 percent vs. 28 percent, P<0.001). The proportions of patients with HCV genotype 1 who had sustained virologic responses were 46 percent, 36 percent, and 21 percent, respectively, for the three regimens. Among patients with HCV genotype 1 and high baseline levels of HCV RNA, the proportions of those with sustained virologic responses were 41 percent, 32 percent, and 13 percent, respectively. The overall safety profiles of the three treatment regimens were similar; the incidence of influenza-like symptoms and depression was lower in the group receiving peginterferon alfa-2a than in the group receiving interferon alfa-2b plus ribavirin.

**Conclusion.** In patients with chronic hepatitis C, once-weekly peginterferon alfa-2a plus ribavirin was once-weekly peginterferon alfa-2a plus ribavirin was tolerated as well as interferon alfa-2b plus ribavirin and produced significant improvements in the rate of sustained virologic responses, as compared with interferon alfa-2b plus ribavirin or peginterferon alfa-2a alone. (In Engl J Med 2002;347:975-82.)

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\*These participants in the study are listed in the Appendix.

Tight blood pressure control and risk of macrovascular and microvascular complications in type 2 diabetes: UKPDS 38

UK Prospective Diabetes Study Group

**Objective.** To determine whether tight control of blood pressure prevents macrovascular and microvascular complications in patients with type 2 diabetes.

**Design.** Randomised controlled trial comparing tight control of blood pressure aiming at a blood pressure of <150/85 mm Hg with the use of an angiotensin converting enzyme inhibitor compared to a 10 mm Hg lower aim in patients with low tight control aiming at a blood pressure of <140/80 mm Hg.

**Subjects.** 1148 hypertensive patients with type 2 diabetes (mean age 56, mean blood pressure at entry 160/94 mm Hg). 724 patients were also used in tight control of blood pressure and 390 patients to low tight control with a median follow up of 6.4 years.

**Main outcome measures.** Predefined clinical end points, fatal and nonfatal stroke related to diabetes, deaths related to diabetes, and all cause mortality. Surrogate measures of macrovascular disease included urinary albumin excretion and retinal photography.

**Results.** Mean blood pressure during follow up was significantly reduced in the group assigned tight blood pressure control (144.0 mm Hg compared with the group assigned to low tight control (154.07 mm Hg) (P<0.0001). Reductions in the group assigned to tight control compared with that assigned to low tight control were 20% in diabetes related end points (95% confidence interval 8% to 30%) (P=0.004), 20% in deaths related to diabetes (0% to 34%) (P=0.02), 44% in strokes (11% to 57%) (P=0.002), and 27% in deaths related end points (11% to 50%) (P=0.002), predominantly microvascular in origin.

There was a non-significant reduction in all cause mortality. More severe types of follow up the group assigned to tight blood pressure control also had a 24% reduction in risk in the proportion of patients with deterioration of retinopathy by two steps (99% confidence interval 11% to 39%) (P=0.0001) and a 47% reduced risk (7% to 79%) (P=0.004) of deterioration in visual acuity by three lines of the early treatment of diabetic retinopathy study (ETDRS) chart. After 12 years of follow up 29% of patients in

the group assigned to tight control required three or more treatments to lower blood pressure to achieve target blood pressure.

**Conclusion.** Tight blood pressure control in patients with hypertension and type 2 diabetes achieves a clinically important reduction in the risk of deaths related to diabetes, complications related to diabetes, progression of diabetic retinopathy, and deterioration in visual acuity.

**Introduction.** Type 2 diabetes and hypertension are commonly associated conditions, both of which carry an increased risk of cardiovascular and renal disease.<sup>1</sup> The prevalence of hypertension in type 2 diabetes is higher than that in the general population, especially in younger patients.<sup>2-6</sup> At the age of 45 around 40% of patients with type 2 diabetes are hypertensive, the proportion increasing to 60% by the age of 75.<sup>7</sup> Hypertension increases the already high risk of cardiovascular disease associated with type 2 diabetes<sup>1,8</sup> and is also a risk factor for the development of macrovascular disease<sup>9</sup> and retinopathy.<sup>10</sup>

In the general population treatment to lower blood pressure reduces the incidence of stroke and myocardial infarction,<sup>11</sup> particularly in elderly people.<sup>12</sup> In patients with type 2 diabetes who have microvascular complications, treatment to lower blood pressure reduces urinary albumin excretion and deterioration in renal function.<sup>13</sup> Lowering blood pressure also decreases albuminuria in type 2 diabetes,<sup>14</sup> but whether it also reduces the risk of end stage renal disease or of cardiac disease is not known.

We report results from the hypertension in diabetes study, a multicentre, randomised, controlled trial conducted within the UK prospective diabetes study designed to determine whether tight blood pressure control (aiming for a blood pressure of <150/85 mm Hg) reduces mortality and mortality in hypertensive patients with type 2 diabetes.<sup>15</sup>

**Subjects and methods.** We studied hypertensive patients with type 2 diabetes who had been recruited to the UK prospective diabetes study.<sup>16</sup> General practitioners were asked to refer

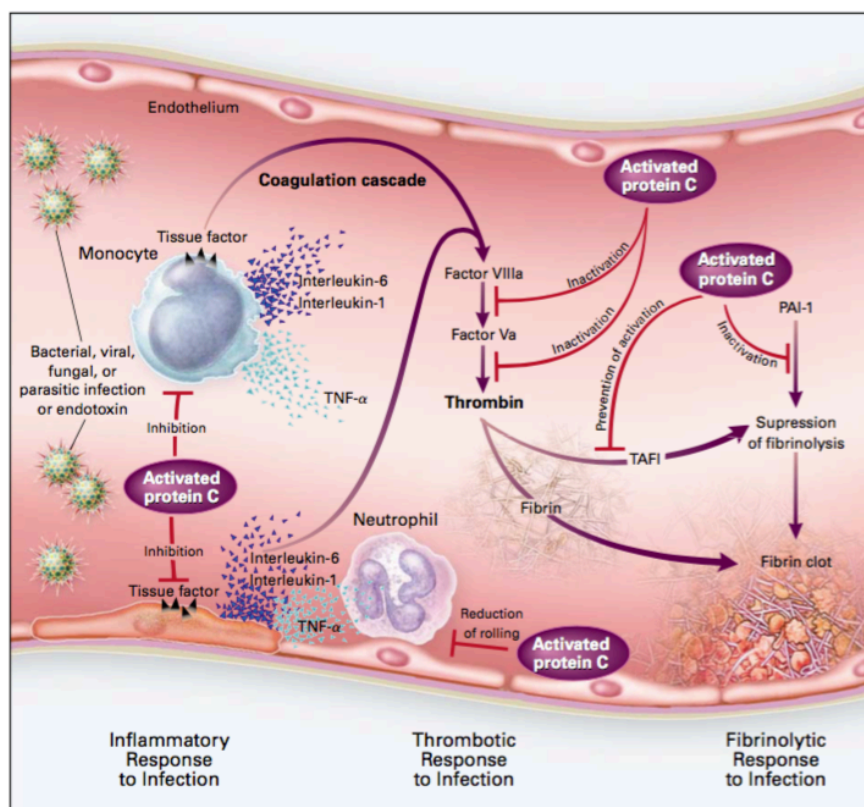
Abstract by Michael W. Fried, M.D., Mitchell L. Shiffman, M.D., K. Rajender Reddy, M.D., Douglas Smith, M.D., George Marinis, M.D., Fernando L. Goncalves, Jr., M.D., Mohamed El-Sayed, M.D., George Carras, M.D., Daniel Dubreuil, M.D., Antonio Crane, M.D., Amy Lin, M.S., Joseph Hoffman, M.D., and Jian-Yu Wu, M.D., Ph.D.\*

(7.51)

(MRAC\_12, MRAC\_40)

The start of the Introduction is marked in one of three ways: most typically by a two-to-four-line 'drop-cap' with block-capital first word (n=39) or, less commonly, by the heading *introduction* (n=8) or a block-capital first word without drop-cap or heading (n=2) (see (7.51) for examples of the first two). The visual prominence of the drop-cap adds to the general thematic prominence of the Introduction as one of the first main units in the research article. The association of this type of lettering with manuscripts from late antiquity may also lend the text a sense of tradition and/or authority. Only paper and PDF versions include this resource; drop-caps are not used in the HTML version.

With regard to visual inscriptions, most Introductions in MRAC contain no graphical, figurative, or numerical images. Only two Introductions—MRAC\_01 and MRAC\_13—contain visual inscriptions, both of which are graphical images (see (7.52) and (7.53)). Example (7.52) has been discussed several times already. Its main purpose, as mentioned above, is to introduce a proposed model. The model is part of the background for a study that aims to test whether increasing amounts of activated protein C might help to reduce the number of deaths in cases of severe sepsis. The image in (7.52), and verbal reference to the image in the research article, is part of the first phase of the Introduction, describing the field of study.

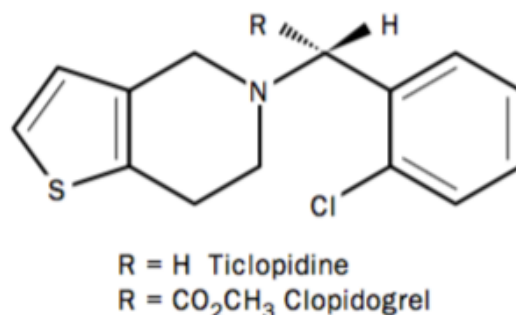


(7.52)

(MRAC\_01)

The image in (7.53), a skeletal structural formula, depicts the molecular structure of two related antiplatelet drugs. Like (7.52), (7.53) is part of the background of the study, which aims to test the efficacy of the then recently approved drug *clopidogrel*. In terms of [engagement], the image is not only prominent for its appearance in the Introduction, a marked placement in MRAC specifically and in medical research articles in general; it is also marked for its image-type, since there are no other structural formulae in MRAC. Structural formulae like (7.53) are two-dimensional representations of three-dimensional objects; they depict the spatial arrangement of atoms and molecules, parts of which are directed specifically towards or away from the reader. In (7.53), the solid wedge labelled *H* represents a chemical bond that points out of the plane of the screen or paper towards the viewer, while the dashed wedge labelled *R* points away from the viewer. The chemical bond labelled *R* indicates both the similarity and difference between the two chemical compounds. It represents an either/or potential, where the bond connects either a hydrogen atom *H* or the molecule  $CO_2CH_3$ , but not both. The representation is amalgamative, similar in some ways to the heart-diagram in (7.7) and

(7.25) above, in which sites of interest across several patients are represented collectively in one-and-the-same heart-diagram. However, unlike the heart-diagram, the structural formula in (7.53) is not representative of any data collected in the study.



**Figure 1: Structure of clopidogrel and ticlopidine**

(7.53) Clopidogrel is the (S) active enantiomer of a racemate.

(MRAC\_13)

The relative lack of visual inscriptions in the Introduction sections of MRAC is perhaps unsurprising then, given that—according to Latour (1990, 22) at least—visual inscriptions tend to be products of the laboratory, generated by a variety of instruments and methods that have yet to be introduced at this point in the research article. If, like the International Committee of Medical Journal Editors (ICMJE 2008), we read the research article as “a direct reflection of the process of scientific discovery”, we might not expect such inscriptions until later in the research article (see, in particular, sections 7.3.2 and 7.3.3). In the two instances described above, both images are part of a description of the overall field of study (phase 1); they are not part of identifying a gap in the field (phase 2) or stating how that gap might be occupied (phase 3). With regard to [engagement], the images seem to be ‘suggestive’ of other domains or text-types, i.e. infographics, popular science, and scientific textbooks (see section 7.2.2.3).

### 7.3.2 Methods Sections

Methods sections of contemporary medical research articles usually have three main functions or phases: describing the study material, explaining how (and why) that material was selected, and recounting the

experimental and data-analysis procedures (see section 4.1.1). In MRAC, the Methods section typically occupies somewhere between one and two pages in print and PDF. The start of the section is indicated by the heading *methods* (n=48), *subjects and methods* (n=1), or *patients and methods* (n=1).

One of the most striking visual features of the Methods section in MRAC is that, in print and PDF, the section is often reproduced at a smaller font size than the other main sections of the research article (n=34; all of which are published in NEJM). While the reasons for this are debatable,<sup>157</sup> the dialogic effect of reducing font size is a reduction in visual prominence and a relative backgrounding of the Methods compared with the three other main sections. This backgrounding complements the relatively ‘monoglossic’ taken-for-grantedness of the verbal resources in the Methods section (see section 6.2.2).<sup>158</sup> An example of this reduction in font size can be seen in the double-page spread in (7.3), reproduced here as (7.54).

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<sup>157</sup> Smaller font size is generally concerned with space constraints associated with print publishing and the relative uniformity of the content of the Methods section compared with other sections of the medical research article. In a letter-to-the-editor published in LAN in 2001, one author (Rothman 2001, 890) notes that the reduced font size of some Methods sections “conveys the message that the description of what was actually done in a study is low-priority information”. A similar point is made by Ferrill, Norton, and Blalock (1999, 371) in a study of pharmacists’ interpretations of statistics in medical journals, in which they suggest that smaller font size “may lead the reader to mistakenly conclude the information presented in the smaller font is of lesser importance”. An editorial published in NEJM in 2003 (Drazen, Anderson, and Curfman 2003) regarding the journal’s decision to restore the Methods section to “full-size type” acknowledges how “critical to research” methods sections are. No reason is given in the editorial for why the journal originally adopted the smaller-font-size Methods section.

<sup>158</sup> As a further example of the relative backgrounding of Methods sections in scientific research articles, Wu (2011, 1348), in a review of the IMRaD model, notes that the journal *Nature* publishes Methods at the end of research articles as well as at a smaller font size.

was to estimate the effects of air pollution on mortality, with control for individual smoking status, sex, age, and other risk factors.

**METHODS**

**Study Population**

We selected random samples of adults from six communities<sup>13</sup> in Worcester, Massachusetts (where study recruitment was conducted in 1974); Worcester, Tennessee, including Knoxville (1970); specific census tracts of St. Louis (1973); Strohmeier, Ohio (1970); Portage, Wisconsin, including Wisconsin and Porterville (1970); and Topka, Kansas (1977). The sample was restricted to the 1811 subjects who were 25 through 74 years of age at enrollment and had completed a mailed questionnaire. The questionnaire included questions about age, sex, weight, height, education level, complete smoking history, occupational exposures, and medical history.

Informational letters and postage-paid return postcards including a question on vital status were mailed to the subjects annually. The vital status of the subjects who did not respond was determined by questioning family members, friends, or neighbors. In addition, we searched the National Death Index<sup>14</sup> for the years 1979 through 1989. Death certificates were obtained for 1017 of the 1811 subjects who had died (56 percent); the causes of death were coded according to the International Classification of Diseases, 9th Revision (ICD-9)<sup>15</sup> by an independent certified necrologist who was blinded both to pollution levels and to the study design and objectives. The remaining 804 subjects who were alive in the last follow-up were followed up again in 1991, depending on the date of the last follow-up contact; the total duration of follow-up was 11 to 16 years (11.07 years on average).

For subjects who died, survival times were calculated by subtracting the date of enrollment from the exact date of death. For surviving participants who were lost to follow-up, censored survival times were defined as the date of the end of the study minus the enrollment date. For those who were lost to follow-up before the period covered by our National Death Index search (i.e., before 1979), censored survival times were estimated by subtracting the enrollment date either from the date of the last follow-up contact plus six months or from the first day of the National Death Index search period (January 1, 1979), whichever came first. For those who were lost to follow-up after the National Death Index search period (i.e., after 1979), censored survival times were estimated by subtracting the enrollment date either from the date of the last follow-up contact plus six months or from the first day of the National Death Index search period, whichever came first. For those who were lost to follow-up during the period covered by the National Death Index search, censored survival times were estimated by subtracting the date of enrollment from the last date in the search period (December 31, 1989).

**Air-Pollution Data**  
As part of the original study design, ambient (outdoor) concentrations of total suspended particulates, sulfur dioxide, ozone, and suspended sulfates were measured in each community at a centrally located air-monitoring station. In the Topka air-monitoring station were placed at three sites in the last 1976, data were collected for two classes of particles: particulate (aerodynamic diameter < 3 µm) and inhalable particulate (aerodynamic diameter < 11 µm below 1000 and < 70 µm at sea level in 1986). In the study, approximately 1000 samples of ambient air were collected by the measurements of hydrocarbons concentration<sup>16</sup> was conducted by approximately 1000 samples in each city. Mean pollution levels for each pollutant were calculated for periods that were consistent and comparable among the six cities.

**Statistical Analysis**  
Life-table survival probabilities for each year of follow-up were estimated for each city, and differences between city-specific hazard rates were assessed with a log-rank test.<sup>17</sup> We estimated adjusted mortality rates from air pollution by unsmoothly adjusting

for other factors in Cox proportional-hazards regression models.<sup>18</sup> In the log-rank test the subjects were stratified according to the five-year age groups, and each age-group had its own baseline hazard. Each model also included indicator variables for current or former smokers, the number of pack-years of smoking (restricted to the weight in kilograms divided by the square of the height in meters).

The approaches were used to evaluate the effects of air pollution in the Cox proportional-hazards models. First, indicator variables for the city of residence were included, with Portage, Wisconsin, the city with the lowest levels of particulate air pollution, as the reference city. Next, adjusted mortality rates were estimated by including city-specific pollution levels directly in the Cox proportional-hazards models. Adjusted rate ratios were calculated and reported for a difference in air pollution equal to that between the city with the highest levels of air pollution and the city with the lowest levels—that is, the adjusted rate ratios across the range of exposure for each pollutant among the six cities.

Analyses were conducted to evaluate the relationship of the models and the possibility of residual confounding. Models were estimated with the inclusion of different covariates on the estimated effect of pollution was evaluated. Models were also estimated after the inclusion of variables that had been used for blood pressure control. If any of the variables in the study and subjects who had been used by a doctor that they had diabetes, had glucose in their urine, or had been hospitalized in the last 12 months. A variety of approaches to estimate censored survival times. Multiple-time points from the Cox proportional-hazards models (with adjustment for cigarette smoking, education, and body-mass index) were estimated separately for the following categories: cigarette nonusers (224), male 60 through 69 and 40 through 59, lung cancer (182), and all others. For each cause-of-death category, those subjects whose deaths were not in that specific category were censored at the time of death.

**RESULTS**

**Characteristics of the Cohort and Air-Pollution Data**

The characteristics of the cohort and the values for air-pollution measures are summarized in Table 1. For all measures of air pollution except the ozone level and aerosol acidity, ambient concentrations were highest in Strohmeier and lowest in Portage or Topka. The mean acidity of the aerosol was highest in Hartman, but second-highest in Strohmeier. The mean ozone concentrations were highest in Portage and Topka. The concentrations of total particulates declined during the study period, especially in Strohmeier and St. Louis; the annual average concentrations of fine and sulfate particles varied relatively little during the study period (Fig. 1). Crude mortality rates (Table 1) and survival curves (Fig. 2) both show that mortality was highest in Strohmeier and lowest in Portage and Topka. Differences in the probability of survival among the cities were statistically significant (P<0.001).

**Adjusted Mortality Rates**

On the basis of the proportional-hazards model, mortality was most strongly associated with cigarette smoking (Table 2). Increased mortality was also associated with having less than a high-school education

Table 1. Characteristics of the Study Population and Mean Air-Pollution Levels in Six Cities.\*

Characteristic	Portage, Wis.	St. Louis, Mo.	Strohmeier, Ohio	Topka, Kan.	Worcester, Mass.	Worcester, Tenn.
No. of participants	21,618	16,411	11,882	17,406	17,713	17,944
Percent of follow-up	21	36	22	21	21	21
Female (%)	10.73	9.48	12.47	12.48	15.86	16.24
Hispanic (%)	31	36	24	31	30	30
Smokers (%)	36	39	40	37	35	35
Former smokers (%)	34	32	31	34	33	33
Average pack-years of smoking	18.8	19.9	20.2	18.5	18.8	18.8
Current smokers	18.8	19.7	21.8	21.1	22.0	22.0
Former smokers	17	17	17	17	17	17
Mean body-mass index (range %)	48.3	48.3	48.5	48.4	51.8	51.6
Average body-mass index	25.3	25.3	25.5	25.1	26.0	26.4
Air-pollution index	17	22	22	25	47	30
Total particulates (µg/m <sup>3</sup> )	341	34.6	40.2	40.4	72.5	89.9
Inhalable particulates (µg/m <sup>3</sup> )	19.2	28.4	26.2	27.5	31.4	40.5
Fine particulates (µg/m <sup>3</sup> )	11.9	12.1	14.9	24.8	19.2	29.4
Sulfate particles (µg/m <sup>3</sup> )	3.3	4.4	4.5	4.3	8.1	12.8
Aerosol acidity (pH)	4.2	3.6	3.7	3.4	3.2	3.2
Sulfate dioxide (ppb)	4.2	1.6	3.9	4.8	14.1	24.9
Nitrogen dioxide (ppb)	4.2	19.6	18.1	14.1	19.7	13.9
Ozone (ppb)	28.0	27.6	19.7	20.7	20.8	22.3

\*Air-pollution index was measured in the following units: total particulates, µg/m<sup>3</sup>; inhalable particulates, µg/m<sup>3</sup>; fine particulates, µg/m<sup>3</sup>; sulfate particles, µg/m<sup>3</sup>; aerosol acidity, pH; sulfate dioxide, ppb; nitrogen dioxide, ppb; ozone, ppb.

and with increased body-mass index (the latter was especially true for women). After simultaneous adjustments for these other risk factors, the differences in mortality among the six cities remained significant.

City-specific mortality rates, adjusted for a variety of health risk factors, were associated with the average levels of air pollution in the cities (Fig. 3). The small differences in ozone levels among the cities (Table 1) limited the power of the study to detect associations between mortality and ozone levels. Mortality was more strongly associated with the levels of inhalable, fine, and sulfate particles than with the levels of total suspended particles, the sulfur dioxide levels, the nitrogen dioxide levels, or the acidity of the aerosol.

When the mean concentrations of each pollutant were included individually in the proportional-hazards model, we found significant associations between mortality and inhalable, fine, and sulfate particles (P<0.005). For a difference in the air-pollution level equal to that between the most polluted city and the least polluted city and with inhalable particles (range, 11.0 to 29.6 µg per cubic meter), fine particles (range, 4.8 to 12.8 µg per cubic meter), and sulfate particles (range, 4.8 to 12.8 µg per cubic meter) used as indicators of air pollution, the adjusted rate ratios were nearly equal at 1.27 (95 percent confidence interval, 1.08 to 1.47), 1.26 (95 percent confidence interval, 1.08 to 1.47), and 1.26 (95 percent confidence interval, 1.08 to 1.47), respectively.

Estimates of the association between mortality and fine-particle pollution among subjects with different smoking status and among men and women (Table 3) showed only small and nonsignificant differences between subgroups. Associations with air pollution were somewhat stronger among subjects with occupational exposure to dust, gases, or fumes (Table 3). However, positive associations between mortality and air-pollution levels were observed in all subgroups defined by occupational exposure and sex, and differences among the subgroups were not statistically significant.

Although cigarette smoking and other risk factors were associated with mortality, our estimates of pollution-related mortality were not significantly affected by the inclusion or exclusion of these variables in the models (Table 4). The estimated association between air pollution and mortality was unchanged when subjects who had been treated for high blood pressure or subjects with diabetes were excluded from the analysis (Table 4). When censored survival times were recalculated as the date of the last follow-up contact minus the enrollment date, or when the analysis was restricted to data on deaths in 1979 through 1989 (the years of the National Death Index search), no appreciable differences in the estimated association between air pollution and mortality were observed.

**Causes of Death**

The estimated effects of air pollution on mortality varied among causes of death (Table 5). For comparison, rate ratios were estimated for current smokers and for former smokers with approximately the average number of pack-years of smoking at enrollment (Table 5). Smoking was most strongly associated with mortality due to lung cancer, significantly associated with mortality due to lung cancer and all other causes. Similarly, air pollution was positively associated with mortality due to lung cancer and cardiopulmonary disease but not with mortality from all other causes. Only 98 deaths were coded on the death certificates as due to nonmalignant respiratory disease (ICD-9 codes 465 through 469), as compared with 646 deaths due to cardiovascular disease (codes 400 through 440). An analysis restricted to deaths from nonmalignant respi-

(7.54)

(MRAC\_07)

There are 25 visual inscriptions in the Methods sections of MRAC. Of these, 13 are tables, five are flowchart diagrams, five are separated mathematical equations, and two are photomicrographs. (There are no graphs.) These inscriptions play different roles with regard to the different generic phases of Methods sections.

Tables typically provide information on baseline characteristics of study groups, contributing primarily to phase 1 of the Methods section, i.e. describing the study material. Tables in Methods sections tend to be 'monoglossic', displaying little or no marked ideation or marked expression. To the degree that they do express some kind of multi- or other-voicedness, 'heteroglossic' resources in Methods tables tend to be dialogically 'contractive' rather than dialogically 'expansive' (cf. tables in Results, section 7.3.3). The table in (7.55), for example, while ostensibly 'monoglossic', contains some instances of verbal [disclaim] and visual [proclaim], i.e. the categorization of patients in terms of their *not* belonging to a particular group (*Non-Hispanic, ... not shown*; cf. section 6.1.1.1 on negation and the relative foregrounding and backgrounding of certain categories through the use of boldface and indentation. Mathematically construed [entertain] and verbally-numerically construed [attribute] are not common features of tables in MRAC Methods sections.

**Table 1.** Sample Size of US Adults, Children, and Adolescents by Sex, Age, and Racial/Ethnic Group, 2003-2004

	All (N = 8389)*	Non-Hispanic White (n = 3448)	Non-Hispanic Black (n = 2246)	Mexican American (n = 2055)
<b>Male</b>				
All ages, y	4240	1727	1141	1048
2-5	402	119	125	111
6-11	463	120	159	140
12-19	1138	305	425	339
20-39	756	336	175	165
40-59	649	340	146	118
≥60	832	507	111	175
<b>Female</b>				
All ages, y	4149	1721	1105	1007
2-5	416	121	133	117
6-11	518	136	183	159
12-19	1021	290	345	316
20-39	661	327	153	130
40-59	662	333	160	110
≥60	871	514	131	175

(7.55)

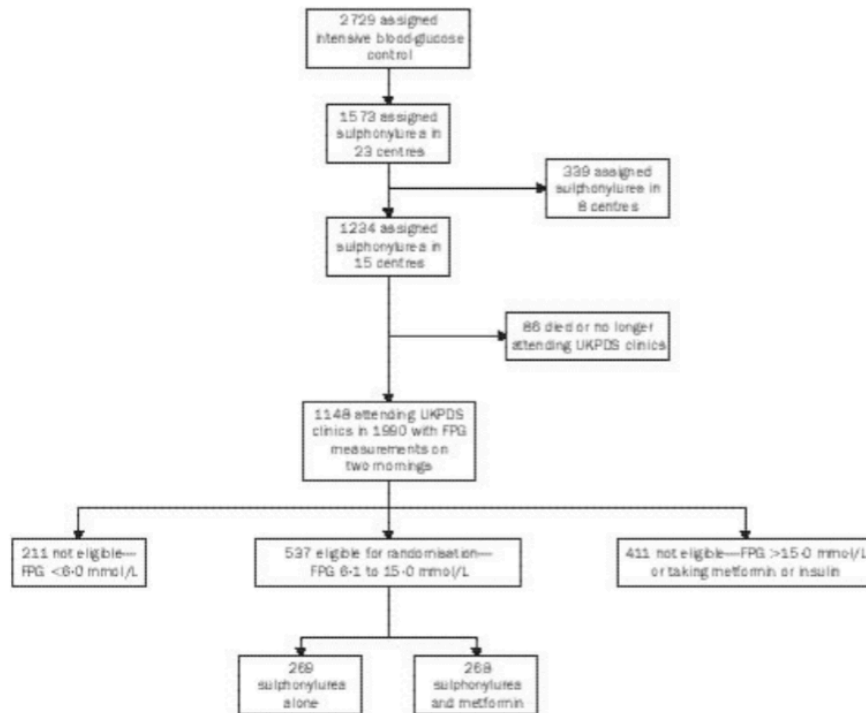
\*Includes racial/ethnic groups not shown separately.

(MRAC\_26)

The five flowcharts in the MRAC Methods sections represent processes in which patients are categorized into different treatment groups. Like the table above in (7.55), flowcharts provide information about the type and size of groups, and thus contribute to generic phase 1 of the Methods, describing the study material. However, flowcharts can also indicate how the study material was collected and categorized, and, in some cases, how that material is to be analysed, contributing to the second phase of the section, explaining how and why certain material was selected. From a dialogic perspective, flowcharts in Methods sections may imply greater interpersonal risk compared with tables, especially if decisions to include or exclude certain groups are based on disputed or “nonstandard” criteria. The flowchart in (7.56) illustrates some of these points.<sup>159</sup> Its vertical ‘rhythm’ or flow is broken at various points, to indicate individuals and groups that were excluded from the study (‘disclaim’). The final exclusions—those towards the bottom of the flowchart, assuming a top-to-bottom temporal reading—indicate ineligibility based on cut-off values for FPG (fasting plasma glucose) of less than 6.0 mmol/L or greater than 15.0 mmol/L. While these may not be controversial values, the lower cut-off values for impaired fasting glycemia, as currently recommended by the

<sup>159</sup> The quality of reproduction in (7.56) is the same as that in the PDF and HTML versions of MRAC\_45.

World Health Organization (WHO) and the American Diabetes Association, are 6.1 and 5.6 mmol/L, respectively (WHO 2006, 21–27). The exclusion criterion used in this study from the year 1998 might act as a basis for disalignment with contemporary readers.



(7.56) Figure 2: Trial profile for sulphonylurea-treated patients with randomisation to metformin

(MRAC\_45)

There are five separated mathematical equations in MRAC, all of which appear in Methods sections (four in MRAC\_47, one in MRAC\_49). These equations are part of the generic phase that recounts data-analysis procedures. The four instances in MRAC\_47 are shown below in (7.57); the single instance from MRAC\_49 is reproduced earlier as (7.40).



The probability of metastasis was calculated from our logistic-regression model, which basically fit the following equation<sup>18</sup>:

$$\log (P/1 - P) = a + B_1x_1 + B_2x_2 . . . ,$$

where  $P$  denotes the probability of the outcome (metastasis). However, our model could be simplified:

$$\log (P/1 - P) = a + Bx,$$

where  $x$  denotes the vessel count at 200 $\times$ . With the microvessel count determined at 200 $\times$ , this model yielded an intercept (constant),  $a$ , of  $-2.614$  and a slope,  $B$ , of  $0.0464$ . Using these numbers and rearranging the above equation, we calculated the predicted probability of metastasis with a given vessel count according to the following equation:

$$P = e^{a+Bx}/(1 + e^{a+Bx}).$$

For example, if the highest microvessel count per 200 $\times$  field was 80, the probability of metastasis would be

$$(7.57) \quad P = e^{-2.614+0.0464(80)}/(1 + e^{-2.614+0.0464(80)}) = 0.735.$$

(MRAC\_47)

Verbally and mathematically, the equations in (7.57) seem to be bare assertions, mathematical statements of what  $P$  and other functional elements are equal to; but they also express varying degrees of ‘entertain’ (see sections 6.1.2.1 and 7.2.2.1). Visually, as noted in section 7.2.1.2, they are highly conspicuous, disrupting the flow of verbiage and staking out or ‘proclaiming’ a certain importance in relation to the rest of the text. The cumulative effect of not just one but four equations on the same page, in the same column of text, further emphasizes the relative importance and potential “epistemological authority” (Jones 2013, 40) such equations can convey.

The two instances of photomicrographs in the Methods sections are both from MRAC\_47. As discussed above, in section 7.2.2.1, these type-II figurative images are relatively unusual in MRAC and certainly marked in comparison with other image-types, especially tables and graphs. This markedness may be more pronounced in the Methods section, since figurative and graphical-figurative images, to the extent they are used in MRAC, appear more often in Results sections ( $n=5$ ), as part of the report of specific observations or findings. In the Methods section, however, their role is to serve as examples, as potential models for what is typically observed under different circumstances, which is part of the generic phase



of recounting the experimental procedure. In the photomicrographs in (7.58) and (7.59) below, panel *A* in each image shows areas of breast cancer (carcinoma), while panel *B* shows normal connective tissue. Both sets of images are described as “representative” in the legend and in the main verbal text. Their use here as models in the Methods section suggests that they are instances of ‘entertain’—as one among a number of possible alternative representations—an interpretation that may only be possible when considering the images from a generic, multisemiotic perspective.

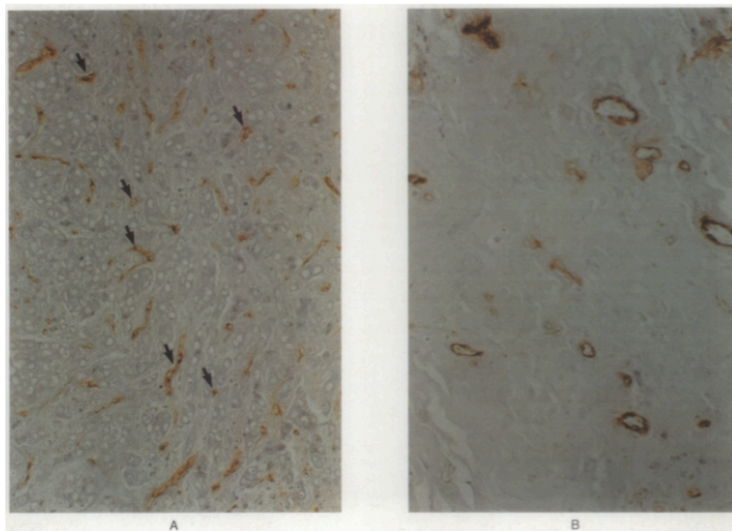


Figure 1. Area with Highest Density of Microvessels in an Invasive Duct Carcinoma (Panel A) and Representative Benign Breast Stroma Immediately Adjacent to the Carcinoma (Panel B) (Immunoperoxidase Stain for Factor VIII,  $\times 36$ ). Some representative microvessels are indicated by the arrows. Each was considered a discrete vessel for counting purposes; we found 85 microvessels in this field. As compared with the highly angiogenic carcinoma — a tumor that had metastasized — the benign tissue contained relatively few microvessels.

(7.58)

(MRAC\_47)

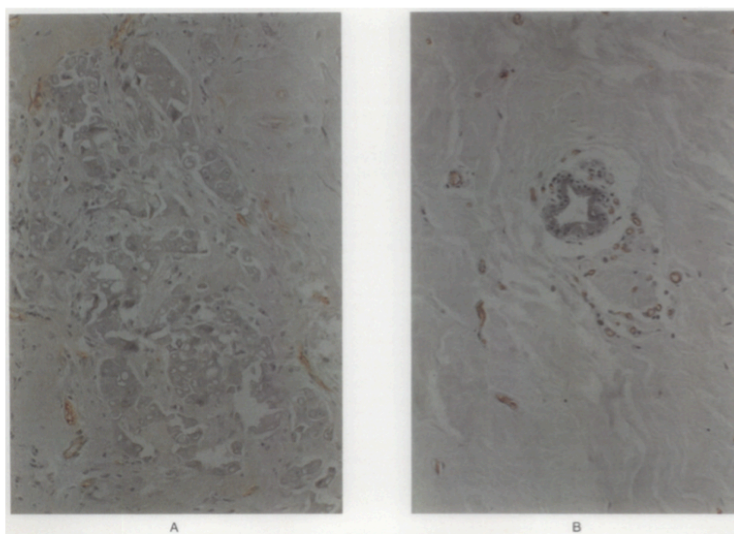


Figure 2. Representative Field of an Invasive Duct Carcinoma That Had Relatively Little Angiogenesis and Did Not Metastasize or Recur (Panel A) and a Representative Area of Benign Breast Stroma Immediately Adjacent to the Invasive Tumor (Panel B) (Immunoperoxidase Stain for Factor VIII,  $\times 36$ ). There are approximately equal numbers of microvessels in the area of the carcinoma (12 microvessels were found in this field) and the adjacent stroma.

(7.59)

(MRAC\_47)



With regard to [engagement], tables and graphs in Results sections are ostensibly ‘monoglossic’; they present the variables studied and the values observed. However, they can also represent (possible) relations between different variables. This can have the effect, on the one hand, of opening up a dialogic space in which alternative values might be ‘entertained’, and, on the other, of closing down the dialogic space for alternatives by rejecting or countering hypothesized relations (‘disclaim’).<sup>160</sup> This is one of the ways in which tables in Results sections differ from those in the Methods, in that the latter tend not to instantiate the kinds of dialogic ‘expansion’ or ‘contraction’ typically construed by mathematical-verbal (statistical) resources such as *p*-values and confidence intervals. Examples of this are provided in (7.39)—reproduced below as (7.61)—in which *p*-values, *z*-scores, risk, and confidence intervals all help to construe probability, thereby ‘entertaining’ the relative likelihood of alternative values and alternative representations in the text. Those same resources can also indicate whether differences between values are deemed statistically significant or not, potentially rejecting or countering expectations or hypotheses that such differences would or would not be statistically significant.

**Table 3. Effect of Treatment on Mortality and Hospitalization for Congestive Heart Failure, and Proportion of Patients Taking Angiotensin-Converting–Enzyme Inhibitors after Various Periods.\***

MONTHS OF FOLLOW-UP	MORTALITY			DEATH OR HOSPITALIZATION FOR HEART FAILURE			PROPORTION TAKING INHIBITORS†	
	PLACEBO	ENALAPRIL	RISK REDUCTION (95% CI)	PLACEBO	ENALAPRIL	RISK REDUCTION (95% CI)	PLACEBO	ENALAPRIL
			number			percent		
3	69	47	33 (2–53)	164	92	46 (30–57)	6	91
6	126	91	29 (8–46)	259	150	45 (33–55)	10	88
12	201	159	23 (5–37)	401	262	40 (30–48)	12	86
24	344	277	23 (10–34)	559	434	30 (21–38)	20	83
36	450	396	16 (4–27)	680	555	28 (19–35)	23	82
48	504	443	17 (5–27)	731	607	27 (18–34)	30	83
Overall‡	510	452	16 (5–26)	736	613	26 (18–34)	—	—
	Z = 2.69; P = 0.0036			Z = 5.65; P < 0.0001				

\*The 95 percent confidence intervals (CI) correspond to a two-sided P value of <0.05 or a one-sided P value of <0.025. Risk reductions were calculated by the log-rank test from the data available at each specific time.

†Values shown for three and six months were based on data obtained after the visits at four and eight months, respectively. The inhibitors were angiotensin-converting–enzyme inhibitors.

‡The total numbers of deaths were 518 and 458 when deaths after January 31, 1991, but before the patients’ last visits, were included. See notes to Table 2.

(7.61)

(MRAC\_49)

<sup>160</sup> These relations are usually set up in the Introduction section, as hypotheses or study aims, as part of the stating-the-research-purpose phase (see section 7.3.1).

Other image-types in the Results section include table-graph hybrids (n=20), numerical-graphical flowcharts (n=8), photomicrographs and computed tomography images (n=3), and graphical-figurative hybrids (one combined Western blot and graph, and one combined electrogram and angiogram). All of those images contribute to the phase of the Results section that reports findings or presents data.

Table-graph hybrids like the one in (7.37)—reproduced as (7.62) below—provide verbal and visual comparisons of study data, in this case a comparison of rates of death according to cause and treatment group. The right-hand column of the inscription visualizes and numericizes the similarities and differences between the two treatment groups and provides numerical measures of their statistical significance. In terms of [engagement], prominence/‘proclaim’ is variously encoded by the use of boldface, capitalization, and solid geometric forms, while ‘entertain’ is construed by *p*-values, 95% confidence intervals, and the relative widths of geometric forms. Although there are 20 of these table-graph hybrids in MRAC, they appear in only six articles (three on heart disease, three on diabetes mellitus), all of which deal with the comparison of two treatment groups.

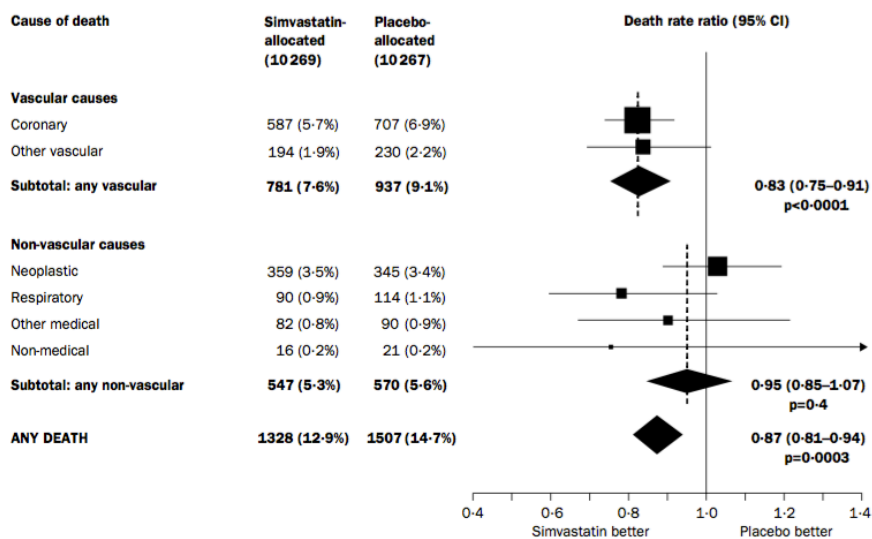


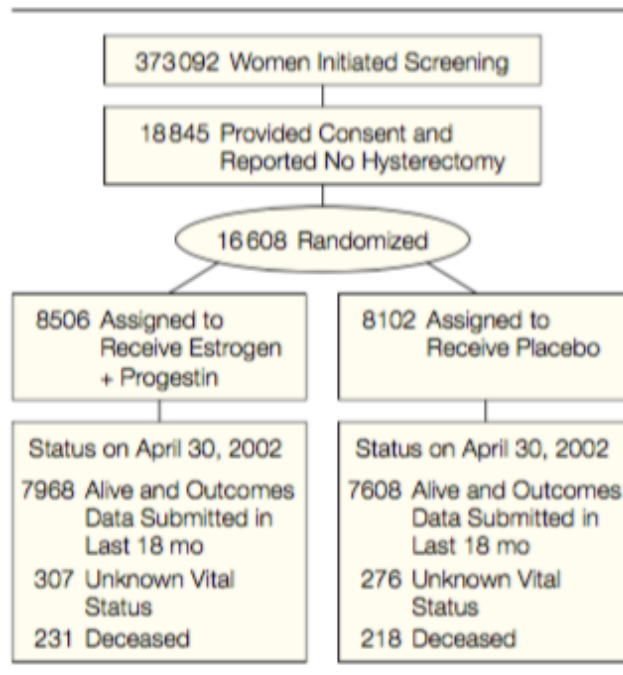
Figure 2: Effects of simvastatin allocation on cause-specific mortality  
Rate ratios (RRs) are plotted (black squares with area proportional to the amount of statistical information in each subdivision) comparing outcome among participants allocated simvastatin to that among those allocated placebo, along with their 95% CIs (horizontal lines; ending with arrow head when CI extends beyond scale). For particular subtotals and totals, the result and its 95% CI are represented by a diamond, with the RR (95% CI) and its statistical significance given alongside. Squares or diamonds to the left of the solid vertical line indicate benefit with simvastatin, but this is conventionally significant ( $p < 0.05$ ) only if the horizontal line or diamond does not overlap the solid vertical line. A broken vertical line indicates the overall RR for a particular subtotal or total.

(7.62)

(MRAC\_03)

The flowcharts in Results sections provide similar information to those in Methods sections, but their placement in one section rather than another suggests different functionality. Flowcharts in Methods sections, as noted above, usually provide information about the categorization and size of study groups; the same applies to flowcharts in Results sections. The main difference, however—beyond mere happenstance—seems to be a matter of how well established the research project is. If the study or parts of the study have been reported previously, the flowchart is placed in the Methods section. If the study is new, or certain patient groups have not been described before, the flowchart appears at the start of the Results section. This distinction may be difficult to make at the level of the flowchart as work and needs to be considered “from above” with regard to generic staging. The Methods and Results flowcharts in (7.63) and (7.64), respectively, demonstrate this similarity at the level of work. The former functions to describe the material, the basis for the study; the latter construes the flowchart as part of the data generated by the study.

**Figure 1.** Profile of the Estrogen Plus Progestin Component of the Women's Health Initiative



(7.63)

(MRAC\_34)



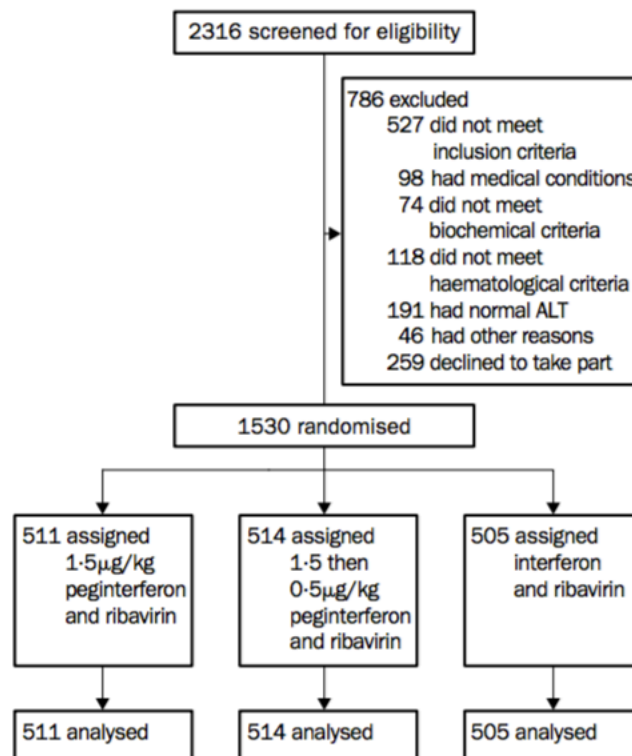
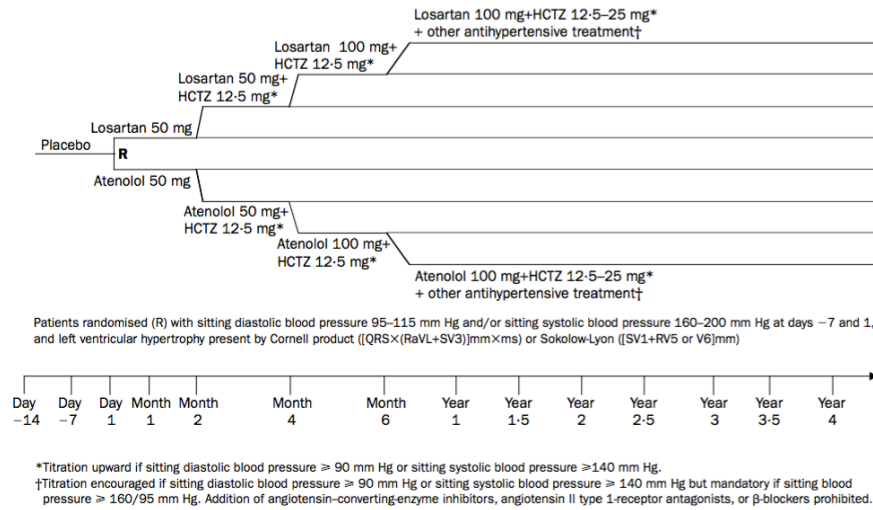


Figure 1: **Trial profile**  
ALT=alanine aminotransferase.

(7.64)

(MRAC\_23)

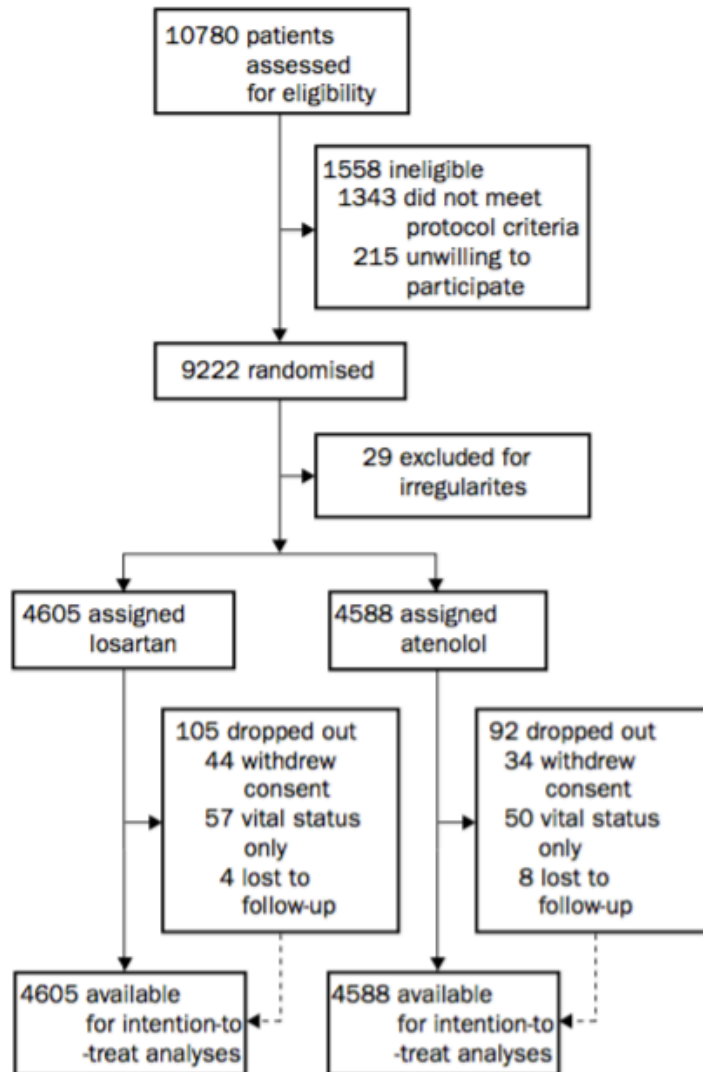
One exception here is MRAC\_06, which includes both a Methods flowchart and a Results flowchart (see (7.65) and (7.66), respectively). The flowchart in (7.65), one of only two organized horizontally in MRAC, provides a plan or schedule for how patients are to be categorized into treatment groups over time; it contains no data per se. The flowchart in (7.66) shows, among other things, specific patient numbers as a result of following the schedule. Seen from the perspective of genre, the Methods flowchart in (7.65) explains how material was selected and the Results flowchart in (7.66) shows the outcome or results of applying those selection criteria, a distinction that can be made at the level of the work.



(7.65)

Figure 1: Titration schedule and electrocardiography criteria  
 HCTZ=hydrochlorothiazide.

(MRAC\_06)



(7.66)

Figure 2: Trial profile

(MRAC\_06)

With regard to [engagement], Results flowcharts, like most visual inscriptions in MRAC, are ostensibly ‘monoglossic’. As works, they present a series of interrelated categories and numerical values that seem to represent a taken-for-granted, authoritative discourse in which, “for the brief textual moment” (Martin and White 2005, 99), no other voices or viewpoints are invoked. On closer inspection, however, certain episodes and figures within those works suggest readings that may be more multi-voiced. These include visual resources such as dashed arrows that indicate possibility, shapes and colours that create varying degrees of prominence, and episodes that run perpendicular and counter to vertically organised episode-nexuses, as well as verbal resources that counter or negate certain propositions.

### **7.3.4 Discussion Sections**

Discussion sections typically comprise several generic stages: reporting main findings (a reiteration of the Results section), exploring connections with the literature, explaining or discussing possible mechanisms or causes, discussing limitations, recommending possible applications and future research, and summarizing or concluding (see section 4.1.1). In MRAC, the Discussion section covers one to three pages, the start of which is marked *discussion* (n=44) or *commentary* (n=6; JAMA articles only).

Like Introduction sections, Discussions are characterized visually by verbiage and few or no inscriptions. Of the four visual inscriptions in MRAC Discussions, two are tables, one is a graph, and one is a key-messages box. Tables contribute to explaining possible mechanisms and study limitations as well as, in one case, providing a possible application for study findings (see example (7.67)); the graph reiterates the main findings (see (7.32), reproduced here as (7.68)); and the key-messages box contributes to summarizing the study (see (7.46), reproduced here as (7.69)).



**TABLE 4. EXPECTED NUMBER OF CARDIOVASCULAR EVENTS PREVENTABLE BY TREATING 1000 PATIENTS WITH PRAVASTATIN FOR FIVE YEARS.\***

EVENT	UNSELECTED PATIENTS	PATIENTS $\geq 60$ YR OF AGE	
		number	WOMEN
Fatal coronary heart disease	11	27	10
Clinical nonfatal myocardial infarction	26	46	83
Coronary-artery bypass grafting	25	32	34
Percutaneous transluminal coronary angioplasty	37	20	66
Stroke or transient ischemic attack	13	25	28
Other cardiovascular event	38	57	7
All cardiovascular events	150	207	228
Patients with $\geq 1$ event prevented	51	71	97

\*We assumed that pravastatin was given to three hypothetical groups of patients with a history of myocardial infarction and a total cholesterol level of less than 240 mg per deciliter: 1000 otherwise unselected patients, 1000 patients 60 or older, and 1000 female patients.

(7.67)

(MRAC\_35)

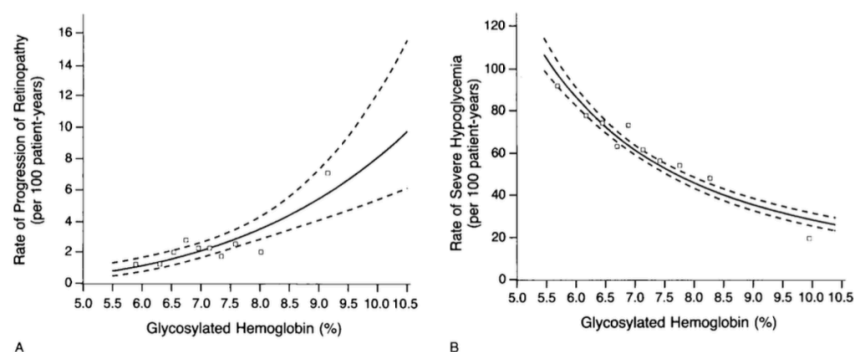


Figure 5. Risk of Sustained Progression of Retinopathy (Panel A) and Rate of Severe Hypoglycemia (Panel B) in the Patients Receiving Intensive Therapy, According to Their Mean Glycosylated Hemoglobin Values during the Trial.

Progression of retinopathy was defined as in the legend to Figure 2. In Panel A, the glycosylated hemoglobin values used were the mean of the values obtained every six months. In Panel B, the mean of the monthly values was used. Squares indicate the crude rates within deciles of the mean glycosylated hemoglobin values during the trial; each square corresponds to more than 400 patient-years. The solid lines are regression lines estimated as a function of the log of the mean glycosylated hemoglobin value in Panel A and the log of the glycosylated hemoglobin value in Panel B; the dashed lines are 95 percent confidence intervals.

(7.68)

(MRAC\_37)

published. Intensive retinopathic subgroup of the Follow-up Program tality.<sup>32</sup> reduction in the rate of or more steps using he 47% reduction in by three lines using change from 6/6 to n chart) suggests that also prevented the pathy, which is the n type 2 diabetes.<sup>33</sup> In y diabetic maculopa- equiring retinal pho- pathy responds less ion than proliferative . of maculopathy by ght provide a major c of blindness. To our 1 patients with type 2 od pressure control ations from diabetic

(7.69) 1 of patients in the

**Key messages**

- This study showed that tight control of blood pressure based on captopril or atenolol as first agents and aiming for both a systolic blood pressure < 150 mm Hg and diastolic pressure < 85 mm Hg achieved a mean 144/82 mm Hg compared with 154/87 mm Hg in a control group
- 29% of patients in the tight control group required three or more hypotensive treatments
- Tight control of blood pressure reduced the risk of any non-fatal or fatal diabetic complications and of death related to diabetes; deterioration in visual acuity was also reduced
- Reducing blood pressure needs to have high priority in caring for patients with type 2 diabetes

and in patients with type 1 diabetes with micro-albuminuria or established nephropathy.<sup>18 19</sup> Guidelines were formulated on the assumption that data relating to hypertensive non-diabetic subjects and

(MRAC\_40)

With regard to [engagement], the ‘rhythm’ or flow of the main verbiage in the Discussion is occasionally interrupted by subheadings, e.g. *strengths and limitations* and *conclusion*, typically making explicit the start of a new phase in the text and guiding readers through what is otherwise a relatively short stage in the research article. (Only seven MRAC articles contain subheadings in the Discussion.) More rarely, the ‘rhythm’ or flow of the verbiage is disrupted by visual inscriptions. These inscriptions have differing dialogic functionality, but all are highly marked or prominent. To take (7.67) above as an example, the table appears to be much the same as other tables in MRAC, with its typical major and minor episodes, variables and values, and the selective deployment of boldface and capitalization—a highly prominent but largely ‘monoglossic’ visual unit. However, on closer inspection, verbal elements within the table suggest a reading that is more dialogically ‘expansive’ than other tables in MRAC. The table-heading makes clear that what is presented are *expected* numbers (not actual numbers), and the conjoined footnote emphasizes assumptions made by the authors. The table essentially functions as a model that utilizes the predictive power of the study’s findings.

### 7.3.5 Abstracts

Abstracts in medical research articles typically comprise four main phases: stating the purpose of the study, recounting the methods, reporting results, and concluding. To these, we might also add identifying a problem and making recommendations (Salager-Meyer 1992, 96; see section 4.1.2). In the paper and PDF versions of MRAC, Abstracts typically occupy half a page and are separated from the rest of the text by horizontal and vertical lines and/or additional white space (see (7.70) below). The section is explicitly marked as *abstract* in 37 articles; seven use a different heading (*summary*), and six do not explicitly label the section (cf. (7.70)). All 50 research articles in MRAC include subheadings in bold, italic, or block-capital typeface, indicating the main phases in the Abstract, e.g. *background*, *objective*, *results*, and *conclusions*.

## Prevalence of Overweight and Obesity in the United States, 1999-2004

Cynthia L. Ogden, PhD  
Margaret D. Carroll, MSPH  
Lester R. Curtin, PhD  
Margaret A. McDowell, MPH, RD  
Carolyn J. Tabak, MD, MPH  
Katherine M. Flegal, PhD

**O**BESITY CONTINUES TO BE A leading public health concern in the United States.<sup>1,2</sup> Between 1980 and 2002, obesity prevalence doubled in adults aged 20 years or older and overweight prevalence tripled in children and adolescents aged 6 to 19 years.<sup>3,4</sup> This article provides the most recent prevalence estimates of overweight and obesity based on national measurements of weight and height in 2003-2004 and compares these estimates with estimates from 1999-2000 and 2001-2002 to determine if the trend is continuing.

### METHODS

Prevalence estimates of overweight and obesity were calculated using data from the National Health and Nutrition Examination Survey (NHANES), a complex, multistage probability sample of the US civilian, noninstitutionalized population.<sup>6</sup> Race/ethnicity was reported by survey participants. During a physical examination in a mobile examination center, height and weight were measured using standardized protocols and calibrated equipment. Body mass index (BMI) was calculated as weight in kilograms divided by the

See also pp 1539 and 1577.

**Context** The prevalence of overweight in children and adolescents and obesity in adults in the United States has increased over several decades.

**Objective** To provide current estimates of the prevalence and trends of overweight in children and adolescents and obesity in adults.

**Design, Setting, and Participants** Analysis of height and weight measurements from 3958 children and adolescents aged 2 to 19 years and 4431 adults aged 20 years or older obtained in 2003-2004 as part of the National Health and Nutrition Examination Survey (NHANES), a nationally representative sample of the US population. Data from the NHANES obtained in 1999-2000 and in 2001-2002 were compared with data from 2003-2004.

**Main Outcome Measures** Estimates of the prevalence of overweight in children and adolescents and obesity in adults. Overweight among children and adolescents was defined as at or above the 95th percentile of the sex-specific body mass index (BMI) for age growth charts. Obesity among adults was defined as a BMI of 30 or higher; extreme obesity was defined as a BMI of 40 or higher.

**Results** In 2003-2004, 17.1% of US children and adolescents were overweight and 32.2% of adults were obese. Tests for trend were significant for male and female children and adolescents, indicating an increase in the prevalence of overweight in female children and adolescents from 13.8% in 1999-2000 to 16.0% in 2003-2004 and an increase in the prevalence of overweight in male children and adolescents from 14.0% to 18.2%. Among men, the prevalence of obesity increased significantly between 1999-2000 (27.5%) and 2003-2004 (31.1%). Among women, no significant increase in obesity was observed between 1999-2000 (33.4%) and 2003-2004 (33.2%). The prevalence of extreme obesity (body mass index  $\geq 40$ ) in 2003-2004 was 2.8% in men and 6.9% in women. In 2003-2004, significant differences in obesity prevalence remained by race/ethnicity and by age. Approximately 30% of non-Hispanic white adults were obese as were 45.0% of non-Hispanic black adults and 36.8% of Mexican Americans. Among adults aged 20 to 39 years, 28.5% were obese while 36.8% of adults aged 40 to 59 years and 31.0% of those aged 60 years or older were obese in 2003-2004.

**Conclusions** The prevalence of overweight among children and adolescents and obesity among men increased significantly during the 6-year period from 1999 to 2004; among women, no overall increases in the prevalence of obesity were observed. These estimates were based on a 6-year period and suggest that the increases in body weight are continuing in men and in children and adolescents while they may be leveling off in women.

JAMA. 2006;295:1549-1555

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square of height in meters and was rounded to the nearest tenth.

The NHANES 2003-2004 overall response rate (of those originally selected for participation) was 68.6% (4742/6916) for adults aged 20 years or older and 83.2% (4105/4932) for

**Author Affiliations:** National Center for Health Statistics, Centers for Disease Control and Prevention, Hyattsville, Md (Drs Ogden, Carroll, Curtin, McDowell, Tabak, and Flegal), and Epidemic Intelligence Service, Centers for Disease Control and Prevention, Atlanta, Ga (Dr Tabak).

**Corresponding Author:** Cynthia L. Ogden, PhD, National Center for Health Statistics, Centers for Disease Control and Prevention, 3311 Toledo Rd, Room 4414, Hyattsville, MD 20782 (Cogden@cdc.gov).

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(7.70)

(MRAC\_26)

Abstracts in MRAC are reproduced in a different typeface and at a different font size from the verbiage in the main text. Sans-serif typefaces are used

in all PDF and paper versions of MRAC Abstracts; the main written text (excluding headings) is always in a serified typeface. The font size of Abstracts is generally smaller than the verbiage of the main text—usually the same size as reduced-font Methods sections, in articles where this applies (cf. section 7.3.2).

Abstracts are a highly salient part of the medical research article. They appear on the opening page of research articles, immediately below or adjacent to the title and author names and affiliations. Choices in typeface and size combined with framing resources such as vertical and horizontal lines and/or extra white spacing (cf. O’Toole 1994; see section 7.1) further emphasize this prominence. They also emphasize a distinction and potential separateness of the Abstract from the rest of the research article (cf. Lane 1992 and Gledhill 1995 on abstract as “péritexte”; section 4.1.2). Abstracts (as well as titles and author names) are often the only parts of the research article that are indexed in databases. As such, they are the most readily accessible parts of the text and usually the first point of contact for readers. They may also be the only part of the research article a reader engages with (ICMJE 2008, 12). For those who choose to read on, the Abstract provides a model for how the rest of the article might be read and a basis for alignment or disalignment with the textual voice.

From a visual perspective, the Abstract is not a research article in miniature (cf. previous chapter, in which verbal and mathematical [engagement] resources generally mirror those of the four main stages), since it contains no visual inscriptions, e.g. tables, graphs, and diagrams. While the prominence and importance of the section is expressed visually, through choices in positioning, framing, and foregrounding, specific instances of [entertain] and [disclaim] expressed in the visual inscriptions and discussed at length in section 7.2 are not reproduced visually in the Abstract.

## **7.3.6 Other Stages of the Medical Research Article**

### **7.3.6.1 Titles**

As the opening segment of the HTML version of MRAC\_23 demonstrates (see (7.71)), two of the most prominent parts of the research article are the article title and the journal name. The same is also true of the PDF and

paper versions (see (7.72)). With regard to [engagement], the high saliency of these visual verbal units ‘proclaims’ their relative importance or attention-worthiness. Those ‘proclamations’ represent the subjectivity of the textual voice (see sections 6.1.1.2 and 7.2.1.2), but it is a subjectivity that is clearly multifaceted. It is not the authors’ voice alone, or the voice of the editors, designers, typesetters, or printers, but an amalgamation of those involved in producing the text. Note that, in (7.72), the journal logo is one of only a few instances of colour in the article. Its visual prominence, together with the journal title, acts as a seal of approval, ‘proclaiming’ a certain authority for the article and ‘attributing’ that authority to the source journal (cf. use of drop-cap discussed in section 7.3.1).

The screenshot shows the ScienceDirect interface for an article in 'THE LANCET'. The article title is 'Peginterferon alfa-2b plus ribavirin compared with interferon alfa-2b plus ribavirin for initial treatment of chronic hepatitis C: a randomised trial'. The authors listed are Prof Michael P Manns MD, John G McHutchison MD, Stuart C Gordon MD, Vinod K Rustgi MD, Mitchell Shiffman MD, Robert Reindollar MD, Zachary D Goodman MD, Kenneth Koury PhD, Mei-Hsiu Ling PhD, and Janice K Albrecht PhD. The article is from Volume 358, Issue 9286, 22 September 2011, Pages 958-965. The DOI is https://doi.org/10.1016/S0140-6736(11)08102-5. The article is categorized under 'Articles' and has a 'Summary' section. The background section states: 'A sustained virological response (SVR) rate of 41% has been achieved with interferon alfa-2b plus ribavirin therapy of chronic hepatitis C. In this randomised trial, peginterferon alfa-2b plus ribavirin was compared with interferon alfa-2b plus ribavirin.' The methods section is also visible. The interface includes navigation options like 'Download PDF', 'Export', and 'Search ScienceDirect'. There are also sections for 'Recommended articles', 'Citing articles (5583)', 'Article Metrics', 'Captures', 'Mentions', 'References', and 'Social Media'.

(7.71)

(MRAC\_23)

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EFFECTS OF AN ANGIOTENSIN-CONVERTING-ENZYME INHIBITOR, RAMIPRIL,  
ON CARDIOVASCULAR EVENTS IN HIGH-RISK PATIENTS

THE HEART OUTCOMES PREVENTION EVALUATION STUDY INVESTIGATORS\*

**ABSTRACT**

**Background** Angiotensin-converting-enzyme inhibitors improve the outcome among patients with left ventricular dysfunction, whether or not they have heart failure. We assessed the role of an angiotensin-converting-enzyme inhibitor, ramipril, in patients who were at high risk for cardiovascular events but who did not have left ventricular dysfunction or heart failure.

**Methods** A total of 9297 high-risk patients (55 years of age or older) who had evidence of vascular disease or diabetes plus one other cardiovascular risk factor and who were not known to have a low ejection fraction or heart failure were randomly assigned to receive ramipril (10 mg once per day orally) or matching placebo for a mean of five years. The primary outcome was a composite of myocardial infarction, stroke, or death from cardiovascular causes.

The trial was a two-by-two factorial study evaluating both ramipril and vitamin E. The effects of vitamin E are reported in a companion paper.

**Results** A total of 651 patients who were assigned to receive ramipril (14.0 percent) reached the primary end point, as compared with 826 patients who were assigned to receive placebo (17.8 percent) (relative risk, 0.78; 95 percent confidence interval, 0.70 to 0.86;  $P < 0.001$ ). Treatment with ramipril reduced the rates of death from cardiovascular causes (6.1 percent, as compared with 8.1 percent in the placebo group; relative risk, 0.74;  $P < 0.001$ ), myocardial infarction (9.9 percent vs. 12.3 percent; relative risk, 0.80;  $P < 0.001$ ), stroke (3.4 percent vs. 4.9 percent; relative risk, 0.68;  $P < 0.001$ ), death from any cause (10.4 percent vs. 12.2 percent; relative risk, 0.84;  $P = 0.005$ ), revascularization procedures (16.0 percent vs. 18.3 percent; relative risk, 0.85;  $P = 0.002$ ), cardiac arrest (0.8 percent vs. 1.3 percent; relative risk, 0.63;  $P = 0.03$ ), heart failure (9.0 percent vs. 11.5 percent; relative risk, 0.77;  $P < 0.001$ ), and complications related to diabetes (6.4 percent vs. 7.6 percent; relative risk, 0.84;  $P = 0.03$ ).

**Conclusions** Ramipril significantly reduces the rates of death, myocardial infarction, and stroke in a broad range of high-risk patients who are not known to have a low ejection fraction or heart failure. (N Engl J Med 2000;342:145-53.)

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**A**LTHOUGH dyslipidemia, diabetes, smoking, and hypertension are major risk factors for cardiovascular disease, they do not fully account for the risk. Therefore, other risk factors must be identified in order to reduce mortality and morbidity even further. Epidemiologic and experimental data suggest that activation of the renin-angiotensin-aldosterone system has an important role in increasing the risk of cardiovascular events.<sup>1</sup> Angiotensin-converting-enzyme inhibitors block the activation of the renin-angiotensin system and could retard the progression of both heart failure and atherosclerosis. In a meta-analysis of three studies<sup>2,3</sup> that included more than 9000 patients with low ejection fractions, treatment with angiotensin-converting-enzyme inhibitors reduced the risk of myocardial infarction by 23 percent. This finding, which has not been widely accepted, was independent of the ejection fraction, the cause of heart disease, concomitant use of medications, diabetes status, and blood pressure, suggesting that angiotensin-converting-enzyme inhibitors may have a role in preventing myocardial infarction in a broad range of patients, not just those with low ejection fractions. Angiotensin-converting-enzyme inhibitors may also reduce the risk of stroke, by lowering blood pressure, and may prevent complications related to diabetes.<sup>4</sup> These hypotheses require direct confirmation in prospective, randomized clinical trials.

Therefore, in a high-risk population, we evaluated the effects of an angiotensin-converting-enzyme inhibitor, ramipril, in preventing the primary out-

Address reprint requests to Dr. Salim Yusuf at the Canadian Cardiovascular Collaboration Project Office, Hamilton General Hospital, 237 Barton St. E., Hamilton, ON L8L 2X2, Canada, or at [hope@ccc.mcmaster.ca](mailto:hope@ccc.mcmaster.ca).  
The writing group (Salim Yusuf, D.Phil., Peter Sleight, D.M., Janice Pogue, M.Sc., Jackie Bosch, M.Sc., Richard Davies, Ph.D., and Gilles Dagenais, M.D.) assumes responsibility for the overall content and integrity of the manuscript.

\*The investigators are listed in the Appendix.

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(7.72)

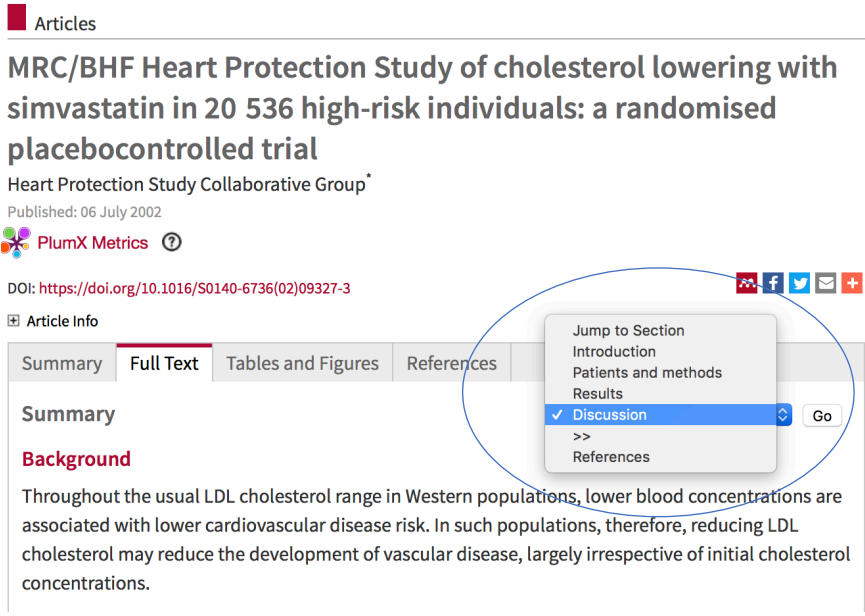
(MRAC\_50)

**7.3.6.2 Acknowledgments and Appendices**

Acknowledgments and Appendices function in similar ways in MRAC: both typically acknowledge and/or thank study participants and collaborators for their roles in the research. Visually, these sections are backgrounded by placing them at the end of articles and at a lower font size than the main text in PDF and paper versions. They are generally considered ancillary to or even separate from the medical research article, as is often reflected in their omission from genre studies (see section 4.1.2 for review). This is also reflected in example (7.73), from the HTML version of one of the MRAC articles, in which a *Jump to Section* scroll-down menu (circled in blue for reference) includes links to only the four main sections and the reference list; there are no links to the Appendix, Acknowledgements, or



Conflict-of-Interest sections of the article.<sup>161</sup> Acknowledgements and Appendices in MRAC do not generally contain visual inscriptions, although it is not uncommon for medical research articles to include large tables of data in Appendices (ICMJE 2008, 13).<sup>162</sup>



The screenshot shows the top portion of a research article page. At the top left, there is a red square icon followed by the word 'Articles'. Below this is the article title: 'MRC/BHF Heart Protection Study of cholesterol lowering with simvastatin in 20 536 high-risk individuals: a randomised placebocontrolled trial'. Under the title, it says 'Heart Protection Study Collaborative Group' and 'Published: 06 July 2002'. There is a 'PlumX Metrics' icon and a DOI link: 'https://doi.org/10.1016/S0140-6736(02)09327-3'. A navigation bar contains tabs for 'Summary', 'Full Text', 'Tables and Figures', and 'References'. A dropdown menu is open over the 'References' tab, listing sections: 'Introduction', 'Patients and methods', 'Results', 'Discussion' (which is selected and highlighted in blue), '>>', and 'References'. A 'Go' button is next to the dropdown. The 'Summary' section is partially visible, starting with the heading 'Background' and the text: 'Throughout the usual LDL cholesterol range in Western populations, lower blood concentrations are associated with lower cardiovascular disease risk. In such populations, therefore, reducing LDL cholesterol may reduce the development of vascular disease, largely irrespective of initial cholesterol concentrations.'

(7.73) (MRAC\_03)

### 7.3.6.3 References

References and reference lists are central to and characteristic of academic writing. They represent an explicit form of [engagement] that ‘acknowledges’ and ‘attributes’ the work of others. In medical research articles, references lists are expected to be relatively short—LAN, for example, suggests a cap of 30 references (LAN 2018a)—and ICMJE (2008, 13) argues that “extensive lists of references to original work on a topic can use excessive space on the printed page”. In MRAC, reference lists are placed at the end of research articles and at a reduced font size. From a dialogic perspective, this conventionalized, relatively low visual prominence emphasizes how readers might expect and be expected to engage with references—as ‘attributions’, ‘endorsements’, and ‘justifications’ that are auxiliary to claims made by the textual voice in the

<sup>161</sup> The symbol >> is a separator between the four main sections and the references; it does not perform a hyperlink function.

<sup>162</sup> The only exception in MRAC is MRAC\_01, which contains two numerical images in its Appendix (see chapter 8).

main body of the research article. There are no visual inscriptions in the reference sections of MRAC.

#### 7.3.6.4 Conflict of Interest and Role of the Funding Source

Conflict-of-Interest (COI) and Role-of-the-Funding-Source (ROFS) sections are disclosures of any positions or relations that could “inappropriately influence (bias)” researchers’ actions and more generally “undermine the credibility of the journal, the authors, and of science itself” (ICMJE 2008, 4). Those disclosures include “financial relationships” as well as “personal relationships, academic competition, and intellectual passion” (ICMJE 2008, 4). Like References, Acknowledgments, and Appendices, COI and ROFS statements in MRAC are reproduced at smaller font sizes than the four main sections of the research article (see (7.74)). While they are important parts of the research articles they appear in, COI and ROFS statements are subordinate and ancillary to the main body of text. In terms of [engagement], their inclusion helps maintain trust and credibility in the scientific process, acting as a potential ‘endorsement’ of the study and the integrity of the textual voice.

*Conflict of interest statement*

K Kristiansson is a Merck employee and was a non-voting member of the steering committee.

*Acknowledgments*

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(7.74)

(MRAC\_06)



### 7.3.7 Summary

From a visual perspective, the Introduction, Results, and Discussion sections of MRAC seem to be given greater prominence than MRAC Methods. MRAC Titles and Journal Names are also highly prominent relative to Acknowledgments, Appendices, and References. MRAC Abstracts, while usually reproduced at a smaller font size than Introductions, Results, and Discussions, are given greater prominence than Acknowledgments, Appendices, and References by virtue of their placement and framing. Visually, then, Titles, Abstracts, Introductions, Results, and Discussions are ‘proclaimed’ more important or worthier of attention than other sections of MRAC.

The distribution of visual inscriptions across MRAC articles suggests that tables, graphs, and diagrams belong almost exclusively to the domain of Methods and Results, with the majority of tables and graphs appearing in the presenting-data phase of the Results section. The dialogic status of visual inscriptions within those sections varies, but the overall effect, i.e. at the level of the image as work, is ostensibly one of [monogloss]. While tables and graphs in Methods and Results are similar in their apparent [monogloss], at a more delicate level visual inscriptions in Results sections tend to demonstrate more [heterogloss], especially through the use of mathematical resources. Inscriptions in Introduction and Discussion sections, while relatively rare, tend to be more ‘heteroglossic’ than those in Methods and Results.

Images in Introduction and Discussion sections seem to have greater potential for disalignment than those in Methods and Results. Unlike images in MRAC Methods and Results, images in MRAC Introductions and Discussions are rarely transformations of measurements and observations made directly in the laboratory or clinic. Rather, they represent generalized models of description or prediction that may be based on empirical data, but that are not a direct transformation of those data. Such images imply a more overtly subjective position and one that may be more at odds with the ostensibly objective, empirically driven basis of the majority of inscriptions in medical research articles. Introduction and Discussion sections do not profess to be data driven in the same way as Methods and Results—and readers are likely to

understand that—but the relative conspicuousness of images in those sections and the more subjective positions they imply make the likelihood of disalignment greater than in other stages or phases of the medical research article.

## 7.4 Contextual Variables

A number of contextual parameters were annotated in MRAC (see section 5.2.1). In this section, I discuss the potential effects of those parameters on choices of visual [engagement].

### 7.4.1 Year of Publication

Table 7.1 shows the distribution of visual inscriptions according to year of publication.<sup>163</sup> The greatest numbers of visual inscriptions per research article are in the years 1998 and 2002; the lowest numbers of visual inscriptions are in 1994 and 2000. Year-on-year values suggest no general pattern of increase or decrease in the number of inscriptions per research article over time.

Table 7.1. Number of visual inscriptions per research article (RA) according to year of publication.

Year	No. of inscriptions	No. of RAs	No. of inscriptions/RA
1991	27	4	6.75
1992	6	1	6.00
1993	27	4	6.75
1994	17	3	5.67
1995	14	2	7.00
1996	30	4	7.50
1997	7	1	7.00
1998	99	12	8.25
1999	6	1	6.00
2000	11	2	5.50
2001	45	7	6.43
2002	51	6	8.50
2003	0	0	0

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<sup>163</sup> Inscriptions include tables, graphs, diagrams, photomicrographs, offset mathematical equations, and key-message boxes.

Year	No. of inscriptions	No. of RAs	No. of inscriptions/RA
2004	12	2	6.00
2005	0	0	0
2006	6	1	6.00
<b>Total</b>	<b>358</b>	<b>50</b>	<b>7.16</b>

Visual inscriptions in MRAC Introductions and Discussions are all published in the 1990s (1993, 1994, 1996, and 1998), with the exception of the blood-vessel diagram discussed above, which is from 2001. Those generally more subjectivized images, which typically construe dialogic ‘expansion’ through [entertain] and [suggest] (see sections 7.3.1 and 7.3.4), are not only rare; their distribution according to year of publication may also indicate that they are becoming rarer.

#### 7.4.2 Source Journal

Among the 358 visual inscriptions in MRAC, 220 are published in NEJM, 82 in LAN, 44 in JAMA, and 12 in BMJ. The average number of visual inscriptions per research article for each source journal is 6.11 for NEJM, 11.71 for LAN, 7.33 for JAMA, and 12.00 for BMJ. The high average number of inscriptions in LAN and BMJ may be indicative of the harder science in those journals or those particular articles (cf. Latour 1990, Smith et al. 2000, Arsenault, Smith, and Beauchamp 2006).

NEJM articles published up to and including 2002 (n=34) have Methods sections that are reproduced at a smaller font size than the Introduction, Results, and Discussion. While the reasons for this reduced prominence are not clear (see section 7.3.2), the dialogic implication is that the voices in that particular section are backgrounded relative to the rest of the main text, complementing the ostensibly ‘monoglossic’ inscriptions typical of that section. In all MRAC source journals, Abstracts, Acknowledgments, Appendices, and References in paper and PDF articles are reproduced at a smaller and/or different (sans-serif) typeface from the standard used for Introductions, Results, and Discussions.

Although colour (beyond black and white) is something of a rarity in MRAC inscriptions (29 of 358 visual inscriptions are reproduced in colour), there is a difference in the use of colour in the four source journals. LAN articles contain no colour inscriptions, and JAMA contains just one.

NEJM and BMJ include 19 and nine colour inscriptions, respectively. Colour in BMJ and JAMA inscriptions is primarily used indexically, to distinguish different episodes, and follows the colour profile of the respective journals (see, for example, (7.21)). Colour in NEJM inscriptions does this, too, but it is also used for stain diagrams and other forms of (semi-)naturalistic representation (see, for example, (7.29) and (7.31)).

### **7.4.3 Author Affiliation**

MRAC articles written by researchers based primarily in the United States contain 203 visual inscriptions. For transnational research groups, the number is 45, for the United Kingdom 58, for Canada 10, for Australia six, for Belgium six, for Finland six, for France six, for the Netherlands six, and for Sweden 12. The average numbers of inscriptions per article according to affiliation is US 6.55, UK 9.00, Canada 5.00, Australia 6.00, Belgium 6.00, Finland 6.00, France 6.00, the Netherlands 6.00, and Sweden 12.00. The Sweden article, MRAC\_06, contains two flowcharts, five graphs, and five tables. MRAC\_44, one of the UK articles, contains one flowchart, six graphs, four numerical-graphical hybrids, and three tables. In each case, all but one of the visual inscriptions are found in the Results section (the other visual inscriptions are in the Methods). None are found in Introduction and Discussion sections. In general terms, these visual inscriptions are primarily ‘monoglossic’ and data driven. However, instances of visual [heterogloss] include [disclaim: counter] episodes in flowcharts, [proclaim] resources that highlight and contrast figures and episodes in graphs and tables, and [entertain] expressed by mathematical resources and error-bars in tables and numerical-graphical hybrids.

### **7.4.4 MeSH Major Topic Key Words**

The number of visual inscriptions per article according to the major topic areas identified in section 6.3.4 are as follows: HIV/AIDS, 5.00; obesity/overweight, 6.83; diabetes mellitus, 8.00; hypertension, 8.00; heart failure/disease, 7.62. The highest concentration of graphical and figurative images is found in diabetes mellitus articles (5.10 per research article), with the lowest in HIV/AIDS (2.00 per research article). Heart failure/disease contains the most numerical images per research article

(4.38 per research article); the fewest numerical images are found in diabetes mellitus (2.80 per research article).

Based on visual measures of scientific hardness proposed by Latour (1990), Smith et al. (2000), and Arsenault et al. (2006), diabetes mellitus articles are 'suggestive' of a relatively hard science, while HIV/AIDS articles are 'suggestive' of a softer science (see section 7.2.2.3). However, the use of colour across the five major topic areas in MRAC 'suggests' a greater interdiscursive influence from popular science and other non-scientific domains on diabetes (1.10 colour inscriptions per article) compared with the other topic areas (average 0.32 colour inscriptions per article) (cf. Rowley-Jolivet 2004, 153, Herrando-Rodrigo 2010, 269).

#### **7.4.5 Publication Type**

Randomized controlled trials contain on average 7.27 visual inscriptions per article. Multicentre and comparative studies contain 7.24 and 8.85 visual inscriptions per article, respectively. The average for MRAC articles not categorized as RCT, multicentre, or comparative studies is 6.85 visual inscriptions per article.

Inscriptions in articles categorized as RCT, multicentre, or comparative studies are typically 'monoglossic' tables and graphs. Colour used in those inscriptions is primarily for distinguishing episodes, but one of the images is the blood-vessel diagram discussed above. Other inscriptions that contain colour and naturalistic representations, e.g. stain images, are not part of RCT, multicentre, or comparative studies.

#### **7.4.6 On the Possible Effects of Contextual Variables**

In MRAC, year of publication has limited effect on the construal of visual [engagement], with the exception of the change made in 2003 to increase the font size of NEJM Methods, adding greater prominence to the section. The use of colour in NEJM articles is noteworthy with regard to prominence and with regard to a potentially more subjectivized position, one that may be more 'suggestive' of other, non-scientific domains. The numbers and types of visual inscriptions differ according to affiliation, with articles from the United Kingdom and Sweden containing considerably more visual inscriptions than articles from other regions.

Those inscriptions are primarily graphs and tables that are ostensibly ‘monoglossic’. Certain MeSH key words imply different types and realizations of visual [engagement], with heart failure/disease articles seemingly more ‘suggestive’ of hard science than the other major topic areas represented by MRAC. RCT, multicentre, and comparative studies contain more visual inscriptions and are visually more ‘monoglossic’ than articles not categorized as such.

The article containing most visual inscriptions in MRAC, MRAC\_44 (n=14), was published in LAN in 1998 by researchers based primarily in the United Kingdom. The article investigates the risk of complications among diabetic patients assigned different treatment regimens. The study is a comparative RCT. In contrast, none of the MRAC articles containing fewest inscriptions—MRAC\_05, MRAC\_14, MRAC\_29, and MRAC\_41 (all n=4)—are published in LAN or by researchers based in the United Kingdom, and only one (MRAC\_41) is categorized as a comparative RCT. The four articles deal with obesity, diabetes and heart disease, gastric carcinoma, and carotid stenosis (narrowing of the carotid artery), respectively.

## **7.5 Disciplinarity and Ideology**

Visually, MRAC articles appear to be primarily ‘monoglossic’, especially with regard to visual inscriptions, with instances of [heterogloss] largely instantiated in episodes, figures, and figure-parts within more ostensibly ‘monoglossic’ works. This differs somewhat from verbal and mathematical [engagement], in which [heterogloss] predominates (see chapter 6). Choices of visual [engagement] in MRAC imply a discourse in which a backdrop of other voices, positions, and propositions is not generally invoked. This may be in contradistinction to the findings of chapter 6, but visual display plays a crucial role in construing for the text the authoritative position that Bakhtin (1981 [1935], 351) identifies as being central to scientific thought. Bakhtin (1981 [1935], 342) describes this as a “prior discourse” whose authority is already established—or “taken for granted”, to use Martin and White’s (2005) terminology. The ostensible

[monogloss] of graphs and tables in MRAC can be seen as a visual expression of that authoritative discourse.<sup>164</sup>

The apparent contradiction between a primarily ‘heteroglossic’ verbal and mathematical text and a primarily ‘monoglossic’ visual text largely disappears when one considers MRAC articles from a generic perspective. Here, the [monogloss] of graphs and tables complements the relative [monogloss] of the Methods and Results, strengthening the claim made in section 6.4 that different generic stages and phases of MRAC articles construe potentially different epistemological positions and writer–reader relations as the text unfolds. The Methods and Results are a textual instantiation of research as action, where the graphs and tables produced, along with the verbiage, are an artefact or documentation of actual laboratory or clinical activities as well as an idealized account of the discipline-specific work carried out by researchers (see Lynch 1985, 57–58). Tables and graphs allow objects of interest to be perceived and analysed (Lynch 1985, 37) and can give the impression that the objects and relations they represent are inherently mathematical (Lynch 1990, 169). In contrast, Introduction and Discussion sections, with fewer visual inscriptions but more overt visual [heterogloss], construe for the text a discourse in which other voices and other positions are invoked, and one in which the singular discourse of mathematics plays a lesser role.

The instantiation of visual [engagement] in MRAC seems to be determined primarily by an abstract/technological coding orientation (Bernstein 1981, Kress and van Leeuwen 1996, 2006, van Leeuwen 1999). Semiotic choices are valued by the extent to which they can represent the generalizable rather than the specific, and the schematic rather than the naturalistic, e.g. colour-coding and lines of best fit. However, there are also certain choices of visual [engagement], e.g. a broad palette of colours and the iconic representation of certain figures, that suggest a more sensory or naturalistic coding orientation. Overall, while an abstract/technological coding orientation arguably predominates, certain semiotic choices at certain points in the text imply a hybrid set of regulative principles that are dynamic and seem to be influenced by other discursive fields.

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<sup>164</sup> That authority can be questioned, of course, even if it is framed as ‘taken for granted’.

## 7.6 Visual Engagement: Summary and Discussion

This chapter shows how [engagement], as set out in the work of O'Toole (1994), Economou (2009), and others, is realized and instantiated visually in a corpus of medical research articles (MRAC). Most instances of [engagement] seem to be 'monoglossic' (i.e. single-voiced), especially for visual inscriptions, with relatively few instances of [heterogloss] (i.e. other-voicedness).

Like verbal and mathematical [engagement], visual [engagement] in MRAC varies in scope. An ostensibly 'monoglossic' work, for example, may include 'heteroglossic' episodes, figures, and/or figure-parts, allowing those meanings to overlap and interact according to a hierarchy that, generally, follows the rank scale for visual display.

As MRAC texts unfold, the instantiation and realization of visual [engagement] changes. Titles are highly salient and 'proclaim' a certain importance or warrantability; Abstracts are also highly salient as a visual unit, but do not mirror the instantiation of visual [engagement] otherwise seen in Introductions, Methods, Results, and Discussions; Introductions are made salient by their positioning and use of drop-caps, but generally lack visual inscriptions; Methods are characterized by ostensibly 'monoglossic' inscriptions, but the section as a whole is given relatively low prominence compared with the Introduction, Results, and Discussion; Results contain the greatest number of inscriptions, the majority of which construe a relatively 'monoglossic' position; Discussions are dominated by visual verbal units, with relatively few inscriptions; Acknowledgments, Appendices, and References have low prominence and are backgrounded compared with other sections.

Among the contextual variables investigated, the only discernible change in the instantiation or realization of visual [engagement] over time concerned the increased prominence of NEJM Methods from 2003. With regard to source journal, NEJM includes more colour inscriptions per article than the other source journals, especially inscriptions that construe 'heteroglossic' meanings such as [entertain] and [proclaim] (e.g. stain images, gene diagrams, and the blood-vessel diagram). Researchers based in the United Kingdom and Sweden use a greater number of visual inscriptions than researchers in other regions, but there is no noticeable



difference in the kinds of [engagement] construed regionally other than the [monogloss] associated with increased numbers of graphs and tables. Based on graph and table use, articles dealing with diabetes mellitus are more 'suggestive' of hard science than the other major topics identified in MRAC; in contrast, articles dealing with HIV/AIDS seem more 'suggestive' of softer science. Articles in MRAC categorized as multicentre, comparative, and/or clinical randomized controlled trials have more inscriptions and more instances of visual [engagement], especially [monogloss], than those not categorized as such.

Overall, the findings in this chapter suggest a collection of texts that, taken as a whole and considered from a visual perspective, tend to be 'monoglossic'. Solidarity between the textual voice and the reader is generally maintained throughout the texts, with very few instances of potential disalignment, even in instances of more subjectivized representations.



## 8 Intersemiotic Engagement

In this chapter, I examine [engagement] from an intersemiotic perspective, by considering how verbal and nonverbal resources are co-deployed and integrated. Sections 8.1–8.4 examine intersemiotic [engagement] in a single text, while section 8.5 takes a broader approach, looking at intersemiotic [engagement] across the various generic stages and phases of MRAC as a whole.

The chapter begins with a description of the single text in question, MRAC\_01 (section 8.1). This is followed by an analysis and discussion of the deployment and distribution of verbal, mathematical, and visual [engagement] in the text (sections 8.2 and 8.3) and how those resources work together to construe for the text a background of different voices and positions (section 8.4). Section 8.5 examines intersemiotic [engagement] from a generic perspective, considering how the instantiation of [engagement] evolves as MRAC texts unfold. The analyses in sections 8.4 and 8.5 provide the basis for a discussion of the potential relations between intersemiotic [engagement] and the disciplines and ideologies of medical research (section 8.6). The chapter concludes with a summary of the main findings (section 8.7).<sup>165</sup>

### 8.1 MRAC\_01

MRAC\_01 is a multicentre, clinical, randomized controlled trial examining the effects of a particular drug—drotrecogin alfa (activated) or recombinant human activated protein C—on the rate of death among patients with severe sepsis. The article was published in NEJM in 2001, by researchers based primarily in the United States (six of the 11 authors work at institutions in the US). MRAC\_01 contains 6046 word-tokens (1666 word-types), eight numerical images, and three graphical images, including the blood-vessel diagram discussed in chapter 7. In its paper and PDF versions, the article comprises 11 pages.

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<sup>165</sup> Parts of this chapter are based on Fryer (2019).

## 8.2 Verbal and Mathematical Engagement in MRAC\_01

There are 208 instances of verbal and mathematical [engagement] in MRAC\_01. Most of those resources are ‘heteroglossic’, with relatively few instances of [monogloss]. Among the ‘heteroglossic’ meanings instantiated in MRAC\_01, the majority are dialogically ‘expansive’ [entertain] and [acknowledge], typically realized or signalled by superscript numbers, *p*, *risk*, *if*, and *may*. Among the most common instances of dialogic ‘contraction’ are [deny] and [endorse], typically realized by *not* and *non-*, and *finding*, *find*, *indicate*, *demonstrate*, and *show*. The article contains no instances of [pronounce], [concede], or [distance]. Figure 8.1 summarizes selections of verbal and mathematical [engagement] in MRAC\_01.

In terms of genre, the distribution of verbal and mathematical [engagement] varies across different generic stages of the article. Most instances of [engagement] are found in the Introduction and Discussion sections, with considerably fewer instances in the Methods, Results, and Abstract. The Title and Acknowledgments contain no instances of [engagement]. The greatest amount of [heterogloss] appears in the Introduction; the greatest amount of [monogloss] in the Abstract. At more delicate levels of the system, there are notable differences in the instantiation of specific [engagement] features, e.g. [deny] in the Introduction and Discussion (0.00 and 11.51 instances per 1000 words, respectively), [counter] in the Introduction, Methods, and Abstract (5.10, 0.00, and 0.00 instances per 1000 words, respectively), [endorse] in the Abstract and Discussion (0.00 and 12.79 instances per 1000 words, respectively), and [acknowledge] in the Introduction and Results (28.06 and 0.00 instances per 1000 words). Choices of realization also differ according to generic stage. Examples include frequent selections of [entertain *may*] in the Introduction and [entertain *p*] in the Results, and frequent selections of [deny *un-*] in the Methods and [deny *not*] in the Discussion.

Overall, the instantiation, realization, and distribution of verbal and mathematical [engagement] in MRAC\_01 closely resembles that for MRAC as a whole (see chapter 6). A summary of [engagement] across the main generic stages of MRAC\_01 is shown in Figure 8.1.

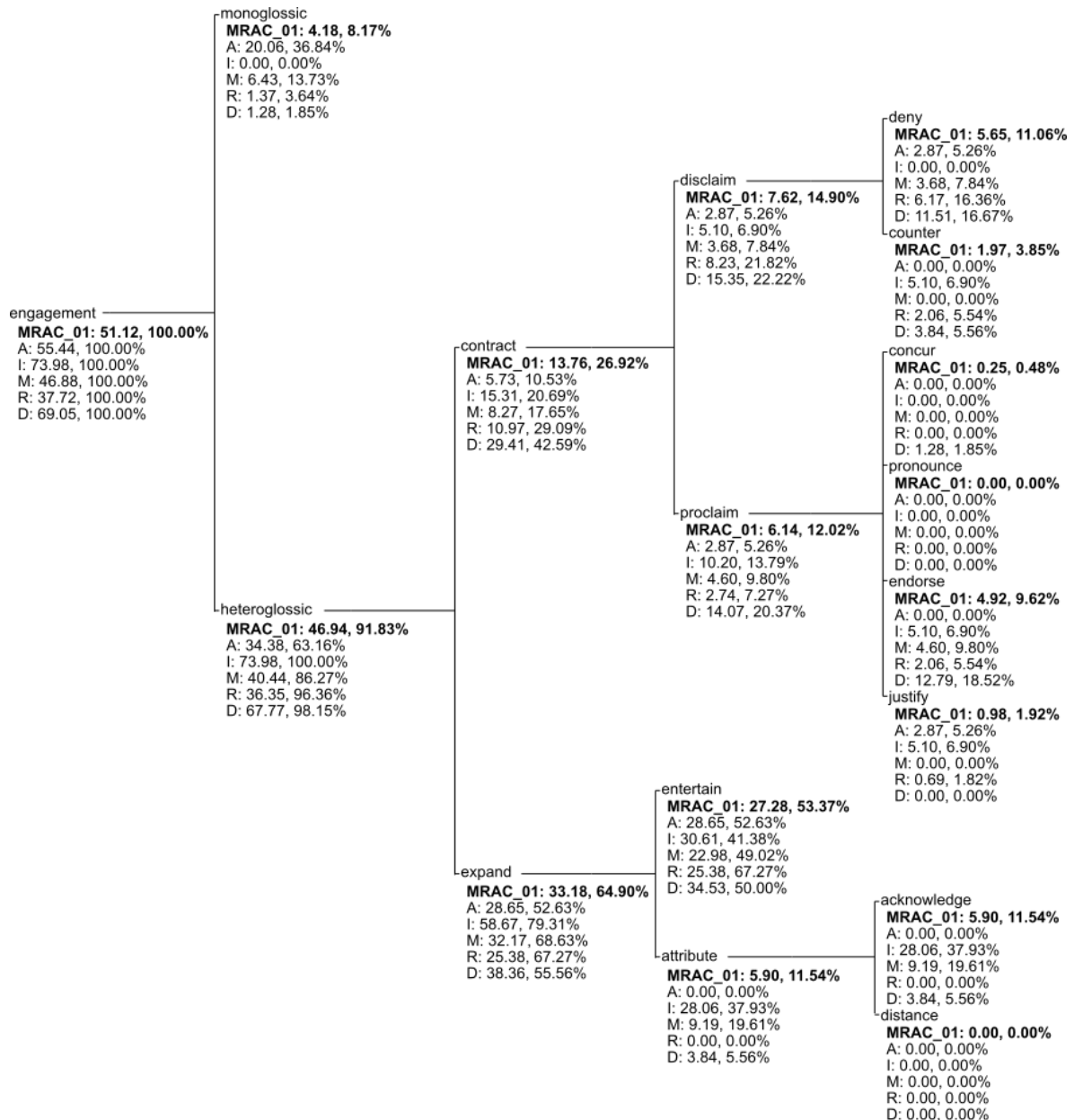


Figure 8.1. Visual and mathematical [engagement] in MRAC\_01: instances per 1000 words, global selection probabilities (%). A: Abstract; I: Introduction; M: Methods; R: Results; D: Discussion.

### 8.3 Visual Engagement in MRAC\_01

The visibility of MRAC\_01 is characterized by verbiage and other inscriptions of varying prominence. Those degrees of prominence, and the relative importance such prominence might 'proclaim' for different parts of the text, are affected by choices of typeface, formatting, size, positioning, framing, and colour. Among the highly prominent visual elements in MRAC\_01 are the placement of a notice at the top of the opening page

above the Title (PDF only), the block capitals and high central placement of the Title, the sans-serif typeface and use of bold in the Abstract, the four-line drop-cap and caps-first-word of the Introduction (paper and PDF only), a full-colour, full-page graphical image in the Introduction, and a series of single- and double-column tables and graphs in the Results and Appendix.<sup>166</sup>

The visual inscriptions in MRAC\_01 are characterized by their relative [monogloss]—i.e. their somewhat typical-for-science representations (cf. Economou 2009)—but one image in particular, the blood-vessel diagram (see, for example, (7.8)), contains several episodes and figures that clearly construe [heterogloss], especially [proclaim] and [entertain] (see sections 7.2.1.2 and 7.2.2.1), and that [suggest] a set of semiotic choices that are partially characteristic of other domains or image-types (see section 7.2.2.3). It is in this respect that visual [engagement] in MRAC\_01 differs most from MRAC as a whole.

## **8.4 Intersemiotic Engagement in MRAC\_01**

### **8.4.1 Reading Paths**

Certain texts—tightly packed written texts or conventionalized comic strips, for example—may be designed to be read in a linear fashion, from left to right and from top to bottom, one line or panel at a time (Kress and van Leeuwen 2006, 204).<sup>167</sup> Others, including scientific articles, may be designed to allow for multiple reading paths, which permit or encourage the reader to move more freely across the text. That freedom is not unlimited, and the composition of a page typically sets up hierarchies of prominence that make some readings more likely than others. In the case of a scientific text, the preferred reading path may be a relatively linear one, but the footnotes and visual inscriptions, the headed sections and subsections, allow the reader to navigate the text according to interest, looking first, perhaps, at tables and graphs before examining the written text, or moving back and forth between sections (Lemke 1998, 95). An

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<sup>166</sup> In the paper and PDF versions of MRAC\_01, the Methods section is reproduced at a smaller font size than the Introduction, Results, and Discussion (see section 7.3.2).

<sup>167</sup> Conventions vary, of course, but I am thinking in particular here of English as a left–right, top–bottom writing system.

expert reader with particular interests is likely to follow a different reading path from a nonexpert reader or an expert reader with other interests. Medium and materiality also affect possible reading paths, with paper, PDF, and HTML versions of articles all having different potentials for engagement (cf. Kress and van Leeuwen 2001, chapter 4). As a nonexpert or peripheral reader (see section 5.4), the analysis I offer here is one based on a relatively linear reading path that largely follows a left-to-right, top-to-bottom, column-by-column direction, but may occasionally be disrupted by verbal references to visual elements or by the presence of visual inscriptions that encourage the reader to move back and forth across the text in a potentially nonlinear manner.

#### 8.4.2 A Close Reading of Selected Passages from MRAC\_01

The PDF version of MRAC\_01 starts with a visual verbal unit—an announcement—at the top of the opening page, placed directly above the title (see title page in (8.1)).<sup>168</sup> The size of the typeface in the announcement is the same as that of the title, but the formatting is in sentence case rather than block capitals. The importance or warrantability ‘proclaimed’ for this highly prominent visual unit is also signalled verbally. The text reads: *Notice: Because of its possible clinical implications, this article is being released before its publication date. The report will be published on March 8.* The scope of this visual-verbal ‘proclamation’, which also includes a verbal ‘justification’ for the advanced publication of the article, is not restricted to the announcement itself.<sup>169</sup> Rather, it extends or projects over the entire article, making explicit a sense of urgency and importance for the text that is not specified elsewhere in MRAC. A reader of the PDF version of MRAC\_01, one who begins from the top of the first page, is made immediately aware of this importance, and their reading is likely to be affected by that.<sup>170</sup>

<sup>168</sup> The announcement is not part of the paper and HTML versions of MRAC\_01.

<sup>169</sup> Note, also, how the ‘justification’ includes [entertain *possible*], allowing for a diversity of propositions and positions concerning the clinical implications of the study.

<sup>170</sup> The claim of warrantability is made by the textual voice, but it is a part of the textual voice that differs from that of the rest of the article. The announcement is primarily representative of the journal editors (an editorial stance or key; cf. Martin and White 2005,

Notice: Because of its possible clinical implications, this article is being released before its publication date. The report will be published on March 8.

EFFICACY AND SAFETY OF RECOMBINANT HUMAN ACTIVATED PROTEIN C FOR SEVERE SEPSIS

GORDON R. BERNARD, M.D., JEAN-LOUIS VINCENT, M.D., PH.D., PIERRE-FRANCOIS LATERRE, M.D., STEVEN P. LA ROSA, M.D., JEAN-FRANCOIS DHAINAUT, M.D., PH.D., ANGEL LOPEZ-RODRIGUEZ, M.D., JAY S. STEINGRUB, M.D., GARY E. GARBER, M.D., JEFFREY D. HELTERBRAND, PH.D., E. WESLEY ELY, M.D., M.P.H., AND CHARLES J. FISHER, JR., M.D., FOR THE RECOMBINANT HUMAN ACTIVATED PROTEIN C WORLDWIDE EVALUATION IN SEVERE SEPSIS (PROWESS) STUDY GROUP\*

ABSTRACT

**Background** Drotrecogin alfa (activated), or recombinant human activated protein C, has antithrombotic, antiinflammatory, and profibrinolytic properties. In a previous study, drotrecogin alfa activated produced dose-dependent reductions in the levels of markers of coagulation and inflammation in patients with severe sepsis. In this phase 3 trial, we assessed whether treatment with drotrecogin alfa activated reduced the rate of death from any cause among patients with severe sepsis.

**Methods** We conducted a randomized, double-blind, placebo-controlled, multicenter trial. Patients with systemic inflammation and organ failure due to acute infection were enrolled and assigned to receive an intravenous infusion of either placebo or drotrecogin alfa activated (24 µg per kilogram of body weight per hour) for a total duration of 96 hours. The prospectively defined primary end point was death from any cause and was assessed 28 days after the start of the infusion. Patients were monitored for adverse events; changes in vital signs, laboratory variables, and the results of microbiologic cultures; and the development of neutralizing antibodies against activated protein C.

**Results** A total of 1690 randomized patients were treated (840 in the placebo group and 850 in the drotrecogin alfa activated group). The mortality rate was 30.8 percent in the placebo group and 24.7 percent in the drotrecogin alfa activated group. On the basis of the prospectively defined primary analysis, treatment with drotrecogin alfa activated was associated with a reduction in the relative risk of death of 19.4 percent (95 percent confidence interval, 6.6 to 30.5) and an absolute reduction in the risk of death of 6.1 percent (P=0.005). The incidence of serious bleeding was higher in the drotrecogin alfa activated group than in the placebo group (3.5 percent vs. 2.0 percent, P=0.06).

**Conclusions** Treatment with drotrecogin alfa activated significantly reduces mortality in patients with severe sepsis and may be associated with an increased risk of bleeding.

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SEVERE sepsis, defined as sepsis associated with acute organ dysfunction, results from a generalized inflammatory and procoagulant response to an infection.<sup>1</sup> The rate of death from severe sepsis ranges from 30 to 50 percent despite advances in critical care.<sup>2,5</sup> In the United States, approximately 750,000 cases of sepsis occur each year, at least 225,000 of which are fatal.<sup>6</sup>

The inflammatory and procoagulant host responses to infection are closely related.<sup>7</sup> Inflammatory cytokines, including tumor necrosis factor α, interleukin-1β, and interleukin-6, are capable of activating coagulation and inhibiting fibrinolysis, whereas the procoagulant thrombin is capable of stimulating multiple inflammatory pathways.<sup>7,11</sup> The end result may be diffuse endothelial injury, multiorgan dysfunction, and death. Activated protein C, an endogenous protein that promotes fibrinolysis and inhibits thrombosis and inflammation, is an important modulator of the coagulation and inflammation associated with severe sepsis (Fig. 1).<sup>18</sup> Activated protein C is converted from its inactive precursor, protein C, by thrombin coupled to thrombomodulin.<sup>18</sup> The conversion of protein C

From the Division of Allergy, Pulmonary and Critical Care Medicine, Vanderbilt University School of Medicine, Nashville (G.R.B., E.W.E.); the Department of Intensive Care, Erasme University Hospital, Brussels, Belgium (J.-L.V.); the Department of Critical Care and Emergency Medicine, Cliniques Universitaires St. Luc, Brussels, Belgium (P.-F.L.); Lilly Research Laboratories, Eli Lilly, Indianapolis (S.F.L., J.D.H., C.J.E.); the Department of Intensive Care, Godijn-Port Royal University Hospital, Paris V University, Paris (J.E.D.); the Unidad de Cuidados Intensivos, Servicio de Medicina Intensiva, Hospital Infanta Cristina, Badajoz, Spain (A.L.-R.); the Critical Care Division, Baystate Medical Center, Springfield, Mass., and Tufts University School of Medicine, Boston (J.S.S.); and the Division of Infectious Diseases, University of Ottawa, Ottawa Hospital, Ottawa, Ont., Canada (G.E.G.). Address reprint requests to Dr. Bernard at the Division of Allergy, Pulmonary and Critical Care Medicine, Department of Medicine, T-1208 Medical Center North, Vanderbilt University School of Medicine, Nashville, TN 37232, or at gordon.bernard@mcmail.vanderbilt.edu.

\*Additional institutions and investigators participating in the study are listed in Appendix 3.

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(8.1)

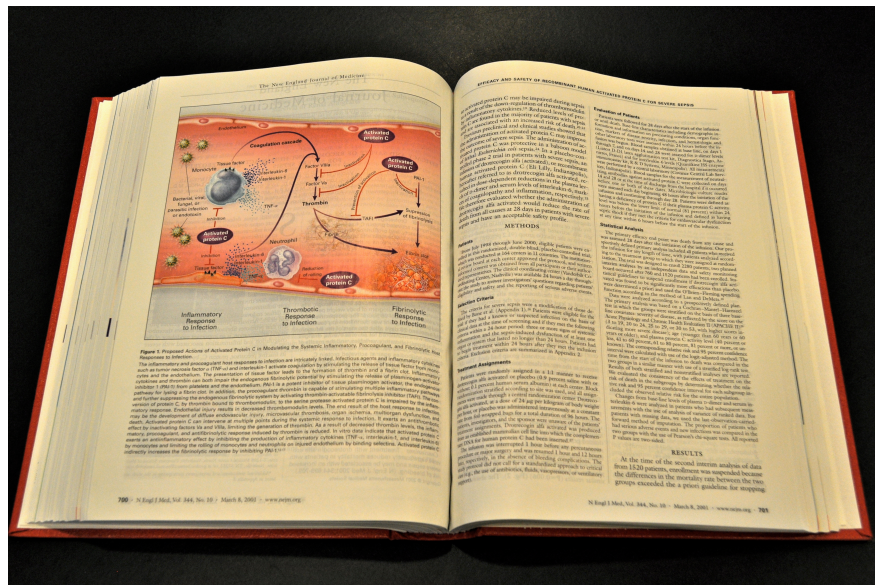
(MRAC\_01)

As discussed in the previous chapter and in section 8.3, MRAC\_01 contains a visual inscription that, in many respects, stands apart from other visual inscriptions in MRAC. The blood-vessel diagram discussed in chapter 7 is reproduced overleaf in its paper, PDF, and HTML 2013 and 2019 editions (examples (8.2), (8.3), (8.4), and (8.5), respectively), showing some of its co-textual environment. Its prominence in MRAC\_01, and in MRAC as a whole, makes it a prime example for discussing in more detail the intersemiotic realization of [engagement] and issues relating to the

163-164); the rest of the article is primarily representative of the authors (an authorial stance or key).

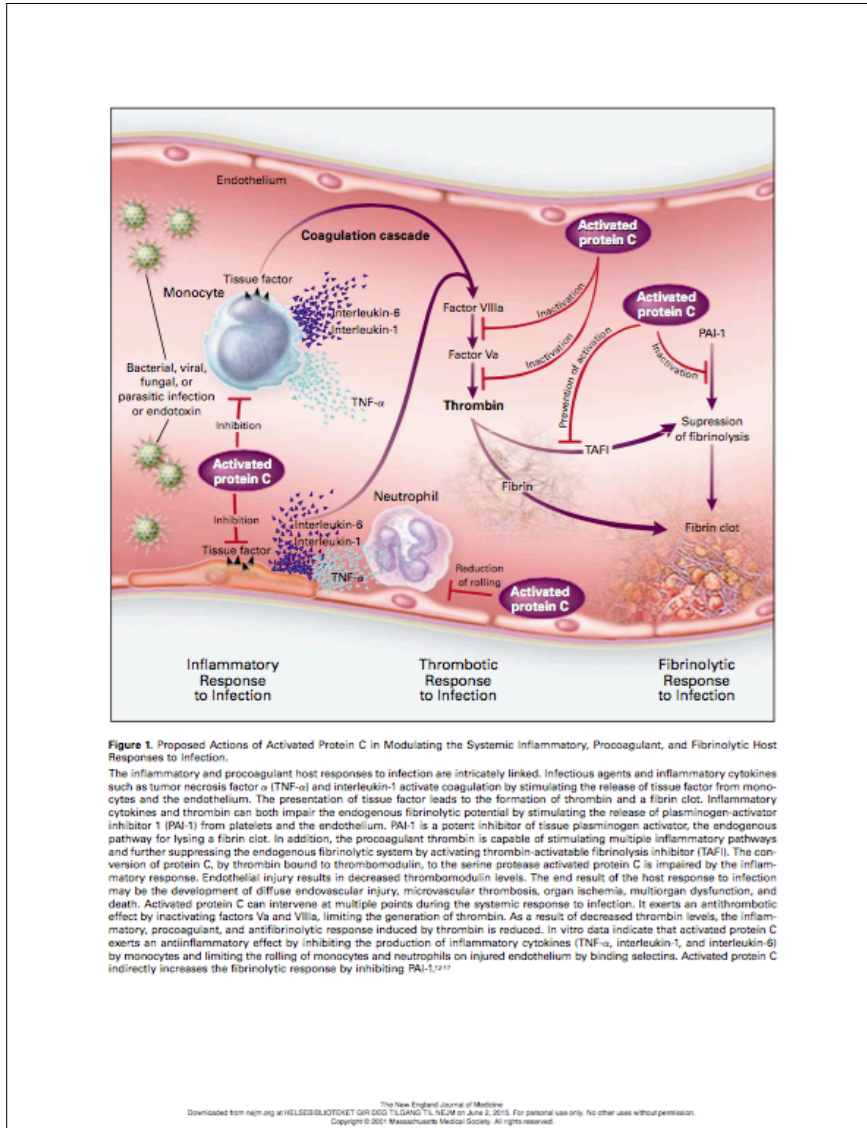


(non)linearity of reading paths in medico-scientific texts (see Fryer 2019 and section 8.4.1).



(8.2)

(MRAC\_01)



(8.3)

(MRAC\_01)

(8.4)

The screenshot shows the top portion of a NEJM article page. At the top left is the NEJM logo and the journal title. Below it are navigation tabs for 'HOME', 'ARTICLES & MULTIMEDIA', 'ISSUES', 'SPECIALTIES & TOPICS', 'FOR AUTHORS', and 'CME'. A search bar is on the right. The main heading is 'ORIGINAL ARTICLE' followed by the title 'Efficacy and Safety of Recombinant Human Activated Protein C for Severe Sepsis'. Below the title is the author list and a DOI link. A 'Share' button with social media icons is present. On the right side, there are 'TOOLS' (PDF, Print, Download Citation, E-Mail, Save, Article Alert, Reprints, Permissions, Share/Bookmark) and 'RELATED ARTICLES' (Editorial, Correspondence, Topics, More In). At the bottom right, there is a 'TRENDS Most Viewed (Last Week)' section and an 'ORIGINAL ARTICLE' label.

(MRAC\_01)

(8.5)

The screenshot shows the text and Figure 1 of the article. The text begins with 'SEVERE SEPSIS, DEFINED AS SEPSIS ASSOCIATED WITH ACUTE ORGAN DYSFUNCTION, results from a generalized inflammatory and procoagulant response to an infection.' It discusses the inflammatory and procoagulant host responses to infection and the role of activated protein C. Figure 1 is a diagram titled 'Proposed Actions of Activated Protein C in Modulating the Systemic Inflammatory, Procoagulant, and Fibrinolytic Host Responses to Infection.' It shows a complex network of interactions between various proteins and pathways. On the right side, there is a 'Medical Director' section with a 'Notable Articles of 2018' collection and a 'Sign up for the free NEJM Weekly Table of Contents email' button. Below that is a 'More Research' section with several article links.

(MRAC\_01)

As can be seen in (8.2)–(8.5), these four versions of MRAC\_01 differ in their materiality and layout, and in the “items” (Kok 2004, O’Halloran 2005), “clusters” (Baldry and Thibault 2006), or “focus groups” (Painter, Martin, and Unsworth 2013) that predominate in each version. A reader is likely to engage with these texts in different ways. For example, in (8.2), the full-colour image may not be immediately visible to the reader, appearing as it does on the second (verso) page of the article. Only after turning the title

page is the image fully revealed.<sup>171</sup> This is also the case for the PDF version in (8.3), since the reader must scroll before seeing the image for the first time. The 2013 HTML version in (8.4) shows the image as a thumbnail and is likely to be immediately visible to the reader upon accessing the article. In the 2019 HTML version in (8.5), the reader has to scroll or move via hyperlink to the Introduction or select the *Figures/Media* tab on the top right of the screen before seeing the image.

With these different materials, layouts, and potential reading paths in mind, we might assume that, upon seeing the full-colour image for the first time, the reader immediately engages and interacts with it in some way, however fleetingly. For readers of the HTML version of MRAC\_01, this is likely to happen before they see or read the verbal reference to the image in the Introduction. For the paper and PDF versions, the reader is more likely to read the verbal reference before seeing the image, since the verbal reference appears on the previous page. The verbal reference to the image is reproduced in (8.6); it can also be seen in the right-hand column of (8.1).

- (8.6) Activated protein C, an endogenous protein that promotes fibrinolysis and inhibits thrombosis and inflammation, is an important modulator of the coagulation and inflammation associated with severe sepsis (Figure 1).<sup>18</sup>  
(MRAC\_01)

Already, a potentially crucial difference in the reading of the image and the kind of [engagement] construed becomes apparent. The [monogloss] of the verbal prompt in the main text (see (8.6)) emphasizes the role and importance of activated protein C in response to sepsis. The image caption, however—see (8.7)—opens with a ‘heteroglossic’ statement that emphasizes a more subjective position and encourages a reading that is potentially more tentative than definitive. For a brief textual moment, the two readings, based on the PDF/paper and HTML versions, may differ: one shows what happens, the other shows what might happen. For some readers, such a reading—the ‘monoglossic’, definitive one—may not create a lasting (or, indeed, any) impression. Nevertheless, it serves as an

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<sup>171</sup> There is in fact considerable show-through due to paper type and low grammage (< 80 g/m<sup>2</sup>), so the colour image is partially discernible from the title page.

interesting example of how verbal and visual semiotics combined with the alternative reading paths offered by different materials and layouts might affect reader engagement.<sup>172</sup>

- (8.7) Figure 1. Proposed Actions of Activated Protein C in Modulating the Systemic Inflammatory, Procoagulant, and Fibrinolytic Host Responses to Infection. The inflammatory and procoagulant host responses to infection are intricately linked. Infectious agents and inflammatory cytokines such as tumor necrosis factor  $\alpha$  (TNF- $\alpha$ ) and interleukin-1 activate coagulation by stimulating the release of tissue factor from monocytes and the endothelium. The presentation of tissue factor leads to the formation of thrombin and a fibrin clot. Inflammatory cytokines and thrombin can both impair the endogenous fibrinolytic potential by stimulating the release of plasminogen-activator inhibitor 1 (PAI-1) from platelets and the endothelium. PAI-1 is a potent inhibitor of tissue plasminogen activator, the endogenous pathway for lysing a fibrin clot. In addition, the procoagulant thrombin is capable of stimulating multiple inflammatory pathways and further suppressing the endogenous fibrinolytic system by activating thrombin-activatable fibrinolysis inhibitor (TAFI). The conversion of protein C, by thrombin bound to thrombomodulin, to the serine protease activated protein C is impaired by the inflammatory response. Endothelial injury results in decreased thrombomodulin levels. The end result of the host response to infection may be the development of diffuse endovascular injury, microvascular thrombosis, organ ischemia, multiorgan dysfunction, and death. Activated protein C can intervene at multiple points during the systemic response to infection. It exerts an antithrombotic effect by inactivating factors Va and VIIIa, limiting the generation of thrombin. As a result of decreased thrombin levels, the inflammatory, procoagulant, and antifibrinolytic response induced by thrombin is reduced. In vitro data indicate that activated protein C exerts an antiinflammatory effect by inhibiting the production of inflammatory cytokines (TNF- $\alpha$ , interleukin-1, and interleukin-6) by monocytes and limiting the rolling of monocytes and neutrophils on injured endothelium by binding selectins. Activated protein C indirectly increases the fibrinolytic response by inhibiting PAI-1.<sup>12-17</sup>

(MRAC\_01)

Returning to the verbal prompt in the Introduction (see (8.6) above), the reader seems to be faced with three, somewhat idealized choices: 1) to click on the reference to the diagram (*Figure 1*), or scroll, swipe, or page-turn to the appropriate place; 2) to click on the reference to the external source (superscript *18*), or scroll, swipe, or page-turn to the appropriate

<sup>172</sup> It also raises the interesting question of whether we are dealing with different versions of the same text, or whether, from a multimedial perspective, we may wish to treat these as different texts—different instantiations—of the same work.

place; or 3) to read the next sentence. Three different reading paths are ‘entertained’ based on a single proposition, creating a “heteroglossic space” (Tan 2010, 98) in which the reader is actively engaged in determining how the text unfolds. Assuming option 1 is the preferred reading path—preferred, that is, by the textual voice—we might expect the reader to go to the diagram (by clicking, scrolling, swiping, or page-turning). There, the reader is *shown*, after having been *told*, how important activated protein C is. (“You doubt what I say? I’ll show you,” as Latour (1990, 38) puts it.) This “show and tell” exchange continues as the reader engages with the caption, moving back and forth between the caption and the diagram, as the caption explains (in considerable detail; see (8.7) above) how the diagram should be read, potentially fixing, anchoring, or ‘proclaiming’ the validity of certain meanings or interpretations over visually invoked alternatives in the image. Indeed, much of what appears in the caption is repetition of what appears in the second paragraph of the Introduction. Both texts describe the processes by which inflammation, coagulation, and fibrinolysis (might) occur, helping to reinforce or complement certain ‘monoglossic’ and ‘heteroglossic’ positions in the text. Compare, for example, the [heterogloss] in (8.8) and (8.9) from the second paragraph of the Introduction and the diagram-caption, respectively.

(8.8) The end result may be diffuse endovascular injury, multiorgan dysfunction, and death.

(MRAC\_01)

(8.9) The end result of the host response to infection may be the development of diffuse endovascular injury, microvascular thrombosis, organ ischemia, multiorgan dysfunction, and death.

(MRAC\_01)

A multisemiotic analysis of the dialogic space created around the diagram in (8.2)–(8.5) shows how that space varies, not just from the perspective of different readers and their differing interests and experiences, but also from the perspective of layout and materiality and the different prompts those choices imply. While the diagram might generally be treated as a model that ‘entertains’ what happens or what usually happens in the event of sepsis and its treatment with activated protein C (see visual analysis in

chapter 7 and Fryer 2019), it can also be read in a more ‘monoglossic’ or dialogically ‘contractive’ sense, especially (in the case of the latter) if we consider the effect of the projected visual-verbal ‘proclamation’ at the start of the article.

As demonstrated above, one of the ways of exploring relations between verbal and visual elements in texts is to look at how images are integrated into the text through language, by explicit verbal reference to and comment on visual inscriptions (cf. Matthiessen 2009, 19, and section 2.2.2.3). There are several additional examples of this in MRAC\_01 that I examine in more detail below.

Although the Methods section of MRAC\_01 contains no visual inscriptions, it does contain two verbal references to visual inscriptions in the Appendix (see (8.10)). Those inscriptions are both tables. However, they differ from other tables in MRAC by virtue of their being primarily verbal rather than numerical images (cf. Rowley-Jolivet’s 2002, 2004 categorization of images in scientific texts). An example of one of those tables is provided in (8.11).

- (8.10) The criteria for severe sepsis were a modification of those defined by Bone et al. (Appendix 1).<sup>26</sup> Patients were eligible for the trial if they had a known or suspected infection on the basis of clinical data at the time of screening and if they met the following criteria within a 24-hour period: three or more signs of systemic inflammation and the sepsis-induced dysfunction of at least one organ or system that lasted no longer than 24 hours. Patients had to begin treatment within 24 hours after they met the inclusion criteria. Exclusion criteria are summarized in Appendix 2.

(MRAC\_01)

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**APPENDIX 2. SUMMARY OF EXCLUSION CRITERIA.**

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Pregnancy or breast-feeding  
 Age <18 yr or weight >135 kg  
 Platelet count <30,000/mm<sup>3</sup>  
 Conditions that increased the risk of bleeding: surgery requiring general or spinal anesthesia within 12 hours before the infusion, the potential need for such surgery during the infusion, or evidence of active bleeding postoperatively; a history of severe head trauma requiring hospitalization, intracranial surgery, or stroke within 3 months before the study or any history of intracerebral arteriovenous malformation, cerebral aneurysm, or mass lesions of the central nervous system; a history of congenital bleeding diatheses; gastrointestinal bleeding within 6 weeks before the study unless corrective surgery had been performed; and trauma considered to increase the risk of bleeding  
 Known hypercoagulable condition, including resistance to activated protein C; hereditary deficiency of protein C, protein S, or antithrombin III; presence of anticardiolipin antibody, antiphospholipid antibody, lupus anticoagulant, or homocysteinemia; or recently documented (within 3 months before the study) or highly suspected deep-vein thrombosis or pulmonary embolism  
 Patient's family, physician, or both not in favor of aggressive treatment of patient or presence of an advanced directive to withhold life-sustaining treatment  
 Patient not expected to survive 28 days because of uncorrectable medical condition, such as poorly controlled neoplasm or other end-stage disease  
 Moribund state in which death was perceived to be imminent  
 Human immunodeficiency virus infection in association with a last known CD4 count of  $\leq 50/\text{mm}^3$   
 History of bone marrow, lung, liver, pancreas, or small-bowel transplantation  
 Chronic renal failure requiring hemodialysis or peritoneal dialysis\*  
 Known or suspected portosystemic hypertension, chronic jaundice, cirrhosis, or chronic ascites  
 Acute pancreatitis with no established source of infection  
 Participation in another investigational study within 30 days before the current study  
 Use of any of the following medications or treatment regimens: unfractionated heparin to treat an active thrombotic event within 8 hours before the infusion†; low-molecular-weight heparin at a higher dose than recommended for prophylactic use (as specified in the package insert) within 12 hours before the infusion; warfarin (if used within 7 days before study entry and if the prothrombin time exceeded the upper limit of the normal range for the institution); acetylsalicylic acid at a dose of more than 650 mg/day within 3 days before the study; thrombolytic therapy within 3 days before the study‡; glycoprotein IIb/IIIa antagonists within 7 days before study entry; antithrombin III at a dose of more than 10,000 U within 12 hours before the study; or protein C within 24 hours before the study

\*Acute renal failure was not an exclusion criterion.

†Prophylactic treatment with a dose of unfractionated heparin of up to 15,000 U per day was permitted.

(8.11) ‡Thrombolytic agents were permitted for the treatment of thromboses within a catheter.

(MRAC\_01)

The first reference in (8.10) ‘attributes’ part of Appendix 1 to some external voice (*Bone et al* and superscript 26). The textual voice continues by summarizing some of the main inclusion criteria. Here, the textual voice ‘entertains’ the possibility of alternative propositions (e.g. *if they had a known or suspected infection...*) and highlights the criteria it deems most relevant to the communicative context, essentially a ‘pronouncement’ in which some criteria from the Appendix are made explicit in the Methods section, while others are not. In the second reference in (8.10), Appendix 2 is not explicitly attributed to any external source, and the textual voice provides no guide as to which criteria are most relevant or important to the current communicative context. The placement of both tables in the Appendix implies that they are considered “[e]xtra or supplementary” material that need “not interrupt the flow of the text” (ICMJE 2008, 13). More generally, their placement in the Appendix complements the general



backgrounding effect of the reduced-font Methods in the paper and PDF versions of MRAC\_01, and the relative [monogloss] of the Methods section remains largely unaffected by the potential [heterogloss] of the atypical, non-numerical tables in the Appendix ([entertain] in Economou 2009).

As noted in section 8.3, the majority of visual inscriptions in MRAC\_01 are found in the Results section. All those inscriptions are reproduced in black and white. The tables in the Results section have more or less the same layout: a column of variables or characteristics, a column of numerical values for those variables for patients given placebo, and a similar column for those given activated protein C (see example in (8.12)).<sup>173</sup> Similarly, graphs in MRAC\_01 present visualized numerical changes in dependent variables over time according to the administration of placebo or activated protein C (see, for example, (8.13)).

**TABLE 3.** BASE-LINE LEVELS OF INDICATORS OF COAGULATION AND INFLAMMATION.\*

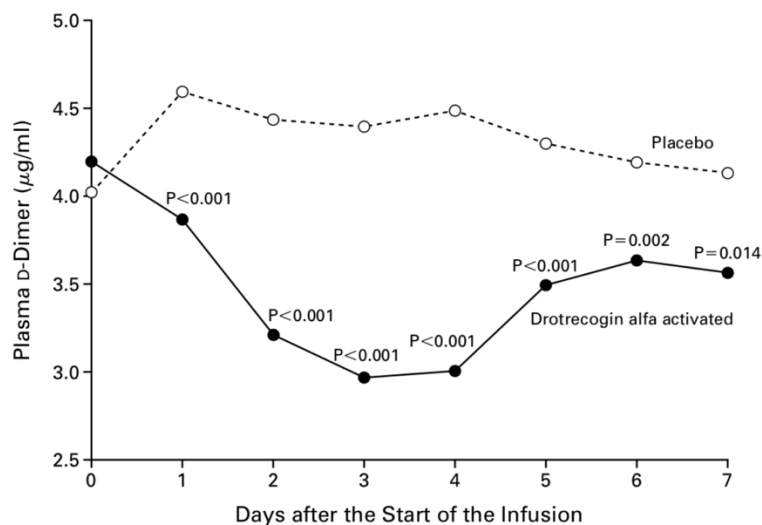
VARIABLE	PLACEBO GROUP	DROTRECIGIN ALFA ACTIVATED GROUP
Plasma D-dimer		
No. of patients	758	792
Median level ( $\mu\text{g/ml}$ )	4.15	4.22
Interquartile range ( $\mu\text{g/ml}$ )	2.18–8.65	2.28–8.11
Serum interleukin-6		
No. of patients	808	827
Median level (pg/ml)	484	497
Interquartile range (pg/ml)	129–2540	153–2701
Plasma protein C activity		
No. of patients	775	799
Median level (%)	50	47
Interquartile range (%)	33–68	30–63
Protein C deficiency (% of patients)		
Yes	79.8	83.4
No	12.5	10.6
Unknown	7.7	6.0

\*The normal range of D-dimer levels is 0.0 to 0.39  $\mu\text{g}$  per milliliter. The normal range of interleukin-6 levels is 0.38 to 10.09 pg per milliliter. The normal range of protein C activity is 81 percent to 173 percent. A deficiency of protein C was defined as an activity level of less than 81 percent.

(8.12)

(MRAC\_01)

<sup>173</sup> Two of the five tables in MRAC\_01 Results contain an additional column of selected *p*-values.



**Figure 3.** Changes in Median Plasma D-Dimer Levels in 770 Patients with Severe Sepsis in the Drotrecogin Alfa Activated Group and 729 Patients in the Placebo Group.

Only patients with base-line values and at least one subsequent value were included in the analysis. The P values are for the comparison with the placebo group.

(8.13)

(MRAC\_01)

Verbal references to tables 1–3 are made in one and the same paragraph (see (8.14)). Here, the textual voice invites the reader to examine the data in the tables and, at the same time, highlights certain numerical values and their relations, construing from a dialogic perspective similar kinds of [entertain] + [pronounce] pairings as identified in (8.10). Taking *Table 3* as an example (see (8.12)), we see that the verbal invitation in (8.14) to examine the data creates a ‘heteroglossic’ space in which certain parts of the ostensibly ‘monoglossic’ table are highlighted or ‘proclaimed’ as being particularly noteworthy. Those ‘proclamations’ or ‘pronouncements’, however, are not instantiated verbally (the propositions referring to *Table 3* are all bare assertions); rather, they are the consequence of a combination of verbal, numerical, and visual resources, none of which independently are likely to be understood as emphasizing some maximally warrantable position or proposition.

(8.14) At base line, the demographic characteristics and severity of disease were similar in the placebo group and the drotrecogin alfa activated group (Table 1). Approximately 75 percent of the patients had at least two dysfunctional organs or systems at the time of enrollment. The lungs and the abdomen were the most common sites of infection, occurring in 53.6 percent and 19.9 percent of the patients, respectively, in the two groups combined (Table 2). The incidence of gram-positive and gram-negative infections was similar within each group

and between the two groups. Base-line levels of indicators of coagulopathy and inflammation were also similar in the two groups (Table 3). Protein C deficiency was present in 87.6 percent of the patients (1379 of 1574) for whom levels were obtained. In addition, plasma D-dimer and serum interleukin-6 levels were elevated in 99.7 and 98.5 percent of the patients, respectively. Among treated patients, 82.4 percent of those in the placebo group and 81.8 percent of those in the drotrecogin alfa activated group received at least 90 percent of the intended infusion and 8.2 percent and 6.4 percent, respectively, died during the 96-hour period of infusion.

(MRAC\_01)

Verbal reference to *Fig. 3* in MRAC\_01 (see (8.13) above) is made two pages before the graph itself, partly it seems because of the large number of visual inscriptions in the Results section and the amount of space those inscriptions occupy relative to the verbiage. The paragraph in which verbal reference is made to *Fig. 3* is reproduced in (8.15). Before inviting the reader to examine the data presented in *Fig. 3*, the paragraph begins by highlighting a particular reading, namely that plasma D-dimer levels were significantly lower among patients taking drotrecogin alfa activated (activated protein C) than among patients taking placebo. While this may seem like an obvious interpretation of the data, other readings, such as the difference was greater on days 2–4 or that plasma D-dimer levels among patients taking drotrecogin alfa activated decrease and then increase, are not acknowledged; this is not primarily what the reader is being encouraged to focus on. Like the previous example, the textual voice privileges one reading over another, potentially contracting the dialogic space for alternative interpretations of the data. This dialogic ‘contraction’ is not construed verbally (the opening sentence in (8.15) is ‘monoglossic’ or undialogized); it results from a combination of verbal, mathematical, and visual resources. Interestingly, the data described in the second sentence of (8.15) are not presented graphically, though obviously they could have been. One might argue, using this as an example, that the meaning of a text, the way that text engages its readers, is not only a matter of what the writer chooses to instantiate, but also what the writer chooses not to instantiate in a particular text (cf. Halliday’s discussion of choice in section 2.2.1.1.4; Halliday 2013, 25–26).

- (8.15) Plasma D-dimer levels were significantly lower in patients in the drotrecogin alfa activated group than in patients in the placebo group on days 1 through 7 after the start of the infusion (Fig. 3). Decreases in serum interleukin-6 levels were significantly greater in the patients in the drotrecogin alfa activated group than in the patients in the placebo group on day 1 ( $P=0.009$ ) and on days 4, 5, 6, and 7 ( $P=0.025$ ,  $P=0.017$ ,  $P=0.016$ , and  $P=0.022$ , respectively).

(MRAC\_01)

Although the Discussion section of MRAC\_01 contains no visual inscriptions and no verbal references to inscriptions elsewhere in the article, it does offer explanations for some of the patterns presented in the tables and graphs. For example, a possible explanation for the increase in serum D-dimer levels shown in Fig. 3 (see (8.13) above) is given, i.e. *The rise in D-dimer levels after the completion of the 96-hour infusion of drotrecogin alfa activated indicates incomplete resolution of the procoagulant state seen in patients with sepsis, along with a potential solution: An evaluation of longer periods of infusion of drotrecogin alfa activated may be warranted.*

The examples discussed above show how instances of verbal, mathematical, and visual [engagement] might converge and diverge in the text. The choices of a wide range of colours and naturalistic representations in the blood-vessel diagram, for example, construe a 'heteroglossic' space that 'entertains' various alternative representations. Those choices complement and are complemented by verbal resources in the diagram-caption, such as *proposed*, *may*, and *can* (see (8.7)), which construe a similarly 'expansive' dialogic space. In contrast, observations regarding the placement of tables in the Appendix suggest potentially diverging instances of [engagement] that are kept separate so as not to affect the overall integrity of the Methods section: compare the visual [heterogloss] of the Appendix tables with the verbal and visual [monogloss] of the Methods section as a whole. Other instances of divergent couplings might include dialogically 'contractive' verbal labels alongside dialogically 'expansive' naturalistic representations of biological entities, or dialogically 'expansive' mathematical resources such as  $p$  and 95% *CI* in ostensibly undialogized or 'monoglossic' graphs and tables.

The examples above look at the intra- and intersemiotic relations of [engagement], i.e. the way in which [engagement] resources are connected

or integrated across or within different semiotic systems. It is important to note, however, that the coupling of semiotic resources described by Martin and others (e.g. Martin 1999, 2008b, 2011, Zappavigna, Dwyer, and Martin 2008, Painter, Martin, and Unsworth 2013) also includes cross-metafunctional and intersystemic relations that go beyond the scope of this study. Such couplings, although not examined here, may need to be borne in mind when considering how intersemiosis and intersemiotic [engagement] work as a whole.

## **8.5 Intersemiotic Engagement in MRAC**

In this section, I briefly examine intersemiotic [engagement] across MRAC as a whole. Based on a synthesis of chapters 6 and 7, and drawing on analyses in section 8.4, I highlight some of the broader patterns of intersemiotic [engagement] across and within the main generic stages of the medical research article.

### **8.5.1 Introduction Sections**

The dialogically expansive spaces typically construed by Introductions are realized by a combination of verbal and visual resources. Verbal ‘attribution’ and ‘entertain’ combine, in some cases, with visual ‘entertain’ to create a space in which different voices, positions, and representations are invoked (part of the phase that describes the field of study). As the space for dialogic alternatives narrows (in the phases that identify a gap in the field and state the main research purposes), verbal [engagement] predominates. The relevance or importance of the research (the research warrant; Hood 2010) is often made explicit by verbal ‘justifications’ and the more general visual prominence of the section itself. Mathematical [engagement] plays little or no role in construing for the text a relatively open dialogic space in which the reader may need to be convinced of the rationale of the study but is otherwise generally assumed to be aligned with the textual voice.

### **8.5.2 Methods Sections**

The relatively undialogized or dialogically ‘contractive’ space of the Methods is characterized by verbal and visual [monogloss] and verbal [proclaim: justify], as the stage progresses through its phases of describing the study material and recounting the experimental and data-analysis procedures. In the latter phase, mathematical resources may be deployed, in the form of separated mathematical equations or expressions and tests of probability, but these are not generally numericized (cf. Results section below). Verbal ‘justifications’ and the relative ‘monogloss’ of visual inscriptions help to construe a text in which the integrity of the textual voice and its choice(s) of methodology are likely to be taken as given.

### **8.5.3 Results Sections**

Like Methods sections, Results sections tend to be relatively undialogized or dialogically ‘contractive’. The narrow dialogic space of the Results is maintained by verbal and visual [monogloss] and by verbal [contract: deny]. ‘Engagement’ in Results sections, however, tends to be more ‘expansive’ than that of the Methods, especially in phases that present data and describe adjustments made to the data analysis. Here, mathematical [entertain] combines with and potentially diverges from visual and verbal [monogloss] to construe for the text a dialogic space that, while narrow, is more ‘expansive’ than that construed by visual and verbal resources alone. It is the quantified or ideationalized expression of probability that construes this narrow ‘expansion’ and that may lend the text a certain epistemological authority.

### **8.5.4 Discussion Sections**

MRAC Discussions are primarily ‘heteroglossic’. Verbal [engagement] variously ‘endorses’, ‘acknowledges’, ‘entertains’, ‘counters’, and ‘justifies’ as the stage unfolds. Visual inscriptions are rare, but, to the extent that they are deployed in Discussion sections, they generally construe a space that is more ‘heteroglossic’ than the visual inscriptions in MRAC Methods and Results, complementing in general the verbal [heterogloss] of, for example, the phases that discuss mechanisms and causes and recommend

possible applications. Mathematical resources do not generally feature in the Discussion, except in the opening phase where main findings are repeated from the previous section.

The Discussion is one of the generic stages in which the potential for writer–reader disalignment may be greatest. Verbally, instances of [pronounce], [affirm], and text-internal [endorse], all of which are more common in the Discussion than MRAC as a whole, may put writer–reader solidarity at risk, since they imply “heightened personal involvement” (White 2003, 269). Some instances of verbal [entertain], as well as visual [entertain] expressed by certain inscriptions, i.e. those that present predictive models, may compound this effect.

### **8.5.5 Abstracts**

Abstracts in MRAC are characterized by verbal and mathematical [engagement] resources that mirror to a large extent those of the Introduction, Methods, Results, and Discussion, but with generally more instances of [monogloss] and fewer instances of [acknowledge] than MRAC as a whole. Visual [engagement] in MRAC Abstracts is primarily concerned with the general prominence of the section (there are no visual inscriptions) and plays a crucial role in establishing the section’s importance. Its function as a standalone text means that the Abstract (along with the Title) may be one of the only stages of the article a reader engages with. For those who read on, the Abstract provides a model for how the rest of the article might be read and a basis for alignment or disalignment with the textual voice.

### **8.5.6 Summary**

Like the analyses of intersemiotic [engagement] in a single text (sections 8.1–8.4), the analyses in section 8.5 show the contributions made by different semiotic systems in construing for the text a background of prior and anticipated (multisemiotic) utterances, a background that varies across and appears to be demarcated by different stages and phases of MRAC articles. The resources of those semiotic systems generally complement each other, e.g. the verbal and visual [monogloss] of the Methods section. However, they sometimes diverge, e.g. the verbal/visual

[monogloss] and the mathematical [heterogloss: entertain] of the Results section. This intersemiotic convergence and divergence is similar to that seen for intrasemiotic choices (see sections 6.1.4 and 7.2.4 on the scope and interaction of verbal/mathematical and visual [engagement] resources, respectively).

## **8.6 Disciplinarity and Ideology**

Considered separately, the verbal, mathematical, and visual instantiations of [engagement] identified and discussed in chapters 6 and 7 highlight different aspects of the disciplines and ideologies of medical research. Overall, the deployment of verbal [engagement] resources in MRAC, which are primarily ‘heteroglossic’, suggests a discourse that attempts to build alliances, to seek consensus and alignment, through propositions and positions that are generally supported by evidence and argumentation or are explicitly grounded in the (un)certainly of the textual voice. Mathematical resources are generally ‘expansive’, but the dialogic space they help to construe is narrower than that typically construed by verbal [expand] resources, reflecting the more objectified position often associated with mathematics and an empirical, positivist epistemology. Visual resources are ostensibly ‘monoglossic’, implying a discourse in which a background of other voices, positions, and propositions is not generally invoked, and which plays a crucial role in construing for the text an authoritative position. From a more fine-grained generic perspective, those verbal, mathematical, and visual resources help to construe a text that variously ‘expands’ and ‘contracts’ the dialogic space, and that implies evolving writer–reader relations and knowledge structures as the text unfolds.

From an intersemiotic perspective, verbal, mathematical, and visual [engagement] resources usually work in harmony, complementing and amplifying the overall dialogic effect. In MRAC Methods, for example, verbal and visual resources combine to accentuate the relative [monogloss] of the section, construing for the text a dialogic space in which alternative voices are not generally invoked or recognized. Seen from above, those resources are part of the textual instantiation of “doing



research”, realized by a combination of ‘monoglossic’ material clauses and ostensibly ‘monoglossic’ tables and diagrams.

Less commonly, instances of verbal, mathematical, and visual [engagement] diverge, creating moments of potential dialogic tension. Examples of divergent couplings include the visual ‘expansion’ of naturalistic episodes and figures with the verbal ‘contraction’ implied by their written labels, or the ostensibly undialogized or ‘monoglossic’ graphs and tables with the mathematical ‘expansion’ construed by expressions and components such as  $p$  and *95% CI*. Both examples construe dialogic spaces that are not simply ‘expansive’ or ‘contractive’, but potentially both. Divergent combinations like these may play an important role in reducing interpersonal risk and tempering the potential for disalignment—a crucial part of building and maintaining alliances with the reader.<sup>174</sup>

As discussed in section 8.4.2, there are several instances of intersemiosis where the kind of [engagement] construed is not explicitly carried by any one semiotic, but has to be understood as emerging from a combination of resources from different semiotic systems. Examples of this are found in MRAC\_01 where instances of [proclaim: pronounce] are realized by a combination of verbal, numerical-mathematical, and visual resources, none of which explicitly construes [pronounce] on its own (most of the instances in question are ‘monoglossic’). Those emergent forms of [engagement] can only be appreciated intersemiotically, meaning that they are essentially “invisible” to a strictly verbal, mathematical, or visual reading. ‘Pronounce’ is a category of [engagement] that generally expresses a high level of personal commitment and one that may threaten writer–reader solidarity. Emergent ‘pronouncements’ like those discussed in section 8.4.2 may mitigate the threat to writer–reader solidarity while, at the same time, allowing for subjective emphasis by the textual voice. This has potentially important ideological implications, since it can allow the textual voice to express a subjectivized position through the resources of largely ‘monoglossic’ authoritative discourse.

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<sup>174</sup> Note how, in the latter example of mathematical [entertain] coupled with visual [monogloss], the [entertain] ‘expands’ the [monogloss] and the [monogloss] ‘contracts’ the [entertain].

## 8.7 Intersemiotic Engagement: Summary and Discussion

This chapter shows how verbal, mathematical, and visual [engagement] resources are co-deployed and integrated to create complementary and divergent positions in the text. Most instances of intersemiotic couplings are complementary or convergent, with verbal, mathematical, and/or visual resources combining to reinforce the meanings construed by each semiotic. Divergent couplings—less common than convergent couplings—construe potentially ambiguous dialogic spaces that can be considered both ‘expansive’ and ‘contractive’. Convergent and divergent couplings help maintain alignment between the writer and reader as the text unfolds.

Crucially, the chapter demonstrates how [engagement] cannot only be described in terms of the contributions made by each semiotic system alone; we also need to account for how the resources of those semiotic systems interact to create potentially new or different meanings from those expressed monosemiotically. This phenomenon is described by Lemke (1998) as “multiplying meaning” (see section 2.2.2.3). While it may be difficult to identify or define what exactly is being multiplied (see, for example, Bateman, Wildfeuer, and Hiippala 2017, 16–17), or indeed if “multiplication” is the right kind of operation to describe the phenomenon, it demonstrates that, in terms of [engagement], the meaning of the whole seems to be greater than or different from the sum of its parts in this particular field (or tenor) of discourse.

## 9 Summary and Conclusions

### 9.1 Engagement in Medical Research Discourse

The overall aim of this thesis is to investigate how medical researchers engage with a background of prior and anticipated utterances, as construed verbally, mathematically, and visually in a collection of highly cited English-language medical research articles (see chapter 1, section 1.2). Based primarily on the systemic-functional framework of ENGAGEMENT, a subsystem of APPRAISAL (see section 3.1), I have accounted for the verbal, mathematical, and visual resources medical researchers use to construe, engage with, and position themselves and others in relation to different voices in the discourse. Verbally, those resources include modality, negation, projection, and concession; mathematically, they include expressions of probability and prediction, and their quantification; and visually, they include lines of action, choices of shading, colour, size, and placement, naturalistic and schematic representations, and hypertext objects. Some verbal, mathematical, and visual resources construe more than one type of [engagement], separately or simultaneously, depending on their co-text or context of deployment. All of the [engagement] resources identified in this thesis can overlap and interact to construe dialogic spaces that are not simply open or closed to other voices, but that are often in a kind of dialogic tension that constantly perturbs the space for those voices. Moreover, the thesis shows that the dialogic space created by those verbal, mathematical, and visual resources evolves logogenetically, with different stages and phases of the medical research article construing different types of [engagement] despite variations across individual research articles. Although difficult to determine through the relatively narrow lens of ENGAGEMENT, the findings in this thesis suggest a discipline that draws upon the characteristics of both hard and soft sciences—as well as other fields of experience—in which different generic stages and phases of the text construe different types of [engagement], different writer–reader relations, and potentially different knowledge structures.

Compared with findings for the kinds of mass-communicative texts discussed by White (1998, 2003, 2012), Martin and White (2005),

Economou (2009), Tan (2010), and Feng and Wignell (2011), as well as the educational English-as-foreign-language (EFL) texts discussed by Chen (2008, 2009, 2010), the medical research article appears to construe a dialogic space that is relatively 'contractive'. This is an important cross-disciplinary observation that suggests that medical research discourse tends to challenge, fend off, or otherwise restrict the scope of alternative voices in the communicative context, compared with mass-media and education discourses. However, this observation may obscure the fact that the majority of [engagement] resources in MRAC, especially verbal and mathematical resources, appear to construe a dialogically 'expansive' space in which the presence and positions of other voices are 'acknowledged' and 'entertained'. A similar concern emerges from applied-linguistic studies that compare medicine with other disciplinary fields. In those studies (see summary and discussion in chapter 4), medicine is often described as a relatively objective discourse, in which other voices are not generally included or heard. The findings in this thesis, however, show that, despite the relative [monogloss] or dialogic 'contraction' of medical discourse suggested by comparative studies, medical research articles express remarkable dialogic diversity. That diversity can be seen in the instantiation and distribution of [engagement] as well as in its realization.

## **9.2 Engagement as Multisemiotic Discourse Semantic System**

A study like this is in many ways an example of theory-testing. The models of engagement used in this thesis are adapted from the literature, and the basic system of ENGAGEMENT is not my own. Part of this project is to test how well such models might apply to a particular field, or a particular collection of texts, for which they were not originally designed or intended.

The ENGAGEMENT system attempts to account for how a text, or the textual voice, refers to, responds to, and is influenced by prior and anticipated utterances, and how the textual voice attempts to align or disalign itself and the reader with the other voices and positions construed in the communicative context (see chapter 3). The ENGAGEMENT system, and

APPRAISAL more generally, is intended to give an “account of the resources of evaluation and intersubjective positioning as these operate within English” (Martin and White 2005, 161), but its development has largely been based on texts from the domains of journalism, advertising, and education.<sup>175</sup> The analyses in this thesis highlight how ENGAGEMENT as an interpersonal discourse-semantic system is instantiated in texts from a different domain or field, and across different semiotic systems.

With regard to the verbal construal of [engagement], there are notably no instances of the [concur: concede] feature in MRAC. Instantiations of the [concur: affirm], [pronounce], and [distance] features are also low compared with other choices of verbal [engagement] (see chapter 6). This tells us something about the kinds of interpersonal risk construed verbally in MRAC, and perhaps about medical research discourse more generally, namely that medical research articles tend to avoid “heightened personal involvement” (White 2003, 269) and the potential for writer–reader disalignment. A system of ENGAGEMENT constructed around meanings instantiated in medical research articles, or similar academic texts, might miss the potential for construing [concur] or other low-frequency features in other texts or text-types. However, it might also reveal the potential for different types of engagement not typically associated with those other texts or text-types. The analyses in chapter 6 suggest, for example, that some [engagement] features might usefully be extended in delicacy in order to account for differences in positions framed as text-internal or text-external. For those features—[deny], [counter], and [endorse] (see relevant sections in chapter 6)—the text-internal position does not seem to be picked up in current models of ENGAGEMENT. Yet the textual voice can ‘deny’, ‘counter’, or ‘endorse’ its own positions or propositions, set up earlier in the text, by construing those positions as part of the dialogic background of different voices in the ongoing communicative context.

Extending the ENGAGEMENT system to include more delicate options may allow for more fine-grained analyses within semiotic systems.

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<sup>175</sup> Notable exceptions include Hood’s (2004, 2010) work on evaluative language in academic writing, although that work does not include material from the discipline of medicine.

However, this gain in delicacy *within* a particular semiotic may be offset by a loss in comparative power *across* semiotics. As the analyses in chapters 6–8 show, there may not be a visual equivalent of verbal [justify] or a mathematical-symbolic equivalent of visual [attribute]. Instead, it may be more useful to make comparisons of visual and verbal [proclaim] or mathematical and visual [expand], taking a less fine-grained perspective, with reduced levels of delicacy, in order to account for intersemiotic complementarity or intersemiotic divergence among choices of [engagement]. Figure 9.1 presents this simplified system network, including example realizations from the verbal, mathematical, and visual expression planes.

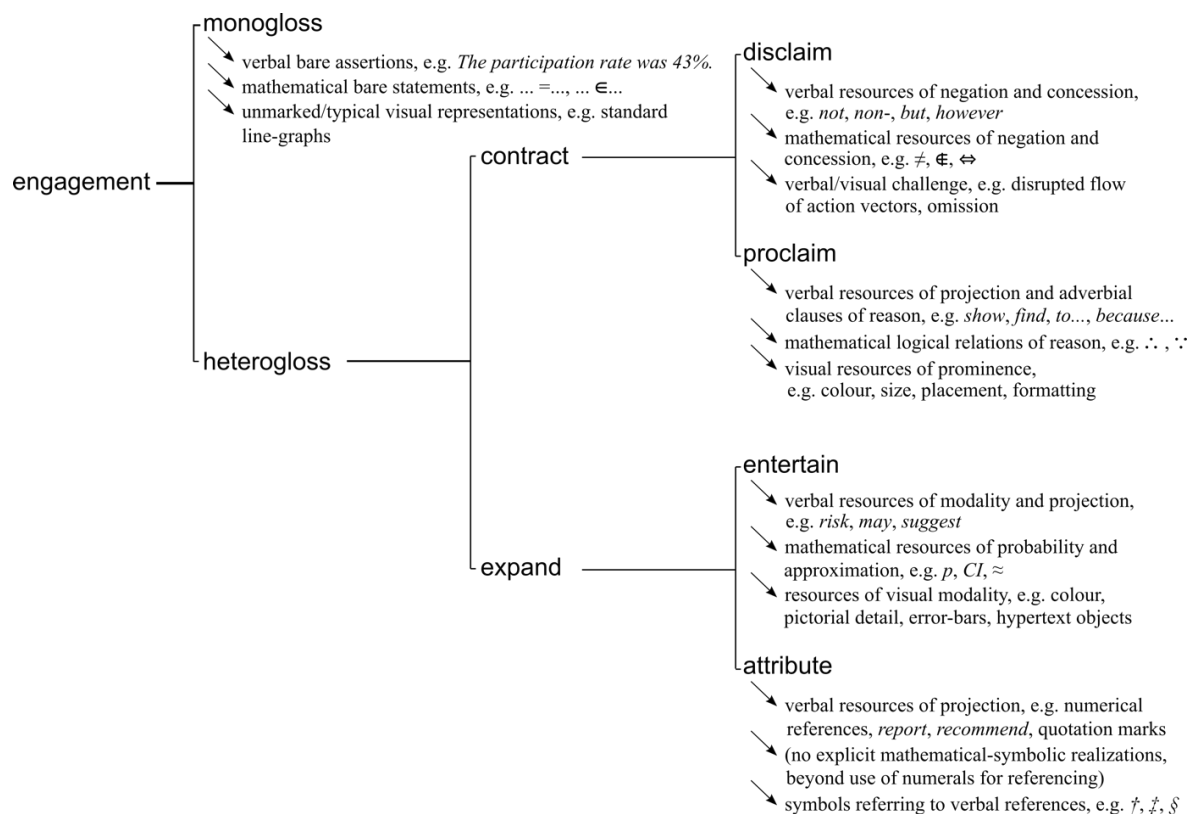


Figure 9.1. Multisemiotic discourse semantic system of ENGAGEMENT.

The analyses in chapters 6–8 suggest that there are few if any instances of writer–reader disalignment in MRAC. In instances where disalignment is likely or possible, there are no obvious one-to-one relations between the choice of [engagement] and the degree of (dis)alignment. Alignment–

disalignment cannot be predicted on the basis of instantiation or realization of [engagement] alone; it can only be identified by considering the co-text and knowing something about the possible positions and interests of the reader. ‘Pronouncements’, for example, imply a subjectivized position that may lead to disalignment between the textual voice and reader (see sections 3.1.2.1.1 and 6.1.1.2.2), but whether or not a particular instantiation of [pronounce] actually serves to disalign depends on co-textual and contextual factors such as the realization of the feature, the interaction of other [engagement] features, the generic stage of the article, and whether or not the reader agrees with or is convinced by the kind of ‘pronouncement’ made. Alignment works in tandem with [engagement] features, but it seems to operate in a plane that is separate from those features. Based on the findings in chapters 6–8, I propose conceptualizing ALIGNMENT as a subsystem of ENGAGEMENT, one that can be considered alongside VOICE, i.e. [monogloss] and [heterogloss], and its various subsystems (see Figure 9.2). ALIGNMENT is presented here as a simple scalar system along which varying degrees of ‘alignment’ or ‘disalignment’ might be mapped.

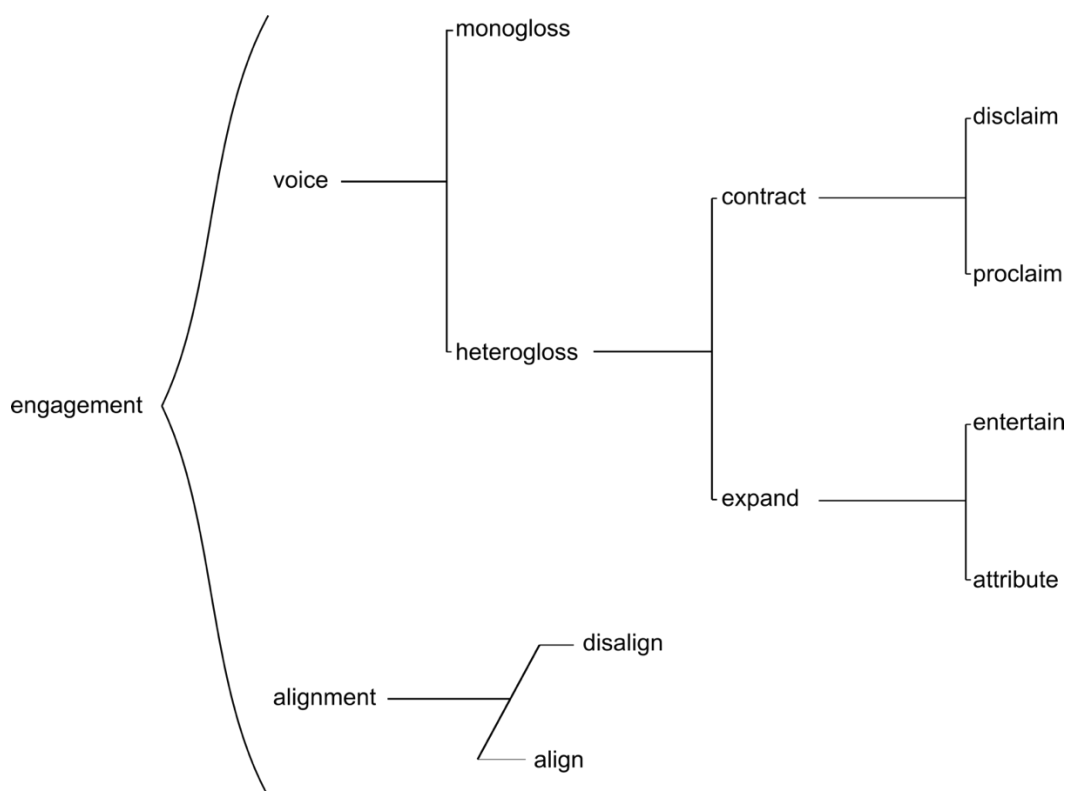


Figure 9.2. ENGAGEMENT, VOICE, and ALIGNMENT.

Such a proposal is not without its potential shortcomings, especially based on the relatively limited number of texts and the relatively narrow field of this study. Indeed, alignment might be better thought of in terms of the cline of instantiation (see section 2.2.1.1.2), as part of the subjectified meaning that emerges from individual readings (Martin and Rose 2007, 310–313). However, given the centrality of “intersubjective stance” or “dialogic positioning” to Martin and White’s (White 2003, Martin and White 2005) accounts of ENGAGEMENT, it seems prudent to try to account for alignment systemically. In MRAC as a whole, the instantiation of [alignment] is heavily skewed towards consensus and the [align] option (cf. Halliday 1991, section 2.2.1.1.4). Only in certain stages and phases of the texts, e.g. the Discussion and the Conflict-of-Interest statement, is there any kind of increased potential for ‘disalignment’.

### **9.3 Practical Implications and Recommendations**

One of the possible practical implications or applications of this study is within the field of academic literacies (see, for example, Lea and Street 1998, Lillis and Scott 2007), especially in areas dealing with medicine and medical research. While the thesis itself does not have a pedagogic focus and is not intended for direct pedagogic use, some of the findings discussed herein may be adaptable for the academic literacies learning environment, and especially the emerging and evolving fields of multiliteracies (Cope and Kalantzis 2000) and multisemiotic or multimodal academic literacies (e.g. Jones 2007, Canagarajah 2013, chapter 7).

Genre-based pedagogies are common in academic literacy programmes like English for Academic Purposes (EAP) (e.g. Swales and Feak 2000, 2012). Those pedagogies typically have an ideational and monosemiotic focus (see comments in Hood 2010), with stages or moves usually described in terms of their experiential or representational functions, e.g. explaining, recounting, and reporting, and how written language fulfils those functions. An interpersonal perspective, however, highlights how those explanations, recounts, or reports “function as invitations to align and to build relationships of solidarity [...] to persuade the readership that the choice of topic is important and interesting, that it



is a legitimate or warranted ‘object’ for research” (Hood 2010, 37–38). A multisemiotic perspective emphasizes the contributions made by mathematical and visual resources in different generic stages, and the degree to which they might complement or diverge from the meanings expressed verbally in a text. A consequence of taking an integrated interpersonal and multisemiotic approach, in addition to the ideational and monosemiotic one, is that it emphasizes the diversity of meanings expressed in text. Based on this approach, one of the conclusions of this study is that the division between the argumentative and relatively subjective Introduction and Discussion sections, on the one hand, and the descriptive and relatively impersonal Methods and Results sections, on the other, while useful for pedagogic purposes, may be misleading or misrepresentative. “[W]riters’ efforts to persuade their audience of their claims” are expressed throughout a text (Hyland 2005, 190), albeit in different ways in different stages and phases of the text. Construing writer–reader solidarity or alignment and emphasizing the importance or warrantability of research are not only established and maintained in the relatively ‘heteroglossic’ Introduction and Discussion sections, but also throughout the more ‘monoglossic’ Methods and Results, as well as other (often overlooked) sections or stages of the medical research article.

Beyond exploring the pedagogic potential of this study, I would recommend extending the multisemiotic study of [engagement] to include other text-types and other fields of discourse. In addition to the obvious comparative value of such studies, they might provide much needed empirical data to test the proposed models in this thesis (see section 9.2) and models of engagement more generally. For example, they could be used to explore whether other texts or text-types show similar evidence of text-internal ‘denial’, ‘counter’, and ‘endorse’, and how the ALIGNMENT system proposed above (see Figure 9.2) might be developed to better account for relations of alignment and disalignment construed by the text.

## 9.4 Conclusions

In this study, I have examined how medical researchers construe, engage with, and position themselves and others in relation to a background of different voices or viewpoints in the discourse, by analysing the

instantiation and realization of [engagement] in a collection of highly cited English-language medical research articles (MRAC). The multistratal analysis (from below, from round about, from above) shows that a wide range of verbal, mathematical, and visual resources are used to express [engagement], and that the instantiation and realization of [engagement] varies across different generic stages and phases of the medical research article, reflecting in part the different kinds of relations and different kinds of knowledge structures encoded by those stages and phases. Despite the general patterns observed across MRAC, considerable variation is noted for individual articles, an important aspect of recognizing semiotic diversity in texts that otherwise share many of the same characteristics.

The study emphasizes the importance of examining [engagement] from a multisemiotic perspective. It considers the different contributions made by each semiotic (verbal, mathematical, visual), as well as the intersemiotic potential of those semiotic systems. As such, the study goes beyond monosemiotic (primarily linguistic) analyses of texts to consider [engagement] from a more holistic perspective, recognizing and treating the medical research article as a multisemiotic instantiation of meaning rather than a monosemiotic one.

The study makes three important contributions to dialogic theory and engagement, and to discourse analysis more generally. Firstly, it contributes to the growing study of medical texts and medical discourse. Secondly, it tests the interpersonal discourse-semantic system of ENGAGEMENT and provides suggestions for possible refinements to it. Thirdly, but less directly, the study may contribute to the field of academic multiliteracies.

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Zhao, Sumin. 2010. "Rank in visual grammar: some implications for multimodal discourse analysis." In *Applicable linguistics*, edited by Ahmar Mahboob and Naomi K. Knight, 251–266. London: Continuum.

## Appendix

Table A1. Medical Research Article Corpus (MRAC).

MRAC code	Bibliographic reference	No. of citations (as of 30 June 2010)
MRAC_01	Bernard, G. R., J. L. Vincent, P. Laterre, S. P. LaRosa, J. F. Dhainaut, A. Lopez-Rodriguez, J. S. Steingrub, G. E. Garber, J. D. Helterbrand, E. W. Ely, C. J. Fisher, and the Recombinant Human Activated Protein C Worldwide Evaluation in Severe Sepsis (PROWESS) Study Group. 2001. "Efficacy and safety of recombinant human activated protein C for severe sepsis." <i>New England Journal of Medicine</i> 344 (10):699-709.	2588
MRAC_02	Brenner, B. M., M. E. Cooper, D. de Zeeuw, W. F. Keane, W. E. Mitch, H. H. Parving, G. Remuzzi, S. M. Snapinn, Z. X. Zhang, S. Shahinfar, and Renaal Study Investigators. 2001. "Effects of losartan on renal and cardiovascular outcomes in patients with type 2 diabetes and nephropathy." <i>New England Journal of Medicine</i> 345 (12):861-869.	2377
MRAC_03	Collins, R., J. Armitage, S. Parish, P. Sleight, R. Peto, and Collaboration Heart Protection Study. 2002. "MRC/BHF Heart Protection Study of cholesterol lowering with simvastatin in 20536 high-risk individuals: a randomised placebo-controlled trial." <i>Lancet</i> 360 (9326):7-22.	3436
MRAC_04	Connor, E. M., R. S. Sperling, R. Gelber, P. Kiselev, G. Scott, M. J. Osullivan, R. Vandyke, M. Bey, W. Shearer, R. L. Jacobson, E. Jimenez, E. Oneill, B. Bazin, J. F. Delfraissy, M. Culnane, R. Coombs, M. Elkins, J. Moye, P. Stratton, and J. Balsley. 1994. "Reduction of maternal-infant transmission of human immunodeficiency virus type 1 with zidovudine treatment." <i>New England Journal of Medicine</i> 331 (18):1173-1180.	1960
MRAC_05	Considine, R. V., M. K. Sinha, M. L. Heiman, A. Kriauciunas, T. W. Stephens, M. R. Nyce, J. P. Ohannesian, C. C. Marco, L. J. McKee, T. L. Bauer, and J. F. Caro. 1996. "Serum immunoreactive leptin concentrations in normal-weight and obese humans." <i>New England Journal of Medicine</i> 334 (5):292-295.	3089
MRAC_06	Dahlof, B., R. B. Devereux, S. E. Kjeldsen, S. Julius, G. Beevers, U. de Faire, F. Fyhrquist, H. Ibsen, K. Kristiansson, O. Lederballe-Pedersen, L. H. Lindholm, M. S. Nieminen, P. Omvik, S. Oparil, H. Wedel, and the LIFE Study Group. 2002. "Cardiovascular morbidity and mortality in the Losartan Intervention For Endpoint reduction in hypertension study	2171

MRAC code	Bibliographic reference	No. of citations (as of 30 June 2010)
	(LIFE): a randomised trial against atenolol." <i>Lancet</i> 359 (9311):995-1003.	
MRAC_07	Dockery, D. W., C. A. Pope, X. P. Xu, J. D. Spengler, J. H. Ware, M. E. Fay, B. G. Ferris, and F. E. Speizer. 1993. "An association between air pollution and mortality in six U.S. cities." <i>New England Journal of Medicine</i> 329 (24):1753-1759.	2562
MRAC_08	Downs, J. R., M. Clearfield, S. Weis, E. Whitney, D. R. Shapiro, P. A. Beere, A. Langendorfer, E. A. Stein, W. Kruyer, A. M. Gotto, and Afcaps TexCAPS Res Grp. 1998. "Primary prevention of acute coronary events with lovastatin in men and women with average cholesterol levels - Results of AFCAPS/TexCAPS." <i>Jama-Journal of the American Medical Association</i> 279 (20):1615-1622.	2782
MRAC_09	Eisenberg, D. M., R. B. Davis, S. L. Ettner, S. Appel, S. Wilkey, M. van Rompay, and R. C. Kessler. 1998. "Trends in alternative medicine use in the United States, 1990-1997 - Results of a follow-up national survey." <i>Jama-Journal of the American Medical Association</i> 280 (18):1569-1575.	2857
MRAC_10	Fischman, D. L., M. B. Leon, D. S. Baim, R. A. Schatz, M. P. Savage, I. Penn, K. Detre, L. Veltri, D. Ricci, M. Nobuyoshi, M. Cleman, R. Heuser, D. Almond, P. S. Teirstein, R. D. Fish, A. Colombo, J. Brinker, J. Moses, A. Shaknovich, J. Hirshfeld, S. Bailey, S. Ellis, R. Rake, and S. Goldberg. 1994. "A randomized comparison of coronary-stent placement and balloon angioplasty in the treatment of coronary artery disease." <i>New England Journal of Medicine</i> 331 (8):496-501.	2768
MRAC_11	Flegal, K. M., M. D. Carroll, C. L. Ogden, and C. L. Johnson. 2002. "Prevalence and trends in obesity among US adults, 1999-2000." <i>Jama-Journal of the American Medical Association</i> 288 (14):1723-1727.	3002
MRAC_12	Fried, M. W., M. L. Shiffman, K. R. Reddy, C. Smith, G. Marinos, F. L. Goncales, D. Haussinger, M. Diago, G. Carosi, D. Dhumeaux, A. Craxi, A. Lin, J. Hoffman, and J. Yu. 2002. "Peginterferon alfa-2a plus ribavirin for chronic hepatitis C virus infection." <i>New England Journal of Medicine</i> 347 (13):975-982.	2435
MRAC_13	Gent, M., D. Beaumont, J. Blanchard, M. G. Bousser, J. Coffman, J. D. Easton, J. R. Hampton, L. A. Harker, L. Janzon, J. J. E. Kusmierek, E. Panak, R. S. Roberts, J. S. Shannon, J. Sicurella, G. Tognoni, E. J. Topol, M. Verstraete, and C. Warlow. 1996. "A randomised, blinded, trial of clopidogrel versus aspirin in patients at risk of ischaemic events (CAPRIE)." <i>Lancet</i> 348 (9038):1329-1339.	2439

MRAC code	Bibliographic reference	No. of citations (as of 30 June 2010)
MRAC_14	Haffner, S. M., S. Lehto, T. Ronnema, K. Pyorala, and M. Laakso. 1998. "Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without prior myocardial infarction." <i>New England Journal of Medicine</i> 339 (4):229-234.	2294
MRAC_15	Haissaguerre, M., P. Jais, D. C. Shah, A. Takahashi, M. Hocini, G. Quiniou, S. Garrigue, A. Le Mouroux, P. Le Metayer, and J. Clementy. 1998. "Spontaneous initiation of atrial fibrillation by ectopic beats originating in the pulmonary veins." <i>New England Journal of Medicine</i> 339 (10):659-666.	2177
MRAC_16	Hansson, L., A. Zanchetti, S. G. Carruthers, B. Dahlof, D. Elmfeldt, S. Julius, J. Menard, K. H. Rahn, H. Wedel, S. Westerling, and H. O. T. Study Grp. 1998. "Effects of intensive blood-pressure lowering and low-dose aspirin in patients with hypertension: principal results of the Hypertension Optimal Treatment (HOT) randomised trial." <i>Lancet</i> 351 (9118):1755-1762.	2662
MRAC_17	Hulley, S., D. Grady, T. Bush, C. Furberg, D. Herrington, B. Riggs, E. Vittinghoff, and Hers. 1998. "Randomized trial of estrogen plus progestin for secondary prevention of coronary heart disease in postmenopausal women." <i>Jama-Journal of the American Medical Association</i> 280 (7):605-613.	3397
MRAC_18	Hurwitz, H., L. Fehrenbacher, W. Novotny, T. Cartwright, J. Hainsworth, W. Heim, J. Berlin, A. Baron, S. Griffing, E. Holmgren, N. Ferrara, G. Fyfe, B. Rogers, R. Ross, and F. Kabbinavar. 2004. "Bevacizumab plus irinotecan, fluorouracil, and leucovorin for metastatic colorectal cancer." <i>New England Journal of Medicine</i> 350 (23):2335-2342.	2957
MRAC_19	Knowler, W. C., E. Barrett-Connor, S. E. Fowler, R. F. Hamman, J. M. Lachin, E. A. Walker, D. M. Nathan, and G. Diabetes Prevention Program Res. 2002. "Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin." <i>New England Journal of Medicine</i> 346 (6):393-403.	3815
MRAC_20	Lewis, E. J., L. G. Hunsicker, R. P. Bain, and R. D. Rohde. 1993. "The effect of angiotensin-converting-enzyme inhibition on diabetic nephropathy." <i>New England Journal of Medicine</i> 329 (20):1456-1462.	3060
MRAC_21	Lewis, E. J., L. G. Hunsicker, W. R. Clarke, T. Berl, M. A. Pohl, J. B. Lewis, E. Ritz, R. C. Atkins, R. Rohde, I. Raz, and Grp Collaborative Study. 2001. "Renoprotective effect of the angiotensin-receptor antagonist irbesartan in patients with	2104

MRAC code	Bibliographic reference	No. of citations (as of 30 June 2010)
	nephropathy due to type 2 diabetes." <i>New England Journal of Medicine</i> 345 (12):851-860.	
MRAC_22	Lynch, T. J., D. W. Bell, R. Sordella, S. Gurubhagavatula, R. A. Okimoto, B. W. Brannigan, P. L. Harris, S. M. Haserlat, J. G. Supko, F. G. Haluska, D. N. Louis, D. C. Christiani, J. Settleman, and D. A. Haber. 2004. "Activating mutations in the epidermal growth factor receptor underlying responsiveness of non-small-cell lung cancer to gefitinib." <i>New England Journal of Medicine</i> 350 (21):2129-2139.	2933
MRAC_23	Manns, M. P., J. G. McHutchison, S. C. Gordon, V. K. Rustgi, M. Shiffman, R. Reindollar, Z. D. Goodman, K. Koury, M. H. Ling, J. K. Albrecht, and Thera Int Hepatitis Interventional. 2001. "Peginterferon alfa-2b plus ribavirin compared with interferon alfa-2b plus ribavirin for initial treatment of chronic hepatitis C: a randomised trial." <i>Lancet</i> 358 (9286):958-965.	2718
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	<p>M. Bayless, H. Schrott, N. Olson, B. Tindal, L. Snetselaar, D. Mueller, A. Dudler, J. Swartzendruber, R. Hoffman, J. Macindoe, J. Kramer, T. Weingeist, A. Kimura, E. Stone, T. Grout, C. Fountain, S. Karakas, C. Vogel, P. Montague, D. Keyser, S. Mennen, C. Doggett, G. Rose, K. Devet, P. Muhle, A. Kowarski, D. Ostrowski, P. Levin, S. Chalew, J. Hylton, D. Younghyman, M. Barlow, R. Mayer, M. Elman, V. Lakhanpal, B. Weiner, M. Millar, S. Blum, W. Buie, B. Mace, D. Greene, C. Martin, J. Floyd, F. Dunn, D. Henry, S. Bennett, A. Lasichak, A. Vine, J. Albers, T. Sandford, J. Loftin, M. Stevens, S. Elner, C. Martonyi, F. Mclver, S. Stanley, J. Willis, K. Ryan, T. Spiegelberg, S. Nalepa, B. Glasgow, E. Chan, P. Dotimas, J. Bantle, M. Mech, M. Balles, W. Kennedy, M. Khan, W. Knobloch, C. Kwong, L. McKenzie, J. Olson, R. Ramsay, W. Robiner, R. Warhol, A. Genia, G. McDonough, B. McMichael, D. Philip, L. Ponwith, R. Sahinen, E. Stinson, J. Verness, L. Fimreite, J. Stein, D. Goldstein, M. Hall, T. Burns, D. Klachko, J. Giangiacomo, S. Rawlings, L. Aston, J. England, H. Wiedmeyer, M. Daugherty, M. Lightfoot, R. Wilson, G. Griffing, D. Gardner, R. Conway, K. Blinder, M. Brownleeduffeck, N. Palmer, L. Gash, D. Schade, C. Johannes, R. Reidy, J. Bicknell, A. Vogel, D. Drumm, P. Boyle, M. Burge, N. Jones, J. Canady, D. Nickell, L. Baker, P. Ilvescorressel, S. Schwartz, S. Braunstein, J. McBride, A. Brucker, L. Rendle, M. Brown, J. Sladky, B. Maschakcarey, D. Lawley, W. Nyberg, L. Weeney, E. Sandburg, S. Byrd, E. Aguado, N. Mulholland, D. Cahn, M. Suscavage, J. Egler, M. Vaughnnorton, C. Collins, H. Mameniskis, A. Drash, J. Wesche, M. Bratkowski, D. Becker, S. Arslanian, B. Doft, L. Lobes, J. Rinkoff, J. Warnicki, D. Curtin, D. Steinberg, G. Vagstad, C. Ryan, F. Harris, L. Steranchak, J. Arch, K. Kelly, P. Ostroska, M. Guiliani, M. Good, T. Williams, K. Olsen, A. Campbell, C. Shipe, R. Conwit, D. Finegold, M. Zaucha, J. Malone, N. Grove, D. McMillan, L. Babione, T. Declue, P. Pavan, J. Korthals, H. Solc, A. Mangione, A. Kitabchi, L. Taylor, L. Jones, K. Pitts, T. Bertorini, J. Bittle, G. Burghen, J. Fisher, T. Hughes, J. Linn, D. Meyer, W. Murphy, M. Justice, A. Sherman, L. Wright, L. Murphy, P. Raskin, S. Strowig, M. Basco, S. Cercone, L. Ramirez, R. Anand, C. Wilson, R. Greenlee, W. Anderson, E. Mendelson, P. Vanacek, J. Howard, C. Ousley, B. Yates, D. Conger, B. Maguire, M. Biggs, B. Newton, K. Sherill, B. Zinman, A. Barnie, R. Ehrlich, D. Daneman, K. Perlman, L. Leiter, I. Gottesman, R. Devenyi, C. Mortimer, K. Moffat, A. Gordon, R. Ferguson, K.</p>	

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	<p>Camelon, S. Simkins, C. Littlefield, G. Rodin, K. Hartley, J. Kwan, D. Gnanapandithen, S. Rogers, L. Haye, J. Rose, S. Mezei, B. Bunphy, S. Maclean, L. Mackeen, M. Mandelcorn, P. Nellis, L. Ruttan, D. Wilsonsmith, J. Palmer, J. Ginsberg, I. Hirsch, J. Kinyoun, H. Doerr, R. Mauseth, K. Sweeney, L. Vanottingham, L. Thomson, C. Greenbaum, L. Sameshima, R. Farkashirsch, G. Rosenbaum, N. Rubner, T. Brown, G. Kraft, J. Broeckel, M. Karlsten, D. Khakpour, M. Ramirez, B. Smit, L. Mix, J. Dupre, P. Colby, W. Rodger, I. Hramiak, M. Jenner, C. Canny, W. Brown, T. Smith, J. Harth, S. Bondy, S. Beath, S. McCabe, C. Gouchie, K. Blanchard, J. McCallum, S. Jung, A. Suetang, R. Lorenz, J. Lipps, J. McRae, J. May, M. May, P. Campbell, S. Feman, A. Kilroy, C. Pulliam, D. Schlundt, K. Jannasch, D. Davis, N. Cullen, T. Adkins, M. Snell, K. Virts, L. Quesenberry, J. Santiago, L. Levandoski, N. White, J. McGill, J. Bubb, L. Schmidt, Y. Strasberg, M. Casso, M. Noetzel, R. Olk, I. Boniuk, M. Grand, M. Thomas, D. Williams, G. Nobel, R. Kacizak, E. Ort, J. Dahl, L. Breeding, G. Hoffmeyer, P. Bilyeu, J. Blank, C. Walters, J. Bodnar, P. Rodriguez, M. Erickson, S. Hedrick, W. Tamborlane, J. Ahern, R. Sherwin, P. Gatcomb, K. Stoessel, N. Held, J. Ebersole, I. Scanlon, R. Louard, C. Wildstein, D. Bilodeau, K. Fong, D. Ottaviano, C. Larson, O. B. Crofford, J. Lachin, P. Cleary, D. Thompson, D. Kenny, S. Lan, G. Lan, A. Brenneman, W. Owen, K. Adams, D. Arnold, R. Campanell, N. Loring, P. Scheirer, D. Lamas, C. Dunegan, H. Veeramachaneni, C. Williams, S. Abdulbaaqiy, A. Kassoff, J. Dorman, R. Spielman, R. Klein, C. Siebert, R. Silverman, M. Pfeifer, M. Schumer, M. Moran, J. Farquhar, C. Rohlfing, M. Davis, L. Hubbard, Y. Magli, S. Thomas, J. Onofrey, K. Jensen, R. Brothers, S. Ansay, J. Armstrong, D. Badal, M. Vanderhoofyoung, B. Esser, P. Geithman, D. Hurlburt, J. Reimers, K. Kewley, K. Miner, M. Steffes, J. Bucksa, R. Catanzaro, A. Lukes, G. Bagovich, T. Woodfill, R. Crow, J. Hughlett, C. Swanson, I. Buzzard, B. Sielaff, B. Pickering, S. Schakel, W. Herman, E. Dasbach, T. Songer, G. Janes, L. Deeb, R. Ewart, T. Orchard, C. Clark, G. Cutter, D. Demets, F. Ferris, C. Furberg, E. Horton, J. Keen, D. Lockwood, P. Palmberg, B. Rourke, A. Tsiatis, R. Levy, R. Frank, J. Grizzle, A. Rubenstein, J. Schneider, J. Skyler, D. M. Nathan, O. Crofford, and L. Rand. 1993. "The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes-mellitus." <i>New England Journal of Medicine</i> 329 (14):977-986.</p>	

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MRAC_39	Slamon, D. J., B. Leyland-Jones, S. Shak, H. Fuchs, V. Paton, A. Bajamonde, T. Fleming, W. Eiermann, J. Wolter, M. Pegram, J. Baselga, and L. Norton. 2001. "Use of chemotherapy plus a monoclonal antibody against HER2 for metastatic breast cancer that overexpresses HER2." <i>New England Journal of Medicine</i> 344 (11):783-792.	2973
MRAC_40	Stearne, M. R., S. L. Palmer, M. S. Hammersley, S. L. Franklin, R. S. Spivey, J. C. Levy, C. R. Tidy, N. J. Bell, J. Steemson, B. A. Barrow, R. Coster, K. Waring, J. Nolan, E. Truscott, N. Walravens, L. Cook, H. Lampard, C. Merle, P. Parker, J. McVittie, I. Draisey, L. E. Murchison, A. H. E. Brunt, M. J. Williams, D. W. Pearson, X. M. P. Petrie, M. E. J. Lean, D. Walmsley, M. J. Lyall, E. Christie, J. Church, E. Thomson, A. Farrow, J. M. Stowers, M. Stowers, K. McHardy, N. Patterson, A. D. Wright, N. A. Levi, A. C. I. Shearer, R. J. W. Thompson, G. Taylor, S. Rayton, M. Bradbury, A. Glover, A. Smyth-Osbourne, C. Parkes, J. Graham, P. England, S. Gyde, C. Eagle, B. Chakrabarti, J. Smith, J. Sherwell, E. M. Kohner, A. Dornhurst, M. C. Doddridge, M. Dumskyj, S. Walji, P. Sharp, M. Sleightholm, G. Vanterpool, C. Rose, G. Frost, M. Roseblade, S. Elliott, S. Forrester, M. Foster, K. Myers, R. Chapman, J. R. Hayes, R. W. Henry, M. S. Featherston, G. P. R. Archbold, M. Copeland, R. Harper, I. Richardson, S. Martin, H. A. Davison, D. R. Hadden, L. Kennedy, A. B. Atkinson, A. M. Culbert, C. Hegan, H. Tennet, N. Webb, I. Robinson, J. Holmes, P. M. Bell, D. R. McCance, J. Rutherford, S. Nesbitt, A. S. Spathis, S. Hyer, M. E. Nanson, L. M. James, J. M. Tyrell, C. Davis, P. Strugnell, M. Booth, H. Petrie, D. Clark, B. Rice, S. Hulland, J. L. Barron, J. S. Yudkin, B. J. Gould, J. Singer, A. Badenock, M. Eckert, K. Alibhai, E. Marriot, C. Cox, R. Price, M. Fernandez, A. Ryle, S. Clarke, G. Wallace, E. Mehmed, S. MacFarlane, R. H. Greenwood, J. Wilson, M. J. Denholm, R. C. Temple, K. Whitfield, F. Johnson, C. Munroe, S. Gorick, E. Duckworth, M. Flatman, S. Rainbow, L. J. Borthwick, D. J. Wheatcroft, R. J. Seaman, R. A. Christie, W. Wheatcroft, P. Musk, J. White, S. McDougal, M. Bond, P. Raniga, R. W. Newton, R. T. Jung, C. Roxburgh, B. Kilgallon, L. Dick, N. Waugh, S. Kilby, A. Ellingford, J. Burns, C. V. Fox, M. C.	2782

MRAC code	Bibliographic reference	No. of citations (as of 30 June 2010)
	<p>Holloway, H. M. Coghill, N. Hein, A. Fox, W. Cowan, M. Richard, K. Quested, S. J. Evans, R. B. Paisey, N. P. R. Brown, A. J. Tucker, R. Paisey, F. Garrett, J. Hogg, P. Park, K. Williams, P. Harvey, R. Wilcocks, S. Mason, J. Frost, C. Warren, P. Rocket, L. Bower, J. M. Roland, D. J. Brown, J. Youens, K. Stanton-King, H. Mungall, V. Ball, W. Maddison, D. Donnelly, S. King, P. Griffin, S. Smith, S. Church, G. Dunn, A. Wilson, K. Palmer, P. M. Brown, D. Humphriss, A. J. M. Davidson, R. Rose, L. Armistead, S. Townsend, P. Poon, I. D. A. Peacock, N. J. C. Culverwell, M. H. Charlton, B. P. S. Connolly, J. Peacock, J. Barrett, J. Wain, W. Beeston, G. King, P. G. Hill, A. J. M. Boulton, A. M. Robertson, V. Katoulis, A. Olukoga, H. McDonald, S. Kumar, F. Abouaesha, B. Abuaisa, E. A. Knowles, S. Higgins, J. Booker, J. Sunter, K. Breislin, R. Parker, P. Raval, J. Curwell, H. Davenport, G. Shawcross, A. Prest, J. Grey, H. Cole, C. Sereviratne, R. J. Young, T. L. Dornan, J. R. Clyne, M. Gibson, I. O'Connell, L. M. Wong, S. J. Wilson, K. L. Wright, C. Wallace, D. McDowell, A. C. Burden, E. M. Sellen, R. Gregory, M. Roshan, N. Vaghela, M. Burden, C. Sherriff, J. Clarke, J. Grenfell, J. E. Tooke, K. MacLeod, C. Searnark, M. Rammell, C. Pym, J. Stockman, C. Yeo, J. Piper, L. Leighton, E. Green, M. Hoyle, K. Jones, A. Hudson, A. J. James, A. Shore, A. Higham, B. Martin, and U.S. Prospective Diabetes Study Group. 1998. "Tight blood pressure control and risk of macrovascular and microvascular complications in type 2 diabetes: UKPDS 38." <i>British Medical Journal</i> 317 (7160):703-713.</p>	
MRAC_41	<p>Taylor, D. W. 1991. "Beneficial effect of carotid endarterectomy in symptomatic patients with high-grade carotid stenosis." <i>New England Journal of Medicine</i> 325 (7):445-453.</p>	3045
MRAC_42	<p>Tonkin, A., P. Aylward, D. Colquhoun, P. Glasziou, P. Harris, S. MacMahon, P. Magnus, D. Newel, P. Nestel, N. Sharpe, D. Hunt, J. Shaw, R. J. Simes, P. Thompson, A. Thomson, M. West, H. White, S. Simes, W. Hague, S. Caleo, J. Hall, A. Martin, S. Mulray, P. Barter, L. Beilin, R. Collins, J. McNeil, P. Meier, H. Willimott, D. Smithers, P. Wallace, D. Sullivan, A. Keech, and the Long-Term Intervention with Pravastatin in Ischaemic Disease (LIPID) Study Group. 1998. "Prevention of cardiovascular events and death with pravastatin in patients with coronary heart disease and a broad range of initial cholesterol levels." <i>New England Journal of Medicine</i> 339 (19):1349-1357.</p>	3021

MRAC code	Bibliographic reference	No. of citations (as of 30 June 2010)
MRAC_43	<p>Tuomilehto, J., J. Lindstrom, J. G. Eriksson, T. T. Valle, H. Hamalainen, P. Ilanne-Parikka, S. Keinanen-Kiukaanniemi, M. Laakso, A. Louheranta, M. Rastas, V. Salminen, M. Uusitupa, S. Aunola, Z. Cepaitis, V. Moltchanov, M. Hakumaki, M. Mannelin, V. Martikkala, J. Sundvall, and the Finnish Diabetes Prevention Study Group. 2001. "Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance." <i>New England Journal of Medicine</i> 344 (18):1343-1350.</p>	2690
MRAC_44	<p>Turner, R. C., R. R. Holman, C. A. Cull, I. M. Stratton, D. R. Matthews, V. Frighi, S. E. Manley, A. Neil, K. McElroy, D. Wright, E. Kohner, C. Fox, D. Hadden, Z. Mehta, A. Smith, Z. Nugent, R. Peto, A. I. Adel, J. I. Mann, P. A. Bassett, S. F. Oakes, T. L. Dornan, S. Aldington, H. Lipinski, R. Collum, K. Harrison, C. MacIntyre, S. Skinner, A. Mortemore, D. Nelson, S. Cockley, S. Levien, L. Bodsworth, R. Willox, T. Biggs, S. Dove, E. Beattie, M. Gradwell, S. Staples, R. Lam, F. Taylor, L. Leung, R. D. Carter, S. M. Brownlee, K. E. Fisher, K. Islam, R. Jelfs, P. A. Williams, F. A. Williams, P. J. Sutton, A. Ayres, L. J. Logie, C. Lovatt, M. A. Evans, L. A. Stowell, I. Ross, I. A. Kennedy, D. Croft, A. H. Keen, C. Rose, M. Raikou, A. E. Fletcher, C. Bulpitt, C. Battersby, J. S. Yudkin, R. Stevens, M. R. Stearn, S. L. Palmer, M. S. Hammersley, S. L. Franklin, R. S. Spivey, J. C. Levy, C. R. Tidy, N. J. Bell, J. Steemson, B. A. Barrow, R. Coster, K. Waring, L. Nolan, E. Truscott, N. Walravens, L. Cook, H. Lampard, C. Merle, P. Parker, J. McVittie, I. Draisey, L. E. Murchison, A. H. E. Brunt, M. J. Williams, D. W. Pearson, X. M. P. Petrie, M. E. J. Lean, D. Walmsley, F. Lyall, E. Christie, J. Church, E. Thomson, A. Farrow, J. M. Stowers, M. Stowers, K. McHardy, N. Patterson, A. D. Wright, N. A. Levi, A. C. I. Shearer, R. J. W. Thompson, G. Taylor, S. Rayton, M. Bradbury, A. Glover, A. Smyth-Osbourne, C. Parkes, J. Graham, P. England, S. Gyde, C. Eagle, B. Chakrabarti, J. Smith, J. Sherwell, N. W. Oakley, M. A. Whitehead, G. P. Hollier, T. Pilkington, J. Simpson, M. Anderson, S. Martin, J. Kean, B. Rice, A. Rolland, J. Nisbet, E. M. Kohner, A. Dornhorst, M. C. Doddridge, M. Dumskyij, S. Walji, P. Sharp, M. Sleightholm, G. Vanterpool, G. Frost, M. Roseblade, S. Elliott, S. Forrester, M. Foster, K. Myers, R. Chapman, J. R. Hayes, R. W. Henry, M. S. Featherston, G. P. R. Archbold, M. Copeland, R. Harper, I. Richardson, H. A. Davison, L. Alexander, J. H. B. Scarpello, D. E. Shiers, R. J. Tucker, J. R. H. Worthington, S. Angris, A. Bates, J. Walton, M.</p>	6676

MRAC code	Bibliographic reference	No. of citations (as of 30 June 2010)
	<p>Teasdale, J. Browne, S. Stanley, B. A. Davis, R. C. Strange, D. R. Hadden, L. Kennedy, A. B. Atkinson, P. M. Bell, D. R. McCance, J. Rutherford, A. M. Culbert, C. Hegan, H. Tennet, N. Webb, I. Robinson, J. Holmes, S. Nesbitt, A. S. Spathis, S. Hyer, M. E. Nanson, L. M. James, J. M. Tyrell, C. Davis, P. Strugnell, M. Booth, H. Petrie, D. Clark, S. Hulland, J. L. Barron, B. C. Gould, J. Singer, A. Badenoch, M. McGregor, L. Isenberg, M. Eckert, K. Alibhai, E. Marriot, C. Cox, R. Price, M. Fernandez, A. Ryle, S. Clarke, G. Wallace, E. Mehmed, J. A. Lankester, E. Howard, A. Waite, S. MacFarlane, R. H. Greenwood, J. Wilson, M. J. Denholm, R. C. Temple, K. Whitfield, F. Johnson, C. Munroe, S. Gorick, E. Duckworth, M. Fatman, S. Rainbow, L. Borthwick, D. J. Wheatcroft, R. J. Seaman, R. A. Christie, W. Wheatcroft, P. Musk, J. White, S. McDougal, M. Bond, P. Raniga, J. L. Day, M. J. Doshi, J. G. Wilson, J. R. Howard-Williams, H. Humphreys, A. Graham, K. Hicks, S. Hexman, P. Bayliss, D. Pledger, R. W. Newton, R. T. Jung, C. Roxburgh, B. Kilgallon, L. Dick, N. Waugh, S. Kilby, A. Ellingford, J. Burns, C. V. Fox, M. C. Holloway, H. M. Coghill, N. Hein, A. Fox, W. Cowan, M. Richard, K. Quested, S. J. Evans, R. B. Paisey, N. P. R. Brown, A. J. Tucker, R. Paisey, F. Garrett, J. Hogg, P. Park, K. Williams, P. Harvey, R. Wilcocks, S. Mason, J. Frost, C. Warren, P. Rocket, L. Bower, J. M. Roland, D. J. Brown, J. Youens, K. Stanton-King, H. Mungall, V. Ball, W. Maddison, D. Donnelly, S. King, P. Griffin, S. Smith, S. Church, G. Dunn, A. Wilson, K. Palmer, P. M. Brown, D. Humphriss, A. J. M. Davidson, R. Rose, L. Armistead, S. Townsend, P. Poon, I. D. A. Peacock, N. J. C. Culverwell, M. H. Charlton, B. P. S. Connolly, J. Peacock, J. Barrett, J. Wain, W. Beeston, G. King, P. G. Hill, A. J. M. Boulton, A. M. Robertson, V. Katoulis, A. Olukoga, H. McDonald, S. Kumar, F. Abouaesha, B. Abuaisha, E. A. Knowles, S. Higgins, J. Booker, J. Sunter, K. Breislin, R. Parker, P. Raval, J. Curwell, H. Davenport, G. Shawcross, A. Prest, J. Grey, H. Cole, C. Sereviratne, R. J. Young, J. R. Clyne, M. Gibson, I. O'Connell, L. M. Wong, S. J. Wilson, K. L. Wright, C. Wallace, D. McDowell, A. C. Burden, E. M. Sellen, R. Gregory, M. Roshan, N. Vaghela, M. Burden, C. Sherriff, S. Mansingh, J. Clarke, J. Grenfell, J. E. Tooke, K. MacLeod, C. Seamark, M. Rammell, C. Pym, J. Stockman, C. Yeo, J. Piper, L. Leighton, E. Green, M. Hoyle, K. Jones, A. Hudson, A. J. James, A. Shore, A. Higham, B. Martin, H. A. W. Neil, W. J. H. Butterfield, W. R. S. Doll, R. Eastman, F. R. Ferris, N. Kurinij, K. McPherson, R. F. Mahler, T. W. Meade,</p>	

MRAC code	Bibliographic reference	No. of citations (as of 30 June 2010)
	G. Shafer, P. J. Watkins, H. Keen, D. Siegel, D. J. Betteridge, R. D. Cohen, D. Currie, J. Darbyshire, J. V. Forrester, T. Guppy, D. G. Johnston, A. McGuire, M. Murphy, A. M. el-Nahas, B. Pentecost, D. Spiegelhalter, Kgmm Alberti, R. Denton, P. D. Home, S. Howell, J. R. Jarrett, V. Marks, M. Marmot, J. D. Ward, and the U.K. Prospective Diabetes Study (UKPDS) Group. 1998. "Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33)." <i>Lancet</i> 352 (9131):837-853.	
MRAC_45	Turner, R. C., R. R. Holman, I. M. Stratton, C. A. Cull, D. R. Matthews, S. E. Manley, V. Frighi, D. Wright, A. Neil, E. Kohner, H. McElroy, C. Fox, D. Hadden, and the U.K. Prospective Diabetes Study (UKPDS) Group. 1998. "Effect of intensive blood-glucose control with metformin on complications in overweight patients with type 2 diabetes (UKPDS 34)." <i>Lancet</i> 352 (9131):854-865.	2288
MRAC_46	Van den Berghe, G., P. Wouters, F. Weekers, C. Verwaest, F. Bruyninckx, M. Schetz, D. Vlasselaers, P. Ferdinande, P. Lauwers, and R. Bouillon. 2001. "Intensive insulin therapy in critically ill patients." <i>New England Journal of Medicine</i> 345 (19):1359-1367.	2781
MRAC_47	Weidner, N., J. P. Semple, W. R. Welch, and J. Folkman. 1991. "Tumor angiogenesis and metastasis: correlation in invasive breast carcinoma." <i>New England Journal of Medicine</i> 324 (1):1-8.	3205
MRAC_48	Young, T., M. Palta, J. Dempsey, J. Skatrud, S. Weber, and S. Badr. 1993. "The occurrence of sleep-disordered breathing among middle-aged adults." <i>New England Journal of Medicine</i> 328 (17):1230-1235.	3132
MRAC_49	Yusuf, S. 1991. "Effect of enalapril on survival in patients with reduced left ventricular ejection fractions and congestive heart failure." <i>New England Journal of Medicine</i> 325 (5):293-302.	2654
MRAC_50	Yusuf, S., P. Sleight, J. Pogue, J. Bosch, R. Davies, G. Dagenais, and the Heart Outcomes Prevention Evaluation Study Investigators. 2000. "Effects of an angiotensin-converting-enzyme inhibitor, ramipril, on cardiovascular events in high-risk patients." <i>New England Journal of Medicine</i> 342 (3):145-153.	3953



Table A2. Medical Subject Heading (MeSH) Major Topic Key Words for MRAC.

<b>MeSH Major Topic Key Word</b>	<b>n</b>
anticholesteremic-agents/therapeutic-use	5
coronary-disease/prevention-&-control	5
diabetes-mellitus,-type-2/complications	5
antihypertensive-agents/therapeutic-use	4
hypoglycemic-agents/therapeutic-use	4
angiotensin-receptor-antagonists	3
anti-inflammatory-agents,-non-steroidal/therapeutic-use	3
aspirin/therapeutic-use	3
captopril/therapeutic-use	3
cardiovascular-diseases/prevention-&-control	3
diabetic-nephropathies/drug-therapy	3
heart-failure/drug-therapy	3
hepatitis-c,-chronic/drug-therapy	3
insulin/therapeutic-use	3
pravastatin/therapeutic-use	3
adrenergic-beta-antagonists/therapeutic-use	2
angioplasty,-balloon,-coronary	2
angiotensin-converting-enzyme-inhibitors/therapeutic-use	2
antineoplastic-combined-chemotherapy-protocols/therapeutic-use	2
antiviral-agents/therapeutic-use	2
atenolol/therapeutic-use	2
c-reactive-protein/analysis	2
cardiovascular-diseases/mortality	2
coronary-disease/drug-therapy	2
coronary-disease/surgery	2
coronary-disease/therapy	2
diabetes-mellitus,-type-2/prevention-&-control	2
estrogen-replacement-therapy	2
estrogens,-conjugated-(usp)/therapeutic-use	2
exercise	2
hypertension/drug-therapy	2
interferon-alpha/therapeutic-use	2
losartan/therapeutic-use	2
medroxyprogesterone-acetate/therapeutic-use	2
metformin/therapeutic-use	2
myocardial-infarction/epidemiology	2
obesity/epidemiology	2
progesterone-congeners/therapeutic-use	2
ribavirin/therapeutic-use	2

<b>MeSH Major Topic Key Word</b>	<b>n</b>
stents	2
weight-loss	2
acquired-immunodeficiency-syndrome/mortality	1
aids-related-opportunistic-infections/epidemiology	1
air-pollution/adverse-effects	1
anti-hiv-agents/therapeutic-use	1
antibodies,-monoclonal/administration-&-dosage	1
antibodies,-monoclonal/therapeutic-use	1
antineoplastic-agents/therapeutic-use	1
arterial-occlusive-diseases/surgery	1
arteriosclerosis/prevention-&-control	1
atrial-fibrillation/etiology	1
atrial-premature-complexes/complications	1
biphenyl-compounds/therapeutic-use	1
blood-glucose/analysis	1
blood-pressure/drug-effects	1
brain-ischemia/etiology	1
brain-ischemia/prevention-&-control	1
breast-neoplasms/blood-supply	1
breast-neoplasms/drug-therapy	1
breast-neoplasms/epidemiology	1
camptothecin/analogs-&-derivatives	1
carbazoles/therapeutic-use	1
carcinoma,-non-small-cell-lung/genetics	1
cardiomegaly/drug-therapy	1
cardiovascular-diseases/drug-therapy	1
cardiovascular-diseases/epidemiology	1
carotid-arteries/surgery	1
carotid-artery-diseases/surgery	1
catheter-ablation	1
cause-of-death	1
cerebrovascular-disorders/drug-therapy	1
cerebrovascular-disorders/prevention-&-control	1
cholesterol,-hdl/blood	1
cholesterol,-ldl/blood	1
cholesterol/blood	1
colorectal-neoplasms/drug-therapy	1
complementary-therapies/trends	1
coronary-disease/epidemiology	1
critical-illness/therapy	1
diabetes-mellitus,-type-1/drug-therapy	1

MeSH Major Topic Key Word	n
diabetes-mellitus,-type-2/drug-therapy	1
diabetes-mellitus/blood	1
diabetic-angiopathies/prevention-&-control	1
diabetic-retinopathy/prevention-&-control	1
diet,-fat-restricted	1
enalapril/therapeutic-use	1
endarterectomy	1
fibrinolytic-agents/therapeutic-use	1
genes,-erbb-1	1
glucose-intolerance/therapy	1
heart-failure/mortality	1
helicobacter-infections/complications	1
helicobacter-pylori	1
hiv-infections/drug-therapy	1
hiv-infections/transmission	1
hiv-protease-inhibitors/therapeutic-use	1
hospital-mortality	1
hypercholesterolemia/drug-therapy	1
hypertension/prevention-&-control	1
infectious-disease-transmission,-vertical/prevention-&-control	1
inflammation/complications	1
interferon-alpha	1
interferon-alpha/therapeutic-use	1
kidney-failure,-chronic/prevention-&-control	1
life-style	1
lovastatin/therapeutic-use	1
lung-neoplasms/genetics	1
mineralocorticoid-receptor-antagonists/therapeutic-use	1
mortality	1
myocardial-infarction/complications	1
myocardial-infarction/drug-therapy	1
myocardial-infarction/etiology	1
myocardial-infarction/prevention-&-control	1
myocardial-ischemia/prevention-&-control	1
neoplasm-metastasis/pathology	1
neovascularization,-pathologic/pathology	1
obesity	1
obesity/blood	1
overweight	1
platelet-aggregation-inhibitors/therapeutic-use	1
polyethylene-glycols	1

<b>MeSH Major Topic Key Word</b>	<b>n</b>
polyethylene-glycols/therapeutic-use	1
postoperative-care/methods	1
pregnancy-complications,-infectious/drug-therapy	1
propranolamines/therapeutic-use	1
protein-c/therapeutic-use	1
protein-tyrosine-kinases/antagonists-&-inhibitors	1
proteins/analysis	1
pulmonary-veins/physiopathology	1
quinazolines/therapeutic-use	1
ramipril/therapeutic-use	1
receptor,-epidermal-growth-factor/genetics	1
receptor,-erbB-2/immunology	1
recombinant-proteins/therapeutic-use	1
sequence-deletion	1
simvastatin/therapeutic-use	1
sleep-apnea-syndromes/etiology	1
spironolactone/therapeutic-use	1
stomach-neoplasms/etiology	1
stroke-volume	1
stroke/epidemiology	1
stroke/prevention-&-control	1
sulfonylurea-compounds/therapeutic-use	1
systemic-inflammatory-response-syndrome/drug-therapy	1
tetrazoles/therapeutic-use	1
ticlopidine/analogs-&-derivatives	1
tissue-plasminogen-activator/therapeutic-use	1
urban-health/statistics-&-numerical-data	1
ventricular-function,-left	1
zidovudine/therapeutic-use	1

Table A3. Frequencies and selection probabilities for realizations of [deny] across MRAC as a whole.

Realization, lemma	n	Selection probability	Inflected forms													Example from MRAC	Definition, OED		
not	839	25.78%																incidence of thrombotic effects was not increased	used [...] to form the negative
non-	486	14.94%																non-coronary heart disease events	negation or absence
no	394	12.11%																there were no differences	not any
un-	344	10.57%																patients with untreated metastatic colorectal cancer	the absence of a quality or state; not
fail	314	9.65%	failure	310	failed	4											heart failure	the action or state of not functioning	
without	177	5.44%																patients without disease progression	in the absence of
in-	148	4.55%																incomplete resolution	not; without; a lack of
dis-	132	4.06%																the trial was discontinued	negation
exclude	97	2.98%	excluded	53	exclusion	19	excluding	12	exclud	9	exclusion	2	exclude	1	exclusiv	1	we excluded patients with secondary hypertension	deny access to a place, group, or privilege	
ab-	52	1.60%																abnormal values	not
except	44	1.35%	except	36	exception	6	exceptions	2									except for three patients	not including; other than	
none	40	1.23%																none of the individual drugs had an adverse effect on cardiovascular outcomes	not any

Realization, lemma	n	Selection probability	Inflected forms											Example from MRAC	Definition, OED		
other than	28	0.86%														use of medications other than insulin	apart from; except
rather than	17	0.52%														it lowers, rather than increases, fasting plasma insulin concentrations	instead of; as opposed to
never	17	0.52%														twelve live-born infants never started treatment	in no time in the past or future; not ever
nor	15	0.46%														nor was lung cancer	to introduce a further negative statement
im-	14	0.43%														it was impossible to identify	not; without; a lack of
absence	16	0.49%	absence	13	absent	3										the absence of detectable HCV RNA	non-existence or lack of
contraindicate	12	0.37%	contraindication	6	contraindicated	4	contraindications	2								such drugs were previously considered to be contraindicated	suggest or indicate that (a particular technique or drug) should not be used in the case in question
refuse	12	0.37%	refused	5	refusal	3	refusers	3	refusing	1						refused to participate	decline; not willing to accept or grant
a-	11	0.34%														patients with asymptomatic carotid stenosis	not; without
neither	11	0.34%														neither wild-type nor mutant EFGR demonstrated autophosphorylation	not the one nor the other; not either

Realization, lemma	n	Selection probability	Inflected forms												Example from MRAC	Definition, OED		
lack	11	0.34%	lack	10	lacking	1											the lack of observed benefit	be without or deficient in
rule out	5	0.15%	rule out	3	ruled out	2											the possibility cannot be ruled out entirely	exclude something as a possibility
ir-	4	0.12%															repetitive focal discharges had irregular cycle lengths	not; without; a lack of
defect	4	0.12%	defects	2	defect	1	defective	1									inactivation of the EFGR gene in the mouse causes minimal defects	shortcoming, imperfection, or lack
refute	3	0.09%	refute	1	refuted	1	refutation	1									which provides some refutation of previous concerns	prove wrong; deny or contradict
outside	2	0.06%															new antiretroviral therapies outside the setting of controlled clinical trials	not belong to or coming from within a particular group
beyond	1	0.03%															infants who were beyond the neonatal period	apart from; except
decline	1	0.03%	declined	1													2 declined treatment	politely refuse
forbidden	1	0.03%															platelet aggregation testing was forbidden	not allowed
nobody	1	0.03%															nobody was excluded	no person; no one
proscribe	1	0.03%	proscribed	1													simultaneous coronary-artery bypass grafting and simultaneous bilateral carotid endarterectomy were proscribed	forbidden
<b>Total</b>	<b>3254</b>	<b>100.00%</b>																

Table A4. Frequencies and selection probabilities for realizations of [counter] across MRAC as a whole.

Realization, lemma	n	Selection probability	Inflected forms								Example from MRAC	Definition, OED
but	284	21.19%									but it is not harmful	contrasting with what has already been mentioned
however	177	13.21%									in previous studies, however, the average duration of treatment was only a few months	used to introduce a statement that contrasts with or seems to contradict something that has been said previously
only	176	13.13%									only 19 women had received any antiretroviral treatment before the current pregnancy	no more than (implying that more was expected); merely
although	126	9.40%									although the trends were in the same direction	in spite of the fact; even though; however; but
remain	63	4.70%	remained	36	remains	15	remain	8	remaining	4	this finding remained essentially unchanged after further adjustment for other coronary risk factors	continue to exist, especially after other similar people or things have ceased to do so
even	53	3.96%									even when alternative therapies are covered, they tend to...	used to emphasize something surprising or extreme; used in comparisons for emphasis
despite	45	3.36%									an increase in major cardiac events, despite the limitations imposed by stent thrombosis	in spite of
except	44	3.28%	except	36	exception	6	exceptions	2			in all patients except those who had died	not including: other than
whereas	41	3.06%									whereas peptic ulcer was negatively associated with the subsequent development of cancer	in contrast or comparison with the fact that
actual	39	2.91%									the actual prevalence of hypersomnolence may be higher	existing in fact; real
regardless	31	2.31%									regardless of the concomitant use of these medications	despite the prevailing circumstances
still	29	2.16%									there were still no significant differences	even now (or then) as formerly
other than	28	2.09%									any condition other than heart failure	apart from; except



Realization, lemma	n	Selection probability	Inflected forms								Example from MRAC	Definition, OED
contrast	23	1.72%	in contrast	14	by contrast	5	in contrast to	3	by contrast with	1	in contrast, the occurrence of metastases increased	the state of being strikingly different from something else in juxtaposition or close association
unless	19	1.42%									will stay at the injection site indefinitely as a tattoo, unless neovascularization is induced	except if (used to introduce the case in which a statement being made is not true or valid)
rather than	17	1.27%									it lowers, rather than increases, fasting plasma insulin concentrations	used to suggest that the opposite of a previous statement is the case; on the contrary
irrespective	15	1.12%									among a wide range of high-risk individuals, irrespective of their initial cholesterol concentrations	regardless of
do	14	1.04%	did	11	do	2	does	1			this therapy did increase the risk of venous thromboembolic events and gallbladder disease	used to give emphasis to a positive verb
while	12	0.90%									while subcutaneous progesterone does not	whereas (indicating a contrast); in spite of the fact that; although
yet	11	0.82%									yet previous trials in heart failure have not demonstrated a reduction in mortality	in spite of that; nevertheless; but at the same time; but nevertheless
though	10	0.75%									though a direct anabolic effect of insulin on respiratory muscles may also play a part	despite the fact that; although; however (indicating that a factor qualifies or imposes restrictions on what was said previously)
just	9	0.67%									added just one event to those in the medical group	simply; only; no more than
persist	9	0.67%	persisted	5	persist	2	persisting	1	persists	1	adverse effects in cardiovascular diseases persisted, although these results were still within the monitoring boundaries	continue in an opinion or course of action in spite of difficulty or opposition
continue	6	0.45%	continued	3	continue	1	continues	1	continuing	1	the prevalence of obesity has continued to increase in men	persist in an activity or process; remain in existence or operation
nevertheless	5	0.37%									nevertheless, patients assigned chlorpropamide did not have the same risk reduction	in spite of that; notwithstanding; all the same
provided	5	0.37%									were eligible provided their blood pressure could be maintained within the blood-pressure goals	on the condition or understanding that
true	5	0.37%									the true prevalence in the general population	real or actual

Realization, lemma	n	Selection probability	Inflected forms							Example from MRAC	Definition, OED
actually	4	0.30%								the rate of coronary heart disease in women in Turku is actually lower than that in women in the United States	used when expressing a contradictory or unexpected opinion or correcting someone
already	4	0.30%								who were already taking drugs other than an angiotensin-converting-enzyme inhibitor	before or by now or the time in question; as surprisingly soon or early as this
nonetheless	4	0.30%								nonetheless, overall, treatment with ramipril was beneficial	in spite of that; nevertheless
otherwise	4	0.30%								otherwise, the worst possible score was assigned	in other respects; apart from that; indicating the opposite of or a contrast to something stated
simply	4	0.30%								it could simply represent random variation	merely; just
albeit	3	0.22%								there was evidence, albeit inconclusive, of a 16% risk reduction	though
in fact	3	0.22%								atrial fibrillation was in fact the result of the abrupt transformation	used to emphasize the truth of an assertion, especially one opposite to what might be expected or what has been asserted
instead	3	0.22%								instead, echocardiograms were obtained at three centers	as a substitute or alternative to; in place of
conversely	2	0.15%								or, conversely, a clear contraindication	introducing a statement or idea which reverses one that has just been made or referred to
in spite of	2	0.15%								occurred in spite of the limited availability of oxaliplatin	without being affected by the particular factor mentioned; although one did not want or expect to do so
now	2	0.15%								chronic hepatitis C infection is now recognized as an important health care problem	at the present time or moment [in contrast to the past]
on the other hand	2	0.15%								on the other hand, the time trend is biologically plausible	used to present factors which are opposed or which support opposing opinions
rather	2	0.15%								we did not try to separate these changes but, rather, tried to achieve changes in lifestyle	used to suggest that the opposite of a previous statement is the case; on the contrary
aside from	1	0.07%								aside from optimization of hemodynamic status, no other strategy to prevent renal failure has proved effective	apart from

Realization, lemma	n	Selection probability	Inflected forms							Example from MRAC	Definition, OED
besides	1	0.07%								there are few other environmental factors, besides H. pylori infection	in addition to; apart from
merely	1	0.07%								men and women who seek evaluation for sleep-disordered breathing are merely a fraction of the total	just; only
real	1	0.07%								the real issue is not	actually existing as a thing or occurring in fact; not imagined or supposed
solely	1	0.07%								derives solely from its restriction of angiotensin activity	not involving anyone or anything else; only
<b>Total</b>	<b>1342</b>	<b>100.00%</b>									

Table A5. Frequencies and selection probabilities for realizations of [concur] across MRAC as a whole.

Realization, lemma	n	Selection probability	Example from MRAC	Definition, OED
clear	25	40.98%	it is clear that the switch to the angiogenic phenotype demarcates two stages in the development of a tumor	leaving no doubt; obvious or unambiguous
clearly	17	27.87%	treatment was clearly beneficial	without doubt; obviously
evident	11	18.03%	a consistent reduction in the risk of retinopathy with intensive therapy was evident in all subgroups	clearly seen or understood; obvious
obvious	5	8.20%	it became obvious a 40% advantage was unlikely to be obtained	easily perceived or understood; clear, self-evident, or apparent
logical	2	3.28%	carotid endarterectomy was introduced in 1954 as a logical procedure for the prevention of ischemic stroke distal to carotid-artery stenosis	expected or sensible under the circumstances
inevitably	1	1.64%	but it inevitably reduced the APACHE II scores	as one would expect; predictably
<b>Total</b>	<b>61</b>	<b>100.00%</b>		

Table A6. Frequencies and selection probabilities for realizations of [pronounce] across MRAC as a whole.

Realization, lemma	n	Selection probability	Inflected forms					Example from MRAC	Definition, OED	
indeed	13	18.57%						indeed, the mean total cholesterol level in our study approximates that in recent epidemiologic studies of patients with CHD	used to emphasize a statement or response confirming something already suggested	
the fact that	13	18.57%	the fact that	11	the facts that	2		the fact that the trial was stopped early decreases the precision of estimates of long-term treatment effects	used to refer to a particular situation under discussion	
note	8	11.43%	note	4	noted	3	noting	1	it should be noted that the number of events during follow-up in our trial was not small	notice or pay particular attention to (something); remark upon (something) in order to draw attention to it
noteworthy	5	7.14%							it is noteworthy that no stent thrombosis occurred in the 13 patients treated with a bailout stent	worth paying attention to; interesting or significant
true	4	5.71%							this is especially true when the investigator is not kept unaware of the treatment assignments	real or actual
emphasize	3	4.29%	emphasized	3					several limitations of stent placement need to be emphasized	give special importance or value to (something) in speaking or writing
in fact	3	4.29%							in fact, this did not occur	used to emphasize the truth of an assertion, especially one opposite to what might be expected or what has been asserted
merit	3	4.29%							several mechanisms merit discussion	deserve or be worthy of (reward, punishment, or attention)
remarkably	3	4.29%							remarkably, all of these deletions overlapped	in a way that is worthy of attention
unequivocally	3	4.29%							the present study has demonstrated unequivocally that lowering LDL cholesterol [...] reduces vascular disease risk	in a way that leaves no doubt
emphasis	2	2.86%							this emphasis on genetic alterations	special importance, value, or prominence given to something
notably	2	2.86%							their architectural topography can accommodate various electrophysiologic mechanisms, notably automaticity	in a way that is striking or remarkable
of note	2	2.86%	of note	1	of particular note	1			of note, most of the recurrent atrial fibrillation was associated with recurrent ectopic beats	worth paying attention to
deserve	1	1.43%							four patients deserve special emphasis	do something or have or show qualities worthy of (a reaction which rewards or punishes as appropriate)
extraordinarily	1	1.43%							H. pylori infection is extraordinarily common	in a very unusual or remarkable way

Realization, lemma	n	Selection probability	Inflected forms						Example from MRAC	Definition, OED
interestingly	1	1.43%							interestingly, [...], completion of therapy with dose reduction was not associated with a substantial decrease in efficacy	in a way that arouses curiosity or interest
of particular interest	1	1.43%							the L861Q mutation is of particular interest	of interest: interesting
pivotal	1	1.43%							part 2, the pivotal study, used four outcome measures	of crucial importance in relation to the development or success of something else
worthwhile	1	1.43%							there was a worthwhile reduction in the number of patients who were hospitalized	of value or importance
<b>Total</b>	<b>70</b>	<b>100.00%</b>								

Table A7. Frequencies and selection probabilities for realizations of [endorse] across MRAC as a whole.

Realization, lemma	n	Selection probability	Inflected forms						Example in MRAC	Definition, OED									
show	141	11.75%	showed	49	4.08%	shown	48	4.00%	show	24	2.00%	shows	12	1.00%	showing	8	0.67%	the BRFS showed a prevalence of obesity of 12% to 14.4% during 1991 to 1994	demonstrate or prove
finding (n)	137	11.42%	findings	89	7.42%	finding	48	4.00%										the WHI findings for CHD and VTE are supported by findings from HERS	information discovered as the result of an inquiry or investigation
indicate	125	10.42%	indicate	53	4.42%	indicated	39	3.25%	indicating	21	1.75%	indicates	12	1.00%				laboratory studies indicate that amplification of HER2 has a direct role in the pathogenesis of these cancers	point out; show; be a sign of; strongly suggest
find	111	9.25%	found	99	8.25%	find	12	1.00%										a recent North American study found that only 30 percent of patients who had survived a myocardial infarction were	ascertain by study, calculation, or inquiry

Realization , lemma	n	Selecti on probabi lity	Inflected forms													Example in MRAC	Definition, OED	
																	prescribed lipid-lowering drugs	
determine	83	6.92%	determine	47	3.92%	determined	35	2.92%	determining	1	0.08%						the independent data monitoring committee determined that the study results warranted terminating the trial	ascertain or establish exactly by research or calculation; firmly decide
evidence (n)	80	6.67%															there is evidence from the Antiplatelet Trialists' Collaboration to support a widespread effect	the available body of facts or information indicating whether a belief or proposition is true or valid
confirm	75	6.25%	confirmed	57	4.75%	confirm	11	0.92%	confirming	4	0.33%	confirms	3	0.25%			reported stroke was confirmed on the basis of medical records	establish the truth or correctness of (something previously believed or suspected to be the case)
demonstrate	69	5.75%	demonstrated	45	3.75%	demonstrate	13	1.08%	demonstrates	7	0.58%	demonstrating	4	0.33%			those trials have demonstrated a clear reduction in the incidence of coronary events	clearly show the existence or truth of (something) by giving proof or evidence
know	56	4.67%	known	55	4.58%	know	1	0.08%									a known or suspected infection	have knowledge or information concerning; be absolutely certain or sure about something
approve	37	3.08%	approved	36	3.00%	approving	1	0.08%									the trial protocol was approved by all local ethics committees	officially agree to or accept as satisfactory
document (v)	33	2.75%	documented	29	2.42%	document	2	0.17%	documenting	1	0.08%	documents	1	0.08%			it is well documented that treatment of hypertension reduces cardiovascular morbidity and mortality	support or accompany with documentation

Realization, lemma	n	Selecti on probability	Inflected forms													Example in MRAC	Definition, OED	
support (v)	32	2.67%	support	16	1.33%	supported	9	0.75%	supporting	5	0.42%	supports	2	0.17%			other studies have supported the notion that therapy with an angiotensin-converting-enzyme inhibitor preserves renal function	suggest the truth of; corroborate
establish	30	2.50%	established	24	2.00%	establish	5	0.42%	establishes	1	0.08%						the diagnosis of acute MI was established according to an algorithm adapted from standardized criteria	show (something) to be true or certain by determining the facts
indicator	18	1.50%	indicators	10	0.83%	indicator	8	0.67%									all three indicators of hypersomnolence	a thing that indicates the state or level of something
prove	15	1.25%	proved	10	0.83%	prove	3	0.25%	proven	2	0.17%						several interventions have been proven to reduce risk for CHD events in patients with coronary disease	demonstrate the truth or existence of (something) by evidence or argument
ascertain	12	1.00%	ascertained	9	0.75%	ascertain	3	0.25%									the vital status of six patients [...] had not yet been ascertained	find (something) out for certain; make sure of
indication	12	1.00%															5% were considered by their own doctors to have a clear indication for (or, rarely, contraindication to) statin therapy	a sign or piece of information that indicates something
contraindication	9	0.75%	contraindication	6	0.50%	contraindications	3	0.25%									hypertension has often been considered a contraindication to acetylsalicylic acid	[see entry for contraindicate]
reveal	9	0.75%	revealed	6	0.50%	reveal	2	0.17%	reveals	1	0.08%						an analysis comparing results at large centers with those at	make (previously unknown or secret information) known to

Realization , lemma	n	Selecti on probabi lity	Inflected forms													Example in MRAC	Definition, OED	
																	small centers [...] revealed no significant differences	others; cause or allow (something) to be seen
validate	9	0.75%	validated	8	0.67%	validate	1	0.08%									results of the primary endpoint analysis were independently validated by the steering committee statistician	demonstrate or support the truth or value of
adjudicate	8	0.67%	adjudicate d	6	0.50%	adjudicate	1	0.08%	adjudicati ng	1	0.08%						all primary and secondary events were documented and were centrally adjudicated with the use of standardized definitions	make a formal judgement on a disputed matter; pronounce or declare judicially
approval	8	0.67%															gefitinib is the first agent designed with a known molecular target to receive FDA approval for the treatment of lung cancer	the action of approving something; the belief that someone or something is good or acceptable
confirmatio n	8	0.67%															we required confirmation of the diagnosis of diabetes by a second oral glucose-tolerance test	the action of confirming something or the state of being confirmed
adjudicatio n	7	0.58%															local adjudication is complete for approximately 96% of the designated self-reported events	the action or process of adjudicating; a formal judgement on a disputed matter
ascertainm ent	7	0.58%															the modified WHO criteria for definite or possible myocardial infarction [...] were used in the ascertainment of the	[see entry for ascertain]



Realization, lemma	n	Select on probability	Inflected forms														Example in MRAC	Definition, OED
																	diagnosis of myocardial infarction	
verify	7	0.58%	verified	6	0.50%	verify	1	0.08%									all fracture outcomes were verified by radiology reports	make sure or demonstrate that (something) is true, accurate, or justified
definitive	6	0.50%															the WHI trial results provide the first definitive data on which to base treatment recommendations for healthy postmenopausal women with an intact uterus	(of a conclusion or agreement) done or reached decisively and with authority
determination	6	0.50%	determinations	5	0.42%	determination	1	0.08%									the determinations were made by the members of an independent response-evaluation committee	the process of establishing something exactly by calculation or research
validation	5	0.42%															the central validation of all reported outcome events provided a consistent assessment	the action of checking or proving the validity or accuracy of something
adjudicator	4	0.33%	adjudicators	3	0.25%	adjudicator	1	0.08%									clinical center physician adjudicators were centrally trained and blinded to treatment assignment and participants' symptoms	a person who adjudicates [see entry for adjudicate]
contraindicate	4	0.33%	contraindicated	4	0.33%												such drugs were previously considered to be contraindicated in this disorder	(of a condition or circumstance) suggest or indicate that (a particular technique or drug) should not be

Realization , lemma	n	Selecti on probabi lity	Inflected forms														Example in MRAC	Definition, OED	
																			used in the case in question
indication	4	0.33%	indications	4	0.33%													an indication for admission other than cardiac surgery	a sign or piece of information that indicates something
knowledge	4	0.33%																this study extends our knowledge of the efficacy of antihypertensive therapy in patients with type 2 diabetes and nephropathy	facts, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject
accept	3	0.25%	accepted	3	0.25%													in line with accepted guidelines	believe or come to recognize (a proposition) as valid or correct
elucidate	3	0.25%	elucidated	2	0.17%	elucidate	1	0.08%										which has been elucidated in studies of carcinoma of the cervix	make (something) clear; explain
identify	3	0.25%	identified	3	0.25%													phase 1 and 2 trials have identified hemorrhage	establish or indicate who or what (someone or something) is
proof	3	0.25%																the randomised comparisons in the study had provided [...] "proof beyond reasonable doubt"	evidence or argument establishing a fact or the truth of a statement
conclusive	2	0.17%																two previous small, randomized studies of intravenous t-PA for stroke found no conclusive evidence of efficacy	(of evidence or argument) having or likely to have the effect of proving a case; decisive
demonstration	2	0.17%																the clear demonstration of a reduction in ischaemic stroke, without any evidence	an act of showing that something exists or is true by giving proof or evidence

Realization , lemma	n	Selecti on probabi lity	Inflected forms														Example in MRAC	Definition, OED	
																		of an adverse effect on haemorrhagic stroke	
documenta tion	2	0.17%																confirmed by the documentation of a positive venography study	material that provides official information or evidence or that serves as a record
recognition	2	0.17%																with the recognition that atherosclerosis is an inflammatory process, several plasma markers of inflammation have also been evaluated	acknowledgement of the existence, validity, or legality of something
recognize	2	0.17%	recognized	1	0.08%	recognised	1	0.08%										chronic hepatitis C infection is now recognized as an important health care problem	acknowledge the existence, validity, or legality of
substantiat e	2	0.17%	substantiat ed	2	0.17%													the indication for a second intervention or for bypass surgery had to be substantiated by symptoms or by electrocardiographic or scintigraphic evidence	provide evidence to support or prove the truth of
confirmato ry	1	0.08%																venous origin of the earliest ectopic activity was demonstrated [...] by confirmatory angiographic visualization	[see entry for confirm]
corroborat e	1	0.08%	corroborat ed	1	0.08%													if the inverse relation between ulcer disease and cancer is corroborated, important clues to	confirm or give support to (a statement, theory, or finding)

Realization, lemma	n	Selecti on probability	Inflected forms													Example in MRAC	Definition, OED	
evidence (v)	1	0.08%	evidenced	1	0.08%												the pathogenesis of carcinoma may be uncovered	be or show evidence of
implicate	1	0.08%															studies in animal models of diabetes and epidemiologic studies implicate hyperglycemia in the pathogenesis of long-term complications	show (someone) to be involved in a crime
validity	1	0.08%															the validity of generalizing the results of previous prevention studies is uncertain	the quality of being logically or factually sound; soundness or cogency
<b>Total</b>	<b>1200</b>	<b>100.00%</b>																

Table A8. Frequencies and selection probabilities for realizations of [justify] across MRAC as a whole.

Realization, lemma	n	Selection probability	Inflected forms						Example from MRAC	Definition, OED
to	295	29.80%							to address these issues, we measured base-line plasma C-reactive protein concentrations in 1086 apparently healthy men participating in the Physicians' Health Study	[infinitive marker typically introducing nonfinite clauses of cause or reason]
because	220	22.22%							because a number of women stopped study medications during follow-up, several analyses were performed to examine the sensitivity of the principal HR estimates	for the reason that; since
since	87	8.79%							platelet aggregation testing was forbidden since the results might have revealed treatment allocation	for the reason that; because

Realization, lemma	n	Selection probability	Inflected forms						Example from MRAC	Definition, OED
due to	83	8.38%							this is due to smaller sample sizes and fewer degrees of freedom than for the overall estimates	caused by or ascribable to; because of; owing to
thus	59	5.96%							thus, only appropriate past information was used in estimation of curves and confidence bands	as a result or consequence of this; therefore
therefore	58	5.86%							therefore, we conducted a multicenter, randomized study	for that reason; consequently
reason (n)	38	3.84%	reasons	31	3.13%	reason	7	0.71%	4059 patients (21–2%) had study drug permanently discontinued early, for reasons other than the occurrence of an outcome event	a cause, explanation, or justification for an action or event
on the basis of	26	2.63%							one hundred twenty-eight subjects with insulin-dependent diabetes had previously been excluded on the basis of C-peptide measurements	the justification for or reasoning behind something
so	22	2.22%							the study medication was discontinued so that open-label therapy with an angiotensin-converting-enzyme inhibitor could be started	and for this reason; therefore
hence	19	1.92%							hence, our study does not allow any conclusions to be drawn about the safety of carvedilol	as a consequence; for this reason
in order to	15	1.52%							two cohorts of patients were studied in order to answer two different, but related, questions	with the purpose of doing something
given	15	1.52%							liver function was monitored routinely, given the experimental stage of clopidogrel	taking into account
consequently	9	0.91%							consequently, our data do not clarify the effects of pravastatin early after an acute coronary event	as a result
as a result	6	0.61%							as a result, more patients in the losartan than in the atenolol group remained on masked drugs	a consequence or outcome
purpose	6	0.61%	purpose	5	0.51%	purposes	1	0.10%	the purpose of this study was to compare the effects of stent placement and standard balloon angioplasty	the reason for which something is done or created or for which something exists
for	5	0.51%							295 of 7092 patients (4.2 percent) were excluded from the study during this phase (1.8 percent for worsening congestive heart failure or worsening angina and 2.4 percent for poor compliance)	having (the thing mentioned) as a reason or cause
accordingly	4	0.40%							accordingly the study was extended	as a result; therefore
owing to	4	0.40%							was higher than the incidence in observational studies, perhaps owing to the greater frequency of glucose testing or to the selection of persons at higher risk in our study	because of or on account of
as	3	0.30%							as this did not happen, the Steering Committee [...] remained unaware of the results	because; since
as a consequence	3	0.30%							as a consequence, the board advised HERS investigators to report the findings [...]	a result or effect, typically one that is unwelcome or unpleasant
rationale	3	0.30%							the underlying rationale for our study was that the inhibition of angiotensin-converting enzyme would prevent events related to ischemia and atherosclerosis	a set of reasons or a logical basis for a course of action or belief

Realization, lemma	n	Selection probability	Inflected forms							Example from MRAC	Definition, OED
based on	2	0.20%								based on the finding of no overall cardiovascular benefit and a pattern of early increase in risk of CHD events, we do not recommend starting this treatment	use (something specified) as the foundation or starting point for something
in order for	2	0.20%								we planned to enroll 2500 patients in order for the study to have the capacity to detect an absolute difference in mortality	so that
in the light of	2	0.20%								in the light of conflicting information from previous reports, we must limit our recommendations	taking (something) into consideration
in view of	2	0.20%								in view of the fact that the relative ranking of the cities in terms of air-pollution levels did not change during the study period, it is not possible to differentiate [...]	because or as a result of
after	1	0.10%								we performed a randomized, double-blind trial of intravenous recombinant tissue plasminogen activator (t-PA) for ischemic stroke after recent pilot studies suggested that t-PA was beneficial	during the period of time following (an event)
justification	1	0.10%								the main justification for the type of intervention used in the high-risk subjects in this study is that it may prevent or postpone the onset of type 2 diabetes	the action of showing something to be right or reasonable
<b>Total</b>	<b>990</b>	<b>100.00%</b>									

Table A9. Frequencies and selection probabilities for realizations of [entertain] across MRAC as a whole.

Realization, lemma	n	Selecti on probab ility	Inflected forms							Example from MRAC	Definition, OED								
risk (n)	1169	13.01%	risk	1082	12.04%	risks	76	0.85%	RR	11	0.12%							the risk of death was reduced by 18 to 20 percent in the subgroups given trastuzumab	the possibility that something unplea sant or unwelcome will happen
p	787	8.76%																differences in the probability of survival among the cities were statistically significant (P<0.001)	statistics: probability
mean (n)	314	3.49%	mean	302	3.36%	means	12	0.13%										the mean age of the patients with intestinal-type adenocarcinoma was 68.7 years, as	the value obtained by dividing the sum of several

Realization, lemma	n	Select on probability	Inflected forms													Example from MRAC	Definition, OED	
																	compared with 65.6 years for patients with diffuse-type adenocarcinoma (P = 0.2)	quantities by their number; an average
confidence interval	301	3.35%	confidence interval	186	2.07%	CI	85	0.95%	confidence intervals	21	0.23%	CIs	9	0.10%			the adjusted CIs are closely related to the monitoring procedures	statistics: a range of values so defined that there is a specified probability that the value of a parameter lies within it
primary	278	3.09%															the primary outcome measure was the duration of overall survival	of chief importance; principal; earliest in time or order
include	271	3.02%	including	135	1.50%	included	107	1.19%	include	18	0.20%	includes	11	0.12%			these endpoints included macrovascular and microvascular complications	comprise or contain as part of a whole; used in a non-restrictive way, implying that there may be other things not specifically mentioned that are part of the same category
if	259	2.88%															if the event persisted, both drugs were discontinued	on the condition or supposition that; in the event that
may	239	2.66%															antiinflammatory agents may have a role in the prevention of cardiovascular disease	expressing possibility
at least	193	2.15%															patients treated with t-PA were at least 30 percent more likely to have minimal or no disability at three	not less than; at the minimum

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	months on the assessment scales	
median	167	1.86%	median	165	1.84%	median s	2	0.02%									the median gestational age at entry was 26 weeks	denoting or relating to a value or quantity lying at the midpoint of a frequency distribution of observed values or quantities, such that there is an equal probability of falling above or below it
would	148	1.65%															some combination of variables would provide a better estimate of the relative risk of metastasis than any single variable	<see entry for will>; indicating the consequence of an imagined event or situation
whether	147	1.64%															it is not clear whether the results of this trial can be extrapolated to these groups	expressing a doubt or choice between alternatives
could	141	1.57%															statin therapy could produce substantial benefits	used to indicate possibility; used to indicate a strong inclination to do something
average (n)	138	1.54%	averag e	133	1.48%	averag es	3	0.03%	on averag e	2	0.02%						all the others underwent carotid endarterectomy, performed an average of two days after randomization	a number expressing the central or typical value in a set of data, in particular the mode, median, or (most commonly) the mean, which is calculated by



Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																		dividing the sum of the values in the set by their number
suggest	137	1.52%	sugges t	48	0.53%	sugges ts	38	0.42%	sugges ting	28	0.31%	sugg este d	23	0.2 6%			our findings suggest that angiotensin II blockade in patients with renal disease decreases the risk of overt heart failure resulting in hospitalization	put forward for consideration; cause one to think that (something) exists or is the case
when	130	1.45%															protease inhibitors and non-nucleoside-analogue reverse-transcriptase inhibitors, when used as part of combination drug regimens, can profoundly suppress viral replication, with consequent repletion of CD4+ cell counts	at or during the time that
estimate (v, + adj forms)	129	1.44%	estimat ed	106	1.18%	estimat e	21	0.23%	estimat ing	2	0.02%						we estimated the effects of air pollution on mortality / the estimated effect of air pollution on mortality was not altered by the inclusion or exclusion of indicator variables for other risk factors	roughly calculate or judge the value, number, quantity, or extent of
indicate	122	1.36%	indicat e	52	0.58%	indicat ed	38	0.42%	indicati ng	21	0.23%	indic ates	11	0.1 2%			our results indicate that captopril therapy is kidney-protecting in patients with insulin-dependent diabetes who have established nephropathy	point out; show; be a sign of; strongly suggest

Realization, lemma	n	Select on probability	Inflected forms														Example from MRAC	Definition, OED	
hazard	120	1.34%	hazard	41	0.46%	hazard	35	0.39%	RH	22	0.24%	HR	19	0.21%	HRs	3	0.03%	after further adjustment for total cholesterol, hypertension, and smoking, this hazard ratio remained close to 1.0	a danger or risk; chance; probability
can	116	1.29%																C-reactive protein can induce monocytes to express tissue factor	be able to; have the opportunity or possibility to; used to indicate that something is typically the case
estimate (n)	114	1.27%	estimates	88	0.98%	estimate	26	0.29%										these estimates from the NHANES conducted in 2003-2004 provide the most recent prevalence estimates of overweight and obesity in the United States	an approximate calculation or judgment of the value, number, quantity, or extent of something
normal	99	1.10%																the normal range is 4.5-6.2%	conforming to a standard; usual, typical, or expected
likely	92	1.02%																inadequate reduction of their blood pressure is a likely cause	such as well might happen or be true; probable
about	91	1.01%																vascular disease risk is reduced by about half as much as would be expected epidemiologically from a long-term difference of the same magnitude	(used with a number or quantity) approximately
possible	84	0.93%																it is possible that patient selection was influenced by competing trials in acute myocardial infarction	that may exist or happen, but that is not certain or probable

Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED		
trend	84	0.93%	trend	43	0.48%	trends	41	0.46%										the trend for non-cardiovascular mortality was also lower in the losartan group	a general direction in which something is developing or changing
consider	80	0.89%	considered	73	0.81%	consider	4	0.04%	considering	2	0.02%	considers	1	0.01%				none of these deaths were considered attributable to the study drug	believe to be; think
target (n)	73	0.81%	target	72	0.80%	targets	1	0.01%										the original blood pressure target of 200/105 mm Hg in the group assigned to less tight control was reduced in 1992	an objective or result towards which efforts are directed
should	72	0.80%																our findings should be interpreted with the knowledge that the trial program had several unusual characteristics for a study of the effect of a drug on survival	used to indicate obligation, duty, or correctness; indicating a desirable or expected state; used to give or ask advice or suggestions; used to indicate what is probable
intention	71	0.79%																the analysis was by intention to treat	a thing intended; an aim or plan <intention-to-treat analyses study the effects of intended treatment rather than actual treatment>
for example	71	0.79%	eg	33	0.37%	for example	19	0.21%	e.g.	19	0.21%							sympathetic antagonists (e.g., beta-blockers) might be useful in the management of heart failure	used to introduce something chosen as a typical case

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
such as	69	0.77%															endurance exercise (such as walking, jogging, swimming, aerobic ball games, or skiing) was recommended	for example
standard deviation	68	0.76%	SD	67	0.75%	standa rd deviati ons	1	0.01%									the respective boundaries indicating that ramipril had a harmful effect were 3 SD and 2 SD	a quantity expressing by how much the members of a group differ from the mean value for the group
most	67	0.75%															most patients with CHD have cholesterol levels that are not markedly elevated	the majority of; nearly all of
potential	64	0.71%															the potential health benefits from reduction in overweight and obesity are of considerable public health importance	having or showing the capacity to develop into something in the future; the possibility of something happening or of someone doing something in the future
some	63	0.70%															some infants became infected despite treatment with zidovudine	an unspecified amount or number of
major	58	0.65%															the major criteria for eligibility included insulin dependence [...]; an age of 13 to 39 years; and the absence of hypertension, hypercholesterolemia,	important, serious, or significant; greater or more important; main

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	and severe diabetic complications or medical conditions	
might	58	0.65%															this anomaly might result from failure to achieve normal blood pressure	used to express possibility or make a suggestion
will	56	0.62%															both these results and our findings suggest that angiotensin-converting-enzyme inhibitors will be beneficial for patients who are at high risk for heart failure	expressing probability or expectation; expressing facts about ability or capacity; expressing a strong intention or assertion about the future
approximately	54	0.60%															the male:female ratio for the prevalence of sleep-disordered breathing was approximately 3:1	used to show that something is almost, but not completely, accurate or exact; roughly
expect (v, + adj form)	53	0.59%	expect ed	51	0.57%	expect	2	0.02%									the plan was expected to produce similar numbers of more than 6000 in each of the clinical subgroups and facilitate study closedown	regard (something) as likely to happen
appear	50	0.56%	appear s	20	0.22%	appear ed	18	0.20%	appear	12	0.13%						it appears that estrogen plus progestin increases the risk of strokes in apparently healthy women	seem; give the impression of being
need (n)	48	0.53%	need	48	0.53%												these findings [...] suggest the need for reassessment of the National Cholesterol Education Program guidelines regarding	circumstances in which something is necessary; necessity; a thing that is wanted or required

Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	pharmacological intervention	
discussion	45	0.50%															DISCUSSION <heading for discussion section in some RAs>	the action or process of talking about something in order to reach a decision or to exchange ideas ; a conversation or debate about a specific topic; a detailed treatment of a topic in speech or writing
need (v)	44	0.49%	needed	33	0.37%	need	8	0.09%	needs	3	0.03%						several limitations of stent placement need to be emphasized	require (somethin g) because it is essential or very important rather than just desirabl e; expressing necessity or obligation
power (n)	43	0.48%	power	43	0.48%												this approach increased the statistical power of the comparison of treatments by including information from all available HIV cultures without requiring an 18- month follow-up of all infants	<measure of probability that null hypothesis can be rejected>
conclusion	42	0.47%	conclus ions	35	0.39%	conclus ion	7	0.08%									we draw four main conclusions from these data	the end or finish of an event, process, or text; a judgement or decision reached by reasoning

Realization, lemma	n	Selecti on probability	Infected forms													Example from MRAC	Definition, OED	
odds ratio	41	0.46%	odds ratio	39	0.43%	odds ratios	2	0.02%									three factors independently and significantly increased the odds of achieving a sustained virologic response: an HCV genotype other than 1 (odds ratio, 3.25; 95 percent confidence interval, 2.09 to 5.12; P<0.001) [...]	the chances or likelihood of something happening or being the case; <odds ratio measures the strength of association between different variables>
common	39	0.43%	common	38	0.42%	commonest	1	0.01%									obesity is common among patients with type 2 diabetes	occurring, found, or done often; prevalent; of the most familiar type
main	39	0.43%															the main justification for the type of intervention used in the high-risk subjects in this study is that it may prevent or postpone the onset of type 2 diabetes and the complications related to the disease	chief in size or importance
plan (v)	39	0.43%	planned	36	0.40%	planning	3	0.03%									these results are expected to be available in 2005, at the planned termination	decide on and make arrangements for in advance; design or make a plan of (something to be made or built); <see entry for plan (n)>
hypothesis	34	0.38%	hypothesis	26	0.29%	hypotheses	8	0.09%									the hypothesis we wished to test was that lesions that have little angiogenesis have a relatively low rate of metastasis	a supposition or proposed explanation made on the basis of limited evidence as a starting point

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED		
																			for further investigation
predictor	34	0.38%	predict or	18	0.20%	predict ors	16	0.18%										plasma cholesterol level is a strong predictor of the risk of cardiovascular events both in patients with diabetes and in patients with coronary heart disease	a person or thing that predicts that something will happen in the future or will be a consequence of something <see entry for predict>
generally	33	0.37%																losartan conferred significant renal benefits in patients with type 2 diabetes and nephropathy, and it was generally well tolerated	in most cases; usually
necessary	33	0.37%																although the relative and absolute effects we observed are clinically important, it is necessary to consider possible biases that may have modified the observed effects	needed to be done, achieved, or present; essential <see entry for need (v)>
standard error	33	0.37%	SE	27	0.30%	standa rd errors	4	0.04%	standa rd error	1	0.01%	SEM	1	0.01%				analyzing our results according to the intention-to-treat principle produced essentially the same levels of significance and standard errors for between-group differences	a measure of the statistical accuracy of an estimate, equal to the standard deviation of the theoretical distribution of a large population of such estimates
principal	32	0.36%																in many populations type 2 diabetes is the principal cause of renal failure	first in order of importance; main



Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
schedule (v, + adj form)	32	0.36%	schedu led	32	0.36%												final visits were scheduled to be completed by June 30, 1999	arrange or plan (a n event) to take place at a particular time
regression	30	0.33%															both the fitted regression lines and the observed response rates show that the likelihood of an SVR can be increased in patients treated with the higher dose of peginterferon alfa-2b by increasing the ribavirin dose	statistics: a measure of the relation between the mean value of one variable (e.g. output) and corresponding values of other variables (e.g. time and cost)
possibility	29	0.32%															the benefits of aspirin appear to be modified by underlying inflammation — an observation that raises the possibility of antiinflammatory as well as antiplatelet effects of this agent	a thing that may happen or be the case; the state or fact of being possible; likelihood
primarily	29	0.32%															type 2 diabetes mellitus is increasingly common, primarily because of increases in the prevalence of a sedentary lifestyle and obesity	for the most part; mainly
allow	28	0.31%	allow	23	0.26%	allows	2	0.02%	allowin g	2	0.02%	allow ed	1	0.0 1%			the extreme statistical significance of this reduction (z-score=9.3), and the large number of events on which it is based, allows reliable assessment of the effects of treatment in various different circumstances	let (someone) have or do something; give the necessary time or opportunity for

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED		
frequent	28	0.31%																a frequent limitation in antihypertensive treatment is that up-titration of drugs to obtain better blood-pressure control increases side-effect	occurring or done many times at short intervals; doing something often; habitual
require	27	0.30%	require d	19	0.21%	requiri ng	5	0.06%	require	2	0.02%	requi res	1	0.01%				we required confirmation of the diagnosis of diabetes by a second oral glucose-tolerance test	officially compulsory, or otherwise considered essential; indispensable; in keeping with one's wishes; desired
probability	26	0.29%	probab ility	21	0.23%	probab ilities	5	0.06%										the probability of users visiting an alternative medicine practitioner increased from 36.3% to 46.3% (P=.002)	the quality or state of being probable; the extent to which something is likely to happen or be the case; mathematics: the extent to which an event is likely to occur, measured by the ratio of the favourable cases to the whole number of cases possible
many	25	0.28%																many physicians have assumed that inhibition of the renin-angiotensin-aldosterone system by an angiotensin-converting-enzyme (ACE) inhibitor will suppress the	a large number of

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	formation of aldosterone	
predict	25	0.28%	predict ed	12	0.13%	predict	7	0.08%	predict ing	3	0.03%	predi cts	3	0.03%			we predicted that recruiting 100 percent of the habitual snorers and a 25 percent random sample of those who were not habitual snorers would yield a cohort with adequate variance in sleep-disordered breathing	say or estimate that (a specified thing) will happen in the future or will be a consequence of something
must	24	0.27%															other risk factors must be identified in order to reduce mortality and morbidity even further	be obliged to; should (expressing necessity); expressing an opinion about something that is logically very likely
apparent	22	0.24%															given the apparent clustering of EGFR mutations, we sequenced exons 19 and 21 in a total of 95 primary tumors and 108 cancer-derived cell lines	seeming real or true, but not necessarily so
had to	22	0.24%															we had to assess the potential for imbalances in important prognostic factors to bias the assessment of treatment effects	be obliged or find it necessary to do the specified thing; be strongly recommended to do something
majority	22	0.24%															these results [...] suggest that such mutations account for the majority of responses to gefitinib reported in clinical studies	the greater number

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED		
potentially	21	0.23%																dietary factors that have been suspected to increase risk, such as nitrates, carbohydrates, and salt, could potentially amplify the risk of mutation beyond that due to inflammation alone	with the capacity to develop or happen in the future
assume	19	0.21%	assumi ng	7	0.08%	assum ed	7	0.08%	assum e	4	0.04%	assu mes	1	0.01%				a greater absolute benefit would be expected, assuming a similar relative effect of treatment	suppose to be the case, without proof
certain	19	0.21%																diabetes is especially frequent in certain racial and ethnic groups	some but not all
in part	19	0.21%																this difference was due in part to a significant incidence of gynecomastia or breast pain among men in the spironolactone group (P<0.001)	to some extent though not entirely
usually	19	0.21%																the vascular phase is usually followed by rapid tumor growth, bleeding, and the potential for metastasis	under normal conditions; generally
average (v, adj)	18	0.20%	averag ed	17	0.19%	averagi ng	1	0.01%										the average amount of weight loss was not large	of the usual or ordinary amount, standard, level, or rate; having qualities that are seen as typical of a particular person, group, or thing
goal	18	0.20%	goal	11	0.12%	goals	7	0.08%										our principal goal was to assess the safety of	the object of a person's ambition

Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED
																carvedilol while recognizing its potential to prolong life, demonstrated by the results of experimental studies	or effort; an aim or desired result
indicator	18	0.20%	indicat ors	10	0.11%	indicat or	8	0.09%								we are confident that the breathing during monitored sleep was a valid indicator of breathing during usual sleep	a thing that indicates the state or level of something
probably	18	0.20%														this lack of benefit is probably due to chance	almost certainly; as far as one knows or can tell
aim (v)	17	0.19%	aiming	9	0.10%	aimed	8	0.09%								we aimed to assess the optimum target diastolic blood pressure and the potential benefit of a low dose of acetylsalicylic acid in the treatment of hypertension	have the intention of achieving
general	17	0.19%														overall, in a general population of such patients, 150 cardiovascular events could be prevented and 51 patients would be spared from having at least one such event	true for all or most cases; normal or usual
r	16	0.18%														like the serum leptin concentration, the ob mRNA content of the adipocytes was correlated with the percentage of body fat (r = 0.68, P<0.001), BMI (r	statistics: correlation coefficient; a quantity measuring the extent of the interdependence

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	= 0.70, P<0.001), and age (r = 0.38, P = 0.01)	of variable quantities
representat ive	17	0.19%															the subjects in this study were representative of the general population in terms of socioeconomic status and risk factors	typical of a class, group, or body of opinion
z	17	0.19%															this corresponds to a 67.5 percent (95 percent confidence interval, 40.7 to 82.1 percent) relative reduction in the risk of HIV transmission (Z = 4.03, P = 0.00006)	<z-scores or standard values measure the difference between sample and population means>
apparently	16	0.18%															it appears that estrogen plus progestin increases the risk of strokes in apparently healthy women	as far as one knows or can see
evaluate	16	0.18%	evaluat ed	16	0.18%												we evaluated tumors from patients with these dramatic responses to determine the underlying mechanisms	form an idea of the amount, number, or value of; assess
often	16	0.18%															about 10 percent of patients have a rapid and often dramatic clinical response	frequently; many times; in many instances
usual	16	0.18%															as is usual with interferon-based therapy, there were reductions in neutrophil and platelet counts with all treatments	habitually or typically occurring or done; customary
indication	16	0.18%	indicati on	12	0.13%	indicati ons	4	0.04%									this analysis also gives some indication of minimum blood pressures—ie, the values around which the	a sign or piece of information that indicates something; a symptom that

Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	maximum benefits of treatment can be expected	suggests certain medical treatment is necessary
tend	16	0.18%	tend	9	0.10%	tended	6	0.07%	tending	1	0.01%						HR estimates tend to be unstable beyond 6 years after randomization	regularly or frequently behave in a particular way or have a certain characteristic; be liable to possess or display (a particular characteristic)
interpretation	15	0.17%															excluding these patients from the analysis reduced by five the events in the medical group and by three the events in the surgical group and did not alter the interpretation of the results	the action of explaining the meaning of something
frequently	15	0.17%															it is frequently associated with recurrent myocardial ischemia that necessitates additional revascularization procedures	regularly or habitually; often
likelihood	15	0.17%															the likelihood of SVR increases as ribavirin dose increases	the state or fact of something's being likely; probability
nearly	15	0.17%															nearly all patients who had SVRs also had normal alanine aminotransferase values at the end of follow-up	very close to; almost
aim (n)	14	0.16%	aim	11	0.12%	aims	3	0.03%									the primary aim was to compare conventional	a purpose or intention;

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	treatment (primarily with diet alone) with intensive treatment with metformin	a desired outcome
almost	14	0.16%															in some developing nations it affects almost all adults	not quite; very nearly
commonly	14	0.16%															it is commonly argued that it is difficult to change the lifestyle of obese and sedentary people	very often; frequently
prediction	14	0.16%															early prediction of virologic response to interferon-based therapy can help identify patients who are unlikely to have a sustained response and allow clinicians the option to discontinue treatment	a thing predicted; a forecast
be	13	0.14%															we propose that this therapy be used in normotensive and hypertensive patients with diabetes and clinically evident nephropathy	subjunctive: relating to or denoting a mood of verbs expressing what is imagined or wished or possible
particular	13	0.14%															for particular subtotals and totals, the result and its 95% CI are represented by a diamond	used to single out an individual member of a specified group or class
particularly	13	0.14%															the effects of treatment with pravastatin on the incidence of stroke are important, particularly because stroke is now	to a higher degree than is usual or average; used to single out a subject to which a



Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	the chief cause of functional impairment in many countries	statement is especially applicable
seem	13	0.14%	seems	5	0.06%	seemed	4	0.04%	seem	4	0.04%						losartan seems to confer benefits beyond reduction in blood pressure	give the impression of being something or having a particular quality; used to suggest in a cautious or polite way that something is the case
convention al	12	0.13%															when the patient was discharged from the intensive care unit, a conventional approach was adopted (maintenance of blood glucose at a level between 180 and 200 mg per deciliter)	based on or in accordance with what is generally done or believed
implication	12	0.13%	implica tions	12	0.13%												although the results of this trial are encouraging with respect to mortality and morbidity and are consistent with the results of other smaller and shorter trials, there are a few sobering implications	the conclusion that can be drawn from something although it is not explicitly state d; a likely consequence of something
interpret	12	0.13%	interpr eted	8	0.09%	interpr et	3	0.03%	interpr eting	1	0.01%						we interpreted this ring of neovascularization (carcinoma in situ angiogenesis) as being a response to an angiogenic factor or factors released by the adjacent duct-carcinoma cells	explain the meaning of (information or actions); understand (an action, mood, or way of behaving) as having a

Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																		particular meaning
largely	12	0.13%															this 47.3% increase in total visits is largely because of increases in visits for relaxation therapy, massage, chiropractic, self-help, and energy healing	to a great extent; on the whole; mostly
necessitate	12	0.13%	necessitating	6	0.07%	necessitated	2	0.02%	necessitates	2	0.02%	necessitate	2	0.02%			one episode of an early increase in the serum creatinine concentration suggestive of renal-artery stenosis necessitated the stopping of the study medication	make (something) necessary as a result or consequence; make it necessary for (someone) to do something
perhaps	12	0.13%															except, perhaps, to identify and then monitor people with pre-existing liver disease	used to express uncertainty or possibility
prognostic	12	0.13%															the prognostic value of these markers of inflammation remains uncertain	relating to or serving to predict the likely course of a medical condition
suspect (v)	12	0.13%	suspected	12	0.13%												computed tomography of the head was performed if cerebrovascular events were suspected	have an idea or impression of the existence, presence, or truth of (something) without certain proof
typical	11	0.12%															the slight predominance of men and the association with type A blood are typical of diffuse disease	having the distinctive qualities of a particular type of person or thing
advice	10	0.11%															both groups received advice on following a	guidance or recommendations

Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	cholesterol-lowering diet	offered with regard to prudent action
assumption	10	0.11%	assumption	5	0.06%	assumptions	5	0.06%									the assumption of a 20% coinsurance rate among users with partial insurance coverage should yield a conservative estimate of out-of-pocket costs	a thing that is accepted as true or as certain to happen, without proof
mainly	10	0.11%															this early worsening, consisting of the development of soft exudates or intraretinal microvascular abnormalities, occurred mainly in the secondary-intervention cohort during the first year of therapy	more than anything else; for the most part
objective	10	0.11%	objective	7	0.08%	objectives	3	0.03%									the objective of this study was to estimate the effects of air pollution on mortality, with control for individual smoking status, sex, age, and other risk factors	a thing aimed at or sought; a goal
recommended	10	0.11%	recommended	6	0.07%	recommend	4	0.04%									frequent ingestion of whole-grain products, vegetables, fruits, low-fat milk and meat products, soft margarines, and vegetable oils rich in monounsaturated fatty acids was recommended	advise or suggest (something) as a course of action
schedule (n)	10	0.11%	schedule	10	0.11%												on the basis of which the follow-up schedule was	a plan for carrying out a process or procedure, giving

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	relaxed to that stated above	lists of intended events and times
suggestive	10	0.11%															fasting plasma glucose was measured if symptoms suggestive of diabetes developed	tending to suggest an idea; indicative or evocative
think	10	0.11%	thought	9	0.10%	think	1	0.01%									1.2 percent were thought to be at risk of serious hypotension and were hospitalized for 24 hours during the initiation of the drug	have a particular belief or idea
advise	9	0.10%	advised	7	0.08%	advise	2	0.02%									the patients were advised to follow a diet high in carbohydrates and fibre and low in saturated fats	offer suggestions about the best course of action to someone; recommend
little	9	0.10%															there was little difference in the number of deaths classified as due to arrhythmia without worsening congestive heart failure and the number of deaths due to noncardiovascular causes	small in size, amount, or degree; relatively unimportant or trivial
option	9	0.10%															on the detection of disease progression, patients were given the option of entering a nonrandomized, open-label study in which trastuzumab was administered at the same doses alone or in combination with other therapies	a thing that is or may be chosen

Realization, lemma	n	Selecti on probability	Inflected forms													Example from MRAC	Definition, OED	
partly	9	0.10%															this was partly because fewer patients required retinal photocoagulation	to some extent; not completely
predictive	9	0.10%															the addition of hs-CRP to lipid screening produced a significant and additive predictive effect when regression analyses were based on cutoff points for quartiles	relating to or having the effect of predicting an event or result
?	8	0.09%															how can this finding be reconciled with the large body of evidence from observational and pathophysiologic studies suggesting that estrogen therapy reduces risk for CHD?	a punctuation mark (?) indicating a question
as	8	0.09%															our study establishes that losartan, along with conventional antihypertensive treatment as needed, confers strong renal protection in patients with type 2 diabetes and nephropathy	used to indicate that something happens during the time when something else is taking place
contraindication	8	0.09%	contraindication	6	0.07%	contraindications	2	0.02%									the criteria for exclusion were a myocardial infarction within the previous seven days; a contraindication to aspirin, dipyridamole, or warfarin sodium; and a left ventricular ejection fraction of 40 percent or less	<see entry for contraindicate>
few	8	0.09%															few patients had late ophthalmic complications such as	a small number of

Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	vitreous haemorrhage or blindness	
prognosis	8	0.09%															the prognosis of the surgical patients did not vary significantly among risk groups and averaged 9 percent at two years	the likely course of a medical condition
selected (adj)	8	0.09%															in selected patients, placement of an intracoronary stent, as compared with balloon angioplasty, results in an improved rate of procedural success	carefully choose as being the best or most suitable
able	7	0.08%															we thus were able to evaluate directly the relative value of each of these 12 measurements as an independent predictor of future cardiovascular events in a large cohort of apparently healthy women	having the power, skill, means, or opportunity to do something
chiefly	7	0.08%															they chiefly involved middle-aged men (since women tend to develop heart disease at an older age than men do)	mainly; for the most part; mostly
comment (n)	7	0.08%	comment	7	0.08%												COMMENT [heading for discussion section in some RAs]	a verbal or written remark expressing an opinion or reaction; discussion, especially of a critical nature
hypothesize	7	0.08%	hypothesized	6	0.07%	hypothesize	1	0.01%									we hypothesized that hyperglycemia or relative insulin	put (something) forward as a hypothesis <see

Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	deficiency (or both) during critical illness may directly or indirectly confer a predisposition to complications, such as severe infections, polyneuropathy, multiple-organ failure, and death	entry for hypothesis>
judge (v)	7	0.08%	judged	5	0.06%	judge	2	0.02%									the majority of the adverse effects were judged to be related to labor and delivery	form an opinion or conclusion about
allowance	6	0.07%															for single endpoints and surrogate variables 99% CI are given to make allowance for potential type I errors	the amount of something that is permitted, especially within a set of regulations or for a specified purpose; take into consideration when planning something
believe	6	0.07%	believe	5	0.06%	believe d	1	0.01%									we believe our findings go a long way toward achieving this goal and may also have an important economic effect	accept that (something) is true, especially without proof; hold (something) as an opinion; think
extrapolate	6	0.07%	extrap olating	2	0.02%	extrap olated	2	0.02%	extrap olate	2	0.02%						extrapolating from the observed data, we estimate that this reduction corresponds to an average delay of two years in the need for dialysis or transplantation	extend the application of (a method or conclusion) to an unknown situation by assuming that existing trends will continue or similar methods

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																		will be applicable; estimate or conclude (something) by extrapolating
in particular	6	0.07%															there was still only limited evidence about the effects of such treatment in many specific types of high-risk patient—in particular, those without diagnosed coronary disease who have diabetes or non-coronary occlusive arterial disease	especially (used to show that a statement applies to one person or thing more than a ny other)
IQR	6	0.07%															the median dose of metformin was 2550 mg/day (IQR 1700–2550)	<statistics, interquartile range (IQR): measure of relative dispersion in a dataset>
one	6	0.07%															this was one of the reasons for doing the present study	the lowest cardinal number; half of two; 1; a single person or thing; just one as opposed to any more or to none at all
possibly	6	0.07%															two deaths, both in patients who had received an anthracycline, cyclophosphamide, and trastuzumab, were possibly related to trastuzumab therapy	perhaps (used to indicate doubt or hesitancy); in accordance with what is likely or achievable



Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED		
postulate (v)	6	0.07%	postula ted	4	0.04%	postula te	2	0.02%										we postulated that even a moderately effective agent (one yielding a reduction of 15 to 20 percent in the number of events) could prevent thousands of hospitalizations and premature deaths each year	suggest or assume the existence, fact, or truth of (something) as a basis for reasoning, discussion, or belief
predomina ntly	6	0.07%																the number of participants reporting nonmelanoma skin cancers, predominantly diagnoses of basal cell and squamous cell cancers, was 250 (7.6%) in the lovastatin group and 243 (7.4%) in the placebo group	mainly; for the most part
presumably	6	0.07%																racial and ethnic-group differences in the incidence of diabetes were presumably reduced in our study by the selection of persons who were overweight and had elevated fasting and post-load glucose concentrations	used to convey that what is asserted is very likely though not known for certain
project (v)	6	0.07%	project ed	6	0.07%													projected out-of-pocket expenditures for all hospitalizations in 1997 in the United States totaled \$9.1 billion, while projected out-of-pocket expenses for all US physician services in the same year were \$29.3 billion	estimate or forecast (something) on the basis of present trends

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
typically	6	0.07%															fine-particulate pollution typically contains a mixture of particles including soot, acid condensates, and sulfate and nitrate particles	in most cases; usually
ability	5	0.06%															the ability of intensive therapy to reduce the development of neuropathy suggests that neuropathy may be preventable	possession of the means or skill to do something
anticipate	5	0.06%	anticip ated	5	0.06%												since it was anticipated (on the basis of earlier studies) that carvedilol could reduce mortality, all statistical analyses were two-sided	regard as probable; expect or predict
chief	5	0.06%															the chief adverse event associated with intensive therapy was a two-to-threefold increase in severe hypoglycemia	most important
example	5	0.06%	exampl es	4	0.04%	exampl e	1	0.01%									examples include vesicular schistosomiasis and bladder cancer, inflammation caused by draining sinus tracts and squamous-cell carcinoma, and ulcerative colitis and colon cancer	a thing characteristi c of its kind or illustrating a general rule
generalize (v, + adj forms)	5	0.06%	general ized	3	0.03%	general ised	1	0.01%	general izing	1	0.01%						the large numbers of participants studied in a wide range of different circumstances (eg, prior disease, age, sex, presenting lipid concentrations, other	make a general or broad statement by inferring from specific cases

Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	management) allow these results to be generalised widely	
plausible	5	0.06%															H. pylori, however, is a plausible pathophysiologic cofactor for cancer	(of an argument or statement) seeming reasonable or probable
presume (v, + adj form)	5	0.06%	presu med	5	0.06%												although the main focus was on events presumed to be due to atherosclerotic disease, primary intracranial haemorrhage and fatal bleeds were possible adverse events	suppose that something is the case on the basis of probability
probable	5	0.06%															the estimate of the effect of treatment in the study group as a whole nonetheless provides a reasonable indication of the probable relative benefits of treatment in these and other subgroups	likely to happen or be the case
provided (conj)	5	0.06%															association of acetylsalicylic acid with antihypertensive therapy can therefore be recommended, provided that blood pressure is well controlled and the risk of gastrointestinal and nasal bleeding is carefully assessed	on the condition or understanding that
alternativel y	4	0.04%															alternatively, the effects of carvedilol on survival	as another option or possibility

Realization, lemma	n	Selection probability	Inflected forms													Example from MRAC	Definition, OED	
																	may differ from those of other beta-blockers	
among	4	0.04%															chiropractic, relaxation techniques, and massage therapy were among the alternative therapies used most commonly to treat principal medical conditions	being a member or members of (a larger set)
conclude	4	0.04%	conclude	4	0.04%												we conclude that the early and continued administration of captopril to patients with asymptomatic left ventricular dysfunction after myocardial infarction improved survival and reduced mortality and morbidity from major cardiovascular events	bring or come to an end; arrive at a judgement or opinion by reasoning
confidence limit	4	0.04%	confidence limits	2	0.02%	CL	2	0.02%									the power calculations were based on the STOP Hypertension study in which the average cardiovascular risk increased, both below and above a diastolic blood pressure of 80 mm Hg, by 3% per mm Hg, with narrow confidence limits	<see entry for confidence interval>
contraindicate	4	0.04%	contraindicated	4	0.04%												use of statin therapy was clearly indicated or clearly contraindicated in terms of a net difference in all-cause mortality	(of a condition or circumstance) suggest or indicate that (a particular technique or drug) should not

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED		
																			be used in the case in question
deem	4	0.04%	deemed	4	0.04%													seven patients were switched to angioplasty: three because of an inability to place the stent and four because of lesion characteristics deemed unfavorable for stent placement at the time of the procedure	regard or consider in a specified way
generalizable	4	0.04%																we believe our data are likely to be generalizable to countries with lower rates of coronary heart disease	<see entry for generalize>
imply	4	0.04%	implies	2	0.02%	imply	1	0.01%	implying	1	0.01%							which implies that the proportional reduction in risk associated with a given absolute difference in usual LDL cholesterol concentration is similar throughout the range that has been studied	indicate the truth or existence of (something) by suggestion rather than explicit reference
in general	4	0.04%																in general, the women in this study had mildly symptomatic HIV disease and, with 19 exceptions, no prior treatment with antiretroviral drugs	usually; mainly; as a whole
intend (v, + adj forms)	4	0.04%	intended	4	0.04%													potentially eligible people entered a prerandomisation "run-in" phase, which was intended chiefly to limit subsequent randomisation to those likely to take the	have (a course of action) as one's purpose or intention; plan

Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	randomly allocated study treatment for at least 5 years	
in the case of	4	0.04%	in the case of	2	0.02%	in case of	1	0.01%	in cases of	1	0.01%						in the case of recurrent events, the relative risk was computed as the ratio of the crude event rates	an instance of a particular situation; an example of something occurring
key	4	0.04%															the key features of the conduct of the trial were as follows	of crucial importance
near	4	0.04%															the median hemoglobin values decreased between weeks 1 and 8 in all treatment groups, then stabilized, and then returned to near base-line values after treatment was completed	at or to a short distance away; almost; similar to
necessarily	4	0.04%															the results do not necessarily apply to lower dosages of these drugs	as a necessary result; inevitably
part of	4	0.04%															a pattern of early harm and later benefit could account for part of the discrepancy between the results of this trial and observational studies of estrogen and CHD	some but not all of something
power (v)	4	0.04%	power ed	4	0.04%												the study was originally powered to detect a 30% difference between the treatment groups after 320 participants had experienced a primary event	<see entry for power (n)>

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
rarely	4	0.04%															angiogenesis is necessary at the beginning of this journey, because without it tumor cells are only rarely shed into the circulation	not often; seldom
requirement	4	0.04%	require ments	3	0.03%	require ment	1	0.01%									after adjustment for the duration of survival, blood-transfusion requirements were similar in the two groups (P=0.90)	a thing that is needed or wanted
speculative	4	0.04%															although the exact cause of the reduction in the risk of death in our study remains speculative, we postulate that [...]	engaged in, expressing, or based on conjecture rather than knowledge
to date	4	0.04%															to date, no drug for the treatment of essential hypertension has prevented cardiovascular morbidity and death beyond the reductions in blood pressure achieved with $\beta$ -blockers and diuretics	until now
virtually	4	0.04%															cholesterol-lowering therapy should now be considered for virtually all patients presenting with CHD	nearly; almost
as long as	3	0.03%															as long as the fasting plasma glucose concentration was less than 140 mg per deciliter, participants were asked to monitor their blood glucose and to continue their	provided that

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	assigned study treatment	
conditional	3	0.03%															conditional power analyses indicate that less than 10% power remained for showing potential benefit if the trial continued	subject to one or more conditions or requirements being met <conditional power: the probability that the final result will be significant>
currently	3	0.03%															the currently recommended daily dose of 250 mg leads to a mean trough concentration of 0.4 µM	at the present time
essentially	3	0.03%															the rates of use of prophylaxis against P. carinii and M. avium complex remained essentially constant throughout the period of analysis	used to emphasize the basic, fundamental, or intrinsic nature of a person or thing
expectation	3	0.03%	expect ations	2	0.02%	expect ation	1	0.01%									a blinded review of overall outcome event rates showed them to be lower than initial expectations	a strong belief tha t something will happen or be the case
extrapolati on	3	0.03%	extrap olation s	3	0.03%												extrapolations to the total US population suggest that an estimated 15 million adults are at risk for potential adverse interactions involving prescription medications and herbs or high-dose vitamin supplements	the action of estimating or concluding something by assuming that existing trend s will continue or a current method will remain applicable



Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED		
feasible	3	0.03%																it was not feasible to conduct the study in a strictly blinded fashion because adjustment of the insulin dose requires blood glucose monitoring	possible and practical to do easily or conveniently; likely; probable
like	3	0.03%																a lifestyle diet included examples like vegetarianism or macrobiotics	having the same characteristics or qualities as; similar to; such as; for example
mostly	3	0.03%																the benefit is mostly achieved in patients with HCV genotype 1 infections	as regards the greater part or number; usually; generally
opportunit y	3	0.03%																we had the unique opportunity to evaluate directly whether aspirin, an agent with both antiplatelet and antiinflammatory properties, might modify any relation between C-reactive protein and the risk of first myocardial infarction	a time or set of circumstances that makes it possible to do something
permit (v)	3	0.03%	permitted	3	0.03%													treatment with digoxin, hydralazine, or nitrates was permitted but not required	officially allow (someone) to do something
projection	3	0.03%	projections	2	0.02%	project ion	1	0.01%										dropout rates over time (Figure 2) exceeded design projections, particularly early on	an estimate or forecast of a future situation based on a study of present trends
rare	3	0.03%																discontinuation for anaemia was rare	(of an event, situation, or condition) not

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED		
																			occurring very often
recommen dation	3	0.03%	recom menda tions	3	0.03%													in the light of conflicting information from previous reports, we must limit our recommendations to those that can be drawn from the results achieved with the agent and dosage that we used in this study	a suggestion or proposal as to the best course of action, especially one put forward by an authoritative body
roughly	3	0.03%																because the six cities were selected as representative of the range of particulate air pollution in the United States, these rate ratios roughly represent the relative risk associated with that range	approximately
sometimes	3	0.03%																pain was sometimes severe, requiring additional doses of nalbuphine	occasionally, rather than all of the time
approximat e (adj)	2	0.02%																it suggests that an LDL cholesterol level of 125 mg per deciliter may be an approximate lower boundary for a clinically important influence of the LDL cholesterol level on coronary heart disease	close to the actual, but not completely accurate or exact
conceivable	2	0.02%																it is conceivable that the estimated prevalence and costs of alternative therapy use would have been lower if it were	capable of being imagined or grasped mentally

Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	possible to correct for those limitations	
confidence	2	0.02%															the sponsors of the program agreed with the Food and Drug Administration in July 1992 to enroll a sufficient number of patients in placebo-controlled trials of carvedilol to rule out (with 95 percent confidence) the risk of a 33 percent increase in mortality	<see entry for confidence interval>
estimation	2	0.02%															only appropriate past information was used in estimation of curves and confidence bands	a rough calculation of the value, number, quantity, or extent of something
intent	2	0.02%															our intent was to consider the balance between risk and benefit	intention or purpose
leading	2	0.02%															diabetic nephropathy is the leading cause of end-stage renal disease	most important
much	2	0.02%															preliminary analyses indicate that the modest difference in blood pressure between groups does not contribute much to an explanation of the increase in strokes (data not shown)	a large amount; to a great extent; a great deal
necessity	2	0.02%															the prevention of both macrovascular and microvascular disease observed in this study	the state or fact of being required

Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	provides evidence for the necessity of tight blood pressure control in type 2 diabetes	
partially	2	0.02%															the reduction in power caused by these deviations from prestudy assumptions was partially offset by the fact that we recruited 18% more participants than planned	only in part; to a limited extent
plan (n)	2	0.02%	plan	2	0.02%												the plan was expected to produce similar numbers of more than 6000 in each of the clinical subgroups and facilitate study closedown	a detailed proposal for doing or achieving something; an intention or decision about what one is going to do
preliminary	2	0.02%															preliminary evidence suggests that stents may reduce the chance of restenosis by decreasing the elastic recoil of the vessel and sealing intimal flaps	preceding or done in preparation for something fuller or more important
presumptio n	2	0.02%															the presumption is that alternative medicine use in the United States has increased at a considerable pace in recent years	an idea that is taken to be true on the basis of probability; the acceptance of something as true although it is not known for certain
propose	2	0.02%	propos ed	1	0.01%	propos e	1	0.01%									we propose that this therapy be used in normotensive and hypertensive patients	put forward (a plan or suggestion) for

Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	with diabetes and clinically evident nephropathy	consideration by others
relatively	2	0.02%															combination therapy was relatively safe, but modifications in the dose and discontinuation of treatment were required more often in patients who received interferon and ribavirin than in those who were treated with interferon alone	in relation, comparison, or proportion to something else; regarded in comparison with something else rather than absolutely; quite
suspicion	2	0.02%															because of the suspicion of incorrect inclusion or data handling at one centre, 403 patients were excluded early in the trial	a feeling or thought that something is possible, likely, or true
to our knowledge	2	0.02%															to our knowledge this is the first report in patients with type 2 diabetes to show that tight blood pressure control reduces the risk of clinical complications from diabetic eye disease	as far as someone knows; judging from the information someone has
whenever	2	0.02%															whenever glucose concentrations were above target concentrations, a letter was sent from the coordinating center with advice on necessary changes in therapy	at whatever time; on whatever occasion (emphasizing a lack of restriction); every time that
advisable	1	0.01%															these data indicate that although hypotension and prerenal azotemia	(of a course of action) to

Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	are infrequent or not usually troublesome, careful monitoring is advisable	be recommended; sensible
and the like	1	0.01%															this analysis ignores the relative effect of various events (i.e., it considers death, a cerebrovascular accident, myocardial infarction, and the like to be equally harmful to the patient)	and similar things; et cetera
arguably	1	0.01%															arguably, therapies such as biofeedback, hypnosis, guided imagery, [...] and (possibly) vitamin therapy can be considered as representative of the more conventional (ie, less alternative) side of the spectrum	it may be argued (used to qualify the statement of an opinion or belief)
around	1	0.01%															at the age of 45 around 40% of patients with type 2 diabetes are hypertensive, the proportion increasing to 60% by the age of 75	(used with a number or quantity) approximately
caution (v)	1	0.01%															we caution readers not to apply our conclusions too broadly	warn or advise against (doing something)
confidence band	1	0.01%															only appropriate past information was used in estimation of curves and confidence bands	<see entry for confidence interval>
confident	1	0.01%															we are confident that the breathing during monitored sleep was a valid indicator of	feeling or showing confidence in oneself or one's abilities or

Realization , lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	breathing during usual sleep	qualities; feeling or showing certainty about something
counseling	1	0.01%															our counseling regarding physical exercise included components designed to improve both cardiorespiratory fitness and muscle strength	give advice to (someone); recommend (a course of action)
credibility	1	0.01%															the central validation of all reported outcome events provided a consistent assessment and should enhance the credibility of the efficacy findings	the quality of being trusted and believed in
discuss	1	0.01%	discussed	1	0.01%												problematic potential primary events were discussed on conference calls or meetings involving the entire subcommittee	talk about (something) with a person or people; talk or write about (a topic) in detail, taking into account different issues or ideas
generalizability	1	0.01%															the strengths of our study include the generalizability of its results to other middle-aged populations	<see entry for generalize>
illustrate (v)	1	0.01%	illustrated	1	0.01%												the need for encouraging these interventions for women with coronary disease is illustrated by the facts that 90% of the HERS cohort had LDL cholesterol exceeding	explain or make (something) clear by using examples, charts, pictures, etc.; serve as an example of

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED
																2.59 mmol/L (100 mg/dL) at baseline and that only 32% were receiving beta-blockers	
indicative	1	0.01%														a TICS-m score below 22 out of 39 was prespecified as indicative of some cognitive impairment	serving as a sign or indication of something
infer	1	0.01%	inferred	1	0.01%											from these data, we inferred that a substantial amount of alternative therapy was used for health promotion or disease prevention	deduce or conclude (something) from evidence and reasoning rather than from explicit statements
on the whole	1	0.01%														on the whole, the rate of cardiovascular events observed during treatment initiated with the calcium antagonist felodipine was much lower than that observed in previous prospective trials with diuretic or $\beta$ -blocker-initiated treatment	taking everything into account; in general
optional	1	0.01%														the initiation of treatment with half a tablet was optional	available to be chosen but not obligatory
plausibly	1	0.01%														additional clinical outcomes chosen as secondary outcomes that may plausibly be affected by hormone therapy include other cardiovascular diseases; endometrial, colorectal, and other cancers; and other fractures	in a way that seems reasonable or probable



Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED		
predomina nt	1	0.01%																the predominant distribution of foci in the superior veins matches the dominant anatomical pattern of these atrial extensions	present as the strongest or main element
presumptiv e	1	0.01%																definitive and presumptive diagnoses	of the nature of a presumption; presumed in the absence of further informati on
principally	1	0.01%																the plasma cholesterol level was not a significant factor, principally because of the narrow range of cholesterol values used as a criterion for entry into the study	for the most part; chiefly
prone	1	0.01%																one specific histologic type of gastric adenocarcinoma, the so-called intestinal type, is particularly prone to the regional and temporal variations of an environmentally related malignant condition	likely or liable to suffer from, do, or experience so mething unpleasa nt or regrettable
provisional	1	0.01%																the remaining classifications are provisional	arranged or existing for the present, possibly to be changed later
reason (v)	1	0.01%	reason ed	1	0.01%													we reasoned from available evidence that in a study on prevention, separations within and amongst clinical subgroups are not	think, understand, and form judgements logically

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	necessary because the underlying condition is atherothrombosis which can become clinically manifest in different ways	
subjectively	1	0.01%															after the area of highest neovascularization was identified and subjectively graded on a scale of 1 to 4+, individual microvessels were counted	in a way that is based on personal feelings, tastes, or opinions
theoretical	1	0.01%															the possibility that zidovudine would delay the detection of HIV infection by culture was a theoretical concern	concerned with or involving the theory of a subject or area of study rather than its practical application; based on or calculated through theory rather than experience or practice
to a large extent	1	0.01%															the only reported adverse effects that exceeded 2% were dizziness, headache, leg oedema, flushing, and coughing, the latter three to a large extent attributable to the use of the calcium antagonist and ACE inhibitors	the particular degree to which something is or is believed to be the case
understanding (n)	1	0.01%															such a benefit from early treatment is consistent with our understanding of the process of	the ability to understand something; comprehension;

Realization, lemma	n	Selecti on probab ility	Inflected forms													Example from MRAC	Definition, OED	
																	infarction and the narrow window of opportunity for effective intervention	an individual's perception or judgement of a situation
<b>Total</b>	<b>8986</b>	<b>100.00 %</b>																

Table A10. Frequencies and selection probabilities for realizations of [acknowledge] across MRAC as a whole.

Realization, lemma	n	Selecti on proba bility	Inflected forms													Example from MRAC	Definition, OED	
<superscript numbers>	1372	65.80 %															the administration of recombinant leptin causes weight loss in these mice.2-4	<numbers refer to numbered references at end of RA>
report (v, incl adj forms)	230	11.03 %	reported	196	9.40%	report	15	0.72%	reportin g	11	0.53%	repo rts	88	0.38%			Bjorck et al. reported a reduction in the pretreatment rate of decline of renal function with the use of captopril	give a spoken or written account of something that one has observed, heard, done, or investigated
report (n)	70	3.36%	report	39	1.87%	reports	31	1.49%									this finding is consistent with data from earlier reports	an account given of a particular matter, especially in the form of an official document, after thorough investigation or consideration by an appointed person or body
describe	40	1.92%	described	39	1.87%	describes	1	0.05%									measurements were made as described earlier	give a detailed account in words of
informed consent	40	1.92%	informed consent	39	1.87%	informed witnessed consent	1	0.05%									all subjects gave informed consent	inform: give (someone) facts or information; tell. consent: permission for something to happen or agreement to do something
approve	37	1.77%	approved	36	1.73%	approving	1	0.05%									the study protocol was approved by the institutional review board of each center	officially agree to or accept as satisfactory; believe that someone or something is good or acceptable

Realization, lemma	n	Selecti on proba bility	Inflected forms											Example from MRAC	Definition, OED	
guideline	27	1.29%	guidelines	26	1.25%	guideline	1	0.05%							the study design and protocol amendments, which conform with the guidelines of the Declarations of Helsinki (1975 and 1983), were approved by the Central Oxford Research Ethics Committee and by the equivalent committees at each centre	a general rule, principle, or piece of advice
recommen d	24	1.15%	recommen ded	21	1.01%	recommen d	3	0.14%							the Data and Safety Monitoring Board recommended that the trial be stopped early for efficacy	put forward (someone or something) with approval as being suitable for a particular purpose or role; advise or suggest (something) as a course of action; advise (someone) to do something
ask	21	1.01%	asked	18	0.86%	asking	2	0.10%	ask	1	0.05%				when asking about high-dose vitamin or megavitamin therapies, interviewers made clear that the survey sought information on vitamins not including a daily vitamin or vitamin prescribed by a doctor	say something in order to obtain an answer or some information
recommen dation	20	0.96%	recommen dations	14	0.67%	recommen dation	6	0.29%							these findings support and extend the recommendations of the NCEP to include HDL-C in addition to TC in initial risk-factor assessment	a suggestion or proposal as to the best course of action, especially one put forward by an authoritative body
consider	19	0.91%	considered	18	0.86%	consider	1	0.05%							participants and their general practitioners were advised of results emerging from other relevant studies, and encouraged to use a non-study statin if they considered that it had become indicated	think carefully about (something), typically before making a decision; believe to be; think
suggest	16	0.77%	suggested	15	0.72%	suggesting	1	0.05%							it has been suggested that such patients should be treated as if they had established coronary heart disease	put forward for consideration
note (v)	15	0.72%	noted	15	0.72%										near the end of the trial, the board noted a trend toward lower rates of nonfatal MI in the hormone group	remark upon (something) in order to draw attention to it
according to	13	0.62%													an estimated 10 million persons in the United States resemble the participants in the Diabetes Prevention Program in terms of age, body-mass index, and glucose	as stated by or in

Realization, lemma	n	Selecti on proba bility	Inflected forms											Example from MRAC	Definition, OED	
															concentrations, according to data from the third National Health and Nutrition Examination Survey	
estimate (v, incl adj form)	13	0.62%	estimated	12	0.58%	estimate	1	0.05%							in that study, it was estimated that five years of active treatment of 1000 men ranging in age from 35 to 64 years would result in six fewer strokes and two fewer cardiovascular events than would be expected	roughly calculate or judge the value, number, quantity, or extent of
propose	10	0.48%	proposed	9	0.43%	propose	1	0.05%							several potential mechanisms whereby estrogen therapy might reduce risk for CHD have been proposed	put forward (a plan or suggestion) for consideration by others
estimate (n)	9	0.43%	estimates	5	0.24%	estimate	4	0.19%							recent estimates by the National Institutes of Health indicate that diabetes represents the single largest cause of end-stage renal disease	an approximate calculation or judgement of the value, number, quantity, or extent of something
state (v)	9	0.43%	stated	8	0.38%	stating	1	0.05%							the American Heart Association [...] stated that continuation of the treatment should be considered on the basis of established noncoronary benefits and risks, possible coronary benefits and risks, and patient preference	express something definitely or clearly in speech or writing
approval	8	0.38%	approval	8	0.38%										both the UK prospective diabetes study and hypertension in diabetes study received ethical approval from the appropriate committee in each centre and conformed with the guidelines of the Declarations of Helsinki (1975 and 1983)	the action of approving something
discuss	7	0.34%	discussed	7	0.34%										only a minority of alternative therapies used were discussed [by respondents] with a medical doctor	talk about (something) with a person or people; talk or write about (a topic) in detail, taking into account different issues or ideas
conclude	6	0.29%	concluded	6	0.29%										a subanalysis of patients in the United Kingdom Prospective Diabetes Study concluded that ACE inhibitors and $\beta$ -adrenergic-blocking agents were equally effective in preventing renal damage	bring or come to an end; arrive at a judgement or opinion by reasoning

Realization , lemma	n	Selecti on proba bility	Inflected forms											Example from MRAC	Definition, OED	
disclose	6	0.29%	disclosed	5	0.24%	disclose	1	0.05%							the extent to which patients disclose their use of alternative therapies to their physicians remains low	make (secret or new information) known
opinion	5	0.24%	opinion	3	0.14%	opinions	2	0.10%							there were differing opinions among members of the National Cholesterol Education Program panel	a view or judgement formed about something, not necessarily based on fact or knowledge
personal communication	5	0.24%													in that study, carvedilol reduced the combined risk of death or hospitalization by 26 percent (Sharpe N: personal communication)	<similar function to numbered references>
acknowledge	4	0.19%	acknowledged	2	0.10%	acknowledges	1	0.05%	acknowledge	1	0.05%				three quarters of respondents who acknowledged use of relaxation techniques said they used meditation	accept or admit the existence or truth of
disclosure	4	0.19%	disclosure	3	0.14%	disclosures	1	0.05%							there was no significant change in disclosure rates between the 2 survey years	the action of making new or secret information known
suspect (v)	4	0.19%	suspected	4	0.19%										dietary factors that have been suspected to increase risk, such as nitrates, carbohydrates, and salt, could potentially amplify the risk of mutation beyond that due to inflammation alone	have an idea or impression of the existence, presence, or truth of (something) without certain proof
judgment	3	0.14%	judgment	3	0.14%										treatment with enalapril or placebo was started at 2.5 mg or 5 mg twice daily on the basis of the patient's clinical condition and the participating physician's judgment	the ability to make considered decisions or come to sensible conclusions; an opinion or conclusion
say	3	0.14%	said	3	0.14%										among the 44% of adults who said they regularly take prescription medications, nearly 1 (18.4%) in 5 reported the concurrent use of at least 1 herbal product, a high-dose vitamin, or both	utter words so as to convey information, an opinion, a feeling or intention, or an instruction
suggestion	3	0.14%	suggestion	2	0.10%	suggestions	1	0.05%							the UKPDS data do not support the suggestion of adverse cardiovascular effects from sulphonylureas	an idea or plan put forward for consideration; something that implies or indicates a certain fact or situation
address (v)	2	0.10%	addressed	1	0.05%	addressing	1	0.05%							the question of whether other beta-blockers (such as metoprolol, bisoprolol, and bucindolol) prolong survival in heart failure is being addressed in ongoing trials	think about and begin to deal with (an issue or problem)
agree	2	0.10%	agreed	2	0.10%										the voting members of the steering committee agreed unanimously on July 3,	have the same opinion about something; concur

Realization, lemma	n	Selecti on proba bility	Inflected forms										Example from MRAC	Definition, OED	
														1997, to accept the recommendation for early termination	
assess	1	0.05%	assessed	1	0.05%									an independent cardiac evaluation committee whose members were unaware of patients' treatment assignments assessed the incidence, severity, treatment, and outcome of cardiac dysfunction	evaluate or estimate the nature, ability, or quality of
believe	2	0.10%	believed	2	0.10%									self-reported sleepiness is not an objective measure and is believed to underestimate the physiologic state of sleepiness	accept that (something) is true, especially without proof; hold (something) as an opinion; think
comment (n)	2	0.10%	comments	2	0.10%									we are indebted to [...] for their many helpful comments and suggestions	a verbal or written remark expressing an opinion or reaction; discussion, especially of a critical nature, of an issue or event
debate (n)	2	0.10%	debate	2	0.10%									the issue of how far blood pressure should be lowered to achieve the greatest benefit, in terms of reduced cardiovascular morbidity and mortality, has been a matter of scientific debate	a formal discussion on a particular matter in a public meeting or legislative assembly, in which opposing arguments are put forward and which usually ends with a vote; an argument about a particular subject, especially one in which many people are involved
dictate (v)	2	0.10%	dictated	2	0.10%									within the limits dictated by the study	state or order authoritatively; control or decisively affect; determine
extrapolation	2	0.10%	extrapolation	2	0.10%									extrapolation of the results of these 3 trials of middle-aged men with moderate-to-severe hypercholesterolemia to the general population with lower TC and LDL-C levels, to women, and to older individuals has remained a matter of debate	the action of estimating or concluding something by assuming that existing trends will continue or a current method will remain applicable
notion	2	0.10%	notion	2	0.10%									studies in humans have supported the notion that ACE inhibitors alter renal hemodynamics primarily by diminishing the action of angiotensin II	a conception of or belief about something

Realization, lemma	n	Selecti on proba bility	Inflected forms											Example from MRAC	Definition, OED	
perceive	2	0.10%	perceived	2	0.10%										the risks of hypoglycaemia and of weight gain, particularly in patients treated by insulin, are perceived by patients as difficulties that limit their ability to achieve improved glucose control (data not shown)	become aware or conscious of (something); come to realize or understand; interpret or regard (someone or something) in a particular way
tell	2	0.10%	told	1	0.05%	tell	1	0.05%							subjects who had ever been told by a doctor that they had diabetes, had glucose in their urine, or had too much glucose in their blood	communicate information to someone in spoken or written words
view (n)	2	0.10%	view	2	0.10%										the Data Monitoring Committee was to advise the Steering Committee if, in their view, the randomised comparisons in the study [...]	a particular way of considering or regarding something; an attitude or opinion
assume	1	0.05%	assumed	1	0.05%										many physicians have assumed that inhibition of the renin-angiotensin-aldosterone system by an angiotensin-converting-enzyme (ACE) inhibitor will suppress the formation of aldosterone	suppose to be the case, without proof
debate (v)	1	0.05%	debated	1	0.05%										it has been debated whether patients with diabetes who have not had myocardial infarctions should be treated as aggressively for cardiovascular risk factors as patients who have had myocardial infarctions	argue about (a subject), especially in a formal manner
estimation	1	0.05%	estimation	1	0.05%										all LDL-C values were calculated based on the Friedewald estimation	a rough calculation of the value, number, quantity, or extent of something
express (v)	1	0.05%	expressed	1	0.05%										concerns have been expressed that too vigorous reduction in blood pressure may be associated with increased cardiovascular risk	convey (a thought or feeling) in words or by gestures and conduct
idea	1	0.05%	idea	1	0.05%										an idea that has been suggested previously	a thought or suggestion as to a possible course of action; an opinion or belief
infer	1	0.05%	inferred	1	0.05%										from studies of migrants, it has further been inferred that the risk is increased by exposure to environmental factors in childhood	deduce or conclude (something) from evidence and reasoning rather than from explicit statements



Realization , lemma	n	Selecti on proba bilty	Inflected forms										Example from MRAC	Definition, OED	
inference	1	0.05%	inferences	1	0.0 5%									inferences drawn from comparisons of outcome between such groups might be misleading	a conclusion reached on the basis of evidence and reasoning
mention (n)	1	0.05%	mention	1	0.0 5%									no mention was made of alternative or complementary therapies	a reference to someone or something
observe	1	0.05%	observed	1	0.0 5%									the increases in the prevalences of obesity and overweight previously observed continued in 1999-2000	notice or perceive (something) and register it as being significant
point out	1	0.05%	pointed out	1	0.0 5%									as pointed out by Collins and Peto, <sup>33</sup> because of the relatively short duration of trials of antihypertensive therapy, analyses of mortality are potentially unreliable	say something to make someone aware of a fact or circumstance
postulate (v)	1	0.05%	postulated	1	0.0 5%									ribavirin has been postulated to inhibit viral-dependent RNA polymerase, the capping structure of viral messenger RNA, and inosine monophosphate dehydrogenase	suggest or assume the existence, fact, or truth of (something) as a basis for reasoning, discussion, or belief
projected (adj)	1	0.05%												estimates for adults were age-standardized to the projected estimates of the 2000 US Census using the age groups of 20 to 39 years, 40 to 59 years, and 60 years or older	estimate or forecast (something) on the basis of present trends
proposal	1	0.05%	proposal	1	0.0 5%									our results support the proposal that captopril slows the progression of diabetic nephropathy by a mechanism that is independent of its antihypertensive properties	a plan or suggestion, especially a formal or written one, put forward for consideration by others
purport	1	0.05%	purported	1	0.0 5%									these purported mechanisms by which captopril exerts its beneficial effects (i.e., the attenuation of ventricular remodeling and the inhibition of neurohumoral activation) are not mutually exclusive	appear to be or do something, especially falsely
recognised (adj)	1	0.05%												anaemia is a well-recognised effect of ribavirin, and the pattern that has been previously observed was seen in this study	acknowledge the existence, validity, or legality of
regard (v)	1	0.05%	regarded	1	0.0 5%									metformin is now the only biguanide in general use, since it has a 10–20-fold lower risk of lactic acidosis than phenformin, and is regarded as a safe drug	consider or think of in a specified way

Realization, lemma	n	Selection probability	Inflected forms										Example from MRAC	Definition, OED		
															provided it is not used in at-risk patients, such as those in renal failure	
speculation	1	0.05%	speculation	1	0.05%										prompting speculation that any early adverse effect of hormones on CHD incidence was confined to women who have experienced prior CHD events	the forming of a theory or conjecture without firm evidence
think	1	0.05%	thought	1	0.05%										the use of neuromuscular blocking agents, corticosteroids, and aminoglycosides are thought to have a role	have a particular belief or idea
view (v)	1	0.05%	viewed	1	0.05%										since patients must continue to receive this therapy throughout their lives, it is often viewed as a hardship	
<b>Total</b>	<b>2089</b>	<b>100.00%</b>														

Table A11. Frequencies and selection probabilities for realizations of [distance] across MRAC as a whole.

Realization, lemma	n	Selection probability	Inflected form			Example from MRAC	Definition, OED
"[...]"	48	82.76%				the dramatic decline in the incidence of gastric carcinoma in the United States and Western Europe over the past 50 years has led some to proclaim an "unplanned triumph"	<single or double quotation marks>
argue	2	3.45%	argued	2	3.45%	it may be argued that [...] However, a number of clinical studies collectively rule out any beneficial effect of anticoagulant therapy on restenosis in humans	give reasons or cite evidence in support of an idea, action, or theory, typically with the aim of persuading others to share one's view; exchange or express diverging or opposite views
criticize	2	3.45%	criticized	2	3.45%	but these studies have been criticized, in part because they did not directly control for cigarette smoking and other health risks	indicate the faults of (someone or something) in a disapproving way; form and express a judgement of (a literary or artistic work)
so-called	2	3.45%				one specific histologic type of gastric adenocarcinoma, the so-called intestinal type, is particularly prone to the regional and temporal variations of an environmentally related malignant condition	used to show that something or someone is commonly designated by the name or term specified; used to express one's view that such a name or term is inappropriate
as if	1	1.72%				many referring physicians have shown a declining interest in carotid endarterectomy and have acted as if the absence of proof were the proof of absence	as would be the case if
assume	1	1.72%	assumed	1	1.72%	many physicians have assumed that inhibition of the renin-angiotensin-aldosterone system by an angiotensin-converting-enzyme (ACE) inhibitor will suppress the formation of aldosterone	suppose to be the case, without proof

Realization, lemma	n	Selection probability	Inflected form			Example from MRAC	Definition, OED
purport	1	1.72%	purported	1	1.72%	these purported mechanisms by which captopril exerts its beneficial effects (i.e., the attenuation of ventricular remodeling and the inhibition of neurohumoral activation) are not mutually exclusive	appear to be or do something, especially falsely
think	1	1.72%	thought	1	1.72%	aldosterone was originally thought to be important in the pathophysiology of heart failure	have a particular belief or idea
<b>Total</b>	<b>58</b>	<b>100.00%</b>					