A study on the effect of terminology on L2 reading comprehension : should specialist terms in medical texts be avoided?

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A Study on the Effect of Terminology on L2 Reading Comprehension

Should Specialist Terms in Medical Texts be Avoided?

PROEFSCHRIFT

ter verkrijging van de graad van doctor
aan de Technische Universiteit Eindhoven,
op gezag van de Rector Magnificus, prof. ir. M. Tels,
voor een commissie aangewezen door het College van Dekanen
in het openbaar te verdedigen op dinsdag 3 januari 1989 te 16.00 uur.

door
ROBERT EDUARD LANKAMP
geboren te Voorburg

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Introduction

1.0 About This Research

This study is about the comprehensibility of the medical terms in English-language medical texts for Dutch readers with varying levels of medical expertise and varying levels of English-language knowledge. There are two main research questions, one in the area of scientific language vs. common language and the other covering native language (L1) vs. foreign-language (L2) comprehension:

1. whether English medical terms cause more comprehension problems for Dutch readers than "simplified" common-English rewrites of these terms;
2. whether similarity (cognate status) of Dutch and English medical terms aids the comprehension of the latter by Dutch readers.

This study aims at supplying answers to these questions which are relevant in two main dimensions:

- a. the theoretical psycholinguistic dimension of a reading comprehension hypothesis and a language transfer hypothesis;
- b. the practical applicational dimension of English-language medical communication in The Netherlands as well as of medical education at Dutch universities and other centers of (para-)medical education.

Both of these points are elaborated in 1.1 and 1.2 below.

The both practically and psycholinguistically oriented medical English research which underlies this study is one of the first of its kind in The Netherlands, chronologically following the research into professional technical English being conducted at Eindhoven University of Technology. The research reported here is based on work done during a two-year medical English research project at the Leiden University Arts Faculty (starting in February 1986). This was the second medical English activity deployed by the arts faculty; the

first was an English course for Health Sciences students at Leiden University (currently the organization of this course has been taken over by the Leiden medical faculty).

This study is distinct from medical English studies emanating from medical professional circles. Such medical English studies are also concerned with the comprehensibility and/or teachability of medical language (see for example Dirckx 1977; also see 2.1.1 below). However, these studies are conducted from a purely practical point of view and, valuable as they may be in other respects, they contribute little to our understanding of the processes of medical communication.

1.1 The Psycholinguistic Perspective

The greater part of this study consists of psycholinguistic research. The two questions to be dealt with were:

1. whether English medical terms cause more comprehension problems than "simplified" common-English rewrites of these terms;
2. whether similarity of Dutch and English medical terms aids the comprehension of the latter by Dutch readers;

What is the psycholinguistic relevance of these questions? Let us scrutinize some of the implications of an affirmative answer to the first question. If this question is answered affirmatively, then success in comprehending a text is apparently determined by lexical-level analysis or word recognition strategies; the more general familiarity of the common-language items thus facilitates comprehension. Such lexical analysis would receive input from bare (i.e. nonconceptual) lexical knowledge. In other words, background knowledge would have little if any effect on comprehension at the lexical level.

Alternately, if it turns out that medical terms do not cause more comprehension problems than common-language equivalents, then other knowledge sources besides bare lexical knowledge may be involved.

This research investigating the effect of a reader's knowledge on a linguistic level of analysis on comprehension of a text parallels research started earlier on the effect of syntactic analysis and syntactic knowledge on reading foreign- and native-language scientific and technical text (see for example

Strother and Ulijn 1987). The compartmentalization in such research of comprehension in terms of linguistic levels of analysis and their allied knowledge sources has a clear advantage in the application of research results: any change that would need to be made in language communication or teaching is easily identified and implemented.

The question of the effect on reading comprehension of medical terms vs. their rewrites does not offer any special second-language perspective. The most obvious second-language perspective in the comprehensibility of medical terms is inherent to the second question of this research, i.e. whether similarity of Dutch and English medical terms aids the comprehension of the latter by Dutch readers. Note that if similarity does aid comprehension, we would have to take into account all those cases where similarity between first and second languages does **not** lead to better comprehension (see e.g. Færch and Kasper 1987).

Also note that if international similarity of medical terms enhances their comprehension across language boundaries, then it would be helpful if first-language medical terms have internationally cognate forms.

Dealing with these questions involved taking the following steps.

1. definition of the relevant linguistic variables, i.e. the definition of medical terms and of their common language rewrites;
2. the formulation of a reading comprehension hypothesis in terms of which the effect on reading comprehension is defined of the medical terms vs. the "simplified" common-English rewrites of these terms;
3. the formulation of a language transfer hypothesis on the association of a form in one language with another form in another language;
4. the design of experiments to test these hypotheses;
5. the design of an experiment exploring the degree to which Dutch medical experts actually prefer Dutch-English cognate vs. Dutch language-specific medical terms; if similarity of L1 and L2 forms aid the comprehension of the latter, then a preference for Dutch-English medical cognates would aid comprehension of the English terms;

6. interpretation of the resulting data and formulation of the implications for the relevant areas in psycholinguistic theory.

In this study these steps are organized as follows.

Chapter 2 deals with the definition of some of the linguistic variables as well as with identification procedures for medical terms in texts used in experiments. The first item dealt with in this chapter is a definition in linguistic terms of the notion **medical language**. The characterization of medical language as a whole is necessary in the context of the present, mainly lexical research if only because the medical lexical items being considered form part of such medical language. The definition of medical language forms a frame of reference for the subsequent definition of medical lexical items and for the formulation of an operational procedure to identify them in a text. The choice of lexical items in the experiments reported in later chapters depends on such an identification procedure.

To this end, the ways are investigated in which written English medical language differs from other English written language variations on the various linguistic levels of analysis (discourse, syntax, semantics, lexicon and morphology). The outcome of this investigation is felt to be able to give an indication of the linguistic relevance of the focus of the present medical English reading research on the lexicon instead of on some other linguistic level of analysis.

In terms of the resulting definition of medical language, the types of lexical items that appear in English-language medical texts are defined. These definitions are used to further narrow down criteria for the selection of medical terms to be used in the experiments reported in later chapters. Also, these definitions can be employed to point out differences between medical terms and other types of lexical items. Last, a practical procedure is established for the identification of medical terms in a text. This procedure is used to select the medical terms for the experiments reported below.

Chapter 3 deals with the formulation of the reading comprehension hypothesis in terms of which the effect on reading comprehension is defined of the medical terms vs. the "simplified" common-English rewrites of these terms. Specifically, in chapter 3 the cognitive mechanisms and knowledge sources are discussed which are involved in reading comprehension as well as the strategies readers employ as they attempt more or less successfully to extract meaning from written texts. In chapter 3, the processes for reading in a non-native lan-

guage (L2) are discussed which do not differ from those employed in reading in the native language (L1), i.e. what could be termed the "reading universals".

The discussion in chapter 3 culminates in the formulation of a reading comprehension hypothesis in terms of which the effect on reading comprehension is defined of the medical terms versus the "simplified" common-English rewrites of these terms.

In chapter 4 experimental evidence is sought for the hypothesis formulated in chapter 3. Implications of the data for the reading comprehension hypothesis of chapter 3 are discussed, along with some possible avenues for further research.

While in the three preceding chapters the effect was discussed of certain textual and knowledge factors on the comprehensibility by Dutch readers of medical concepts in English-language texts, in chapters 5 and 6 the concern is with the effect of interference (transfer) from Dutch on the comprehensibility of English medical terms for medically knowledgeable speakers of Dutch.

Chapter 5 deals with first the differences and similarities of Dutch and English medical terms. Next, a hypothesis is stated which says how the formal similarities between Dutch and English medical terms can aid (or hinder) comprehension of the latter by Dutch readers. This hypothesis is then tested experimentally. The implications of the data are discussed for the hypothesis and for further research, as well as for the more practical aims of this research.

Finally, chapter 6 deals with the question as to what degree the cognate medical terms discussed in chapter 5 are accepted by Dutch medical experts. A preference for cognate terms would undoubtedly help enhance comprehension of English medical terms, as discussed in chapter 5. A preference for language-specific forms would not enhance such comprehension. The investigation of the degree to which Dutch medical experts prefer cognate terms consists of first, a discussion of the various alternatives of cognate and language-specific term formation, then an experiment is reported on the preference of Dutch physicians for cognate vs. language-specific terms.

1.2 The Application Dimension of This Research

As reported above, this study aims at providing results in the practical, applicational dimension as well as in the theoretical psycholinguistic dimension. Below, various issues relating to the application perspective are discussed first.

1.2.1 University Medical Education in The Netherlands

How relevant is a study on the comprehensibility of English medical terms for Dutch medical communication (and by implication for medical English teaching)? Below, answers to this question are sought in terms of

1. the extent to which medical English is used in The Netherlands and
2. problems for Dutch users of medical English.

English-language Dutch medical communication is concentrated at various centers of medical research, the biggest of which are the universities. It therefore seems worthwhile to briefly consider university-level medical education in The Netherlands. There are eight medical faculties which provide university-level medical education. No two of these eight medical faculties teach exactly the same program. They do have in common that most of their students are training to be physicians.

The area in which these eight Dutch medical faculties differ most is in the fields of medical study they offer which do **not** lead to physician's qualifications. These are study programs called **Health Sciences** (Leiden, Nijmegen, Maastricht) **General Health Care** (Rotterdam), or **Medical Biology** (Amsterdam, Utrecht). Most medical faculties also offer optional programs dealing with medically-oriented law, computer science, philosophy etc.

The older and more traditional variant of medical education shared by all eight faculties is the variant which trains physicians. It is called (in translation) "Medical Science". This variant yearly produces about 1,500 physicians. The total number of physicians in The Netherlands (population: 14.5 million) is 30,000. Of these 30,000 physicians, some 5,900 are general practitioners, 10,800 are medical specialists and another 12,700 are specialists in social medicine or work in other medical capacities. About 1,500 physicians are registered as unemployed.

In very broad terms, the Medical Science programs at all eight Dutch medical faculties are structured into two "phases" (like all other Dutch university education). The "first phase" lasts four years and mainly consists of theoretical courses. The "second phase" of two years consists of clinical clerkships.

Physician's qualifications are attained after successful completion of the second phase. Before these doctors can start to practice, they require further vocational training. Such training lasts one year for a general physician, two years for a specialism in social medicine or three to six years for a medical specialism. Vocational training is completed by registration, after which independent practice is allowed.

The variants of medical education which do not train physicians are motivated by the suspicion that the Medical Science program is not the most efficient means to obtain categories of medical professionals who are not directly involved with health care such as managers or researchers. General Health Care (Rotterdam) is a medical education variant in which students specialize in medical policy and management matters from the outset. Health Sciences (Nijmegen) aims at both policy/management and at medical research, while Health Sciences (Leiden) together with the variants called Medical Biology aim at producing medical researchers. Health Sciences (Leiden) is broadly oriented in this field, and includes such non-medical subjects as Dutch and mathematics. It is also the only medical education variant in The Netherlands to include English as a separate subject in its curriculum from the first year onwards.

1.2.2 The Use of Medical English in The Netherlands

The extent to which English functions as international language in worldwide biomedical publications is illustrated by figures given in Maher (1986a: 209). According to these figures, in 1966 53.3% of biomedical publications listed in the *Index Medicus* (the international index of articles published in medical periodicals all over the world) were in English. In 1980 that figure had risen to 72.2%, or almost three quarters of the world production in biomedical articles. The lead English has in this area is demonstrated by the fact that the two runners-up, Russian and German, accounted for only 6.2% and 5.8% respectively of publications in 1980.

Maher (1986a: 212-213) also provides some figures on the extent to which English is used at international biomedical conferences. In a single twelve-

month period a total of 373 biomedical meetings were registered, only one of which did not specify English as the official language or one of the official languages.

Let us now consider the extent of the use of medical English in The Netherlands. The modest role of English as a subject in only one medical education program belies the large part English in fact plays in Dutch medical education. Claessen et al. (1977) provides some figures on the use of medical English at the medical faculties of Dutch universities. Although these figures are possibly dated by now, they can be seen as indications of the position of medical English at Dutch medical faculties. According to this study, English is the most frequently used foreign language at Dutch medical faculties. The average staff member at a Dutch medical faculty reads a scientific book or article in medical English three or four times a month. About once a year, such an average staff member attends a medical meeting where medical English is spoken. The average staff member also writes a report or publication in medical English about once a year. If anything, the use of English by staff members and students has increased in the intervening period.

The same study reports that the average medical student reads scientific books and articles in medical English slightly less often than the average staff member. The average medical student also attends medical meetings less often: not more than once every few years. The same holds for writing reports or publications in English.

It is evident from the lists of required reading that students are confronted from the outset with a large number of English-language books they have to study, usually two-thirds to three-quarters of the total number of books, the remainder mostly being in Dutch. Reading medical textbooks is quantitatively the single most important English-language skill required by Dutch medical students.

Other English language skills are, at least in the undergraduate (first) phase, are employed less often. These include things such as listening to English language lectures or asking questions in English, and sometimes writing short reports in English.

As for medical communication outside medical education, English is less often used in Dutch hospitals (with the exception of university hospitals) than at medical research centers, most hospital staff and of course most of the pa-

tients being Dutch. Doctor-patient communication research in The Netherlands is therefore a matter for medical Dutch.

At Dutch medical research centers (pharmaceutical companies, university institutions etc.) English does play an important role. For one thing, a large proportion of workers at such institutions come from abroad and English is the language everyone seems to have in common. Also, many Dutch medical researchers (like researchers in most other fields) publish in English-language journals, deliver papers in English at conferences or deliver lectures abroad in English. In the area of medical research in The Netherlands, then, the use of English tends to cover a whole range of language skills from talking to colleagues to writing articles for English-language medical journals.

1.2.3 Problems with Reading English-Language Medical Texts

What are the problems in English-language Dutch medical communication and how can the present study play a part in solving them? From 1.2.2 it may be concluded that medical English, especially medical English reading, has widespread use in Dutch medical communication. By itself this could be enough to warrant some interest from a second-language acquisition/reading comprehension/psycholinguistic perspective, such as this study. Practical relevance is of course achieved to a greater extent when such research can be called upon to define or perhaps solve a specific problem in English-language Dutch medical communication.

Something which is seen as a major problem at Dutch medical faculties (as well as other faculties) is that students generally prefer Dutch texts to the required English texts. This is worrisome because many of the required English textbooks lack Dutch translations or other Dutch equivalents. The main reason for the preference for Dutch texts given by medical students themselves is that it takes longer to read the English texts than it does to read Dutch texts (this information was gained over a period of time through informal interviews with medical and Health Sciences (Leiden) students). Much of the extra time needed for reading English texts seems to go into looking up unfamiliar vocabulary. On the other hand, some students see the slower pace in reading English texts as an advantage, since, according to such students, it makes you pay closer attention to what is in the text.

Generally it is the beginning students who experience most problems with reading medical English texts - more advanced students seem to experience less problems in this area. Reading seems less of a problem for more advanced medical students and for medical professionals, possibly because they have been continually exposed to it for a longer period of time (cf. Stephens 1986: 22). Note that these reading problems exist despite all the attention that is paid to reading in English at Dutch secondary schools (English is a compulsory subject at almost all schools). This may indicate that the reading problems that students experience are caused by features of medical English texts which are not present in the types of common English texts which are read at school.

1.2.4 The Role of This Study in Finding Solutions

What part can this study play in solving these problems? Recall that the first research question in 1.0 was whether English medical terms (which tend to be restricted to medical texts) cause more comprehension problems than "simplified" common-English rewrites of these terms (employing generally familiar vocabulary). If this proves to be the case, then a solution to at least part of the reading problem would be to review the effectiveness of teaching English medical terms, which would be clearly lacking in its present form.

Interestingly enough, there are some research results which seem to indicate that the reading problem discussed above does not wholly derive from problems with English. Vendel (1982) reports an experiment with Dutch first-year psychology and physics students, where it turned out that these students were better at reading English texts in their own field than Dutch texts in the field of the other group. The conclusion was that subjects' English reading proficiency was linked to their knowledge of the subject matter dealt with in the texts. This is an important observation which underlies the hypothesis developed in chapter 3 on the comprehensibility of English medical terms vs. their common-language counterparts.

The conclusions of Vendel (1982) suggest that reading problems with English medical texts can (partly) be solved by familiarizing students beforehand with the relevant subject matter (and thus also with the relevant technical terms). Assuming that these research results are applicable to Dutch medical students' reading problems, this would mean that, at least at first sight, the solution should be sought in adapting medical teaching rather than teaching medi-

cal English. These conclusions would be corroborated if the present study turns up no effect on the comprehensibility of medical concepts in English texts by rewriting the terms through which they are customarily expressed as common-language synonyms. In such a case it is less language knowledge than medical knowledge which determines the degree of comprehension. If this study does not turn up such results, then further study of the problem is required, or it may be concluded that learning English medical terms requires extra effort.

However, it may be that the similarity of Dutch and English medical terms (see the second research question in 1.0) helps Dutch students understand English medical terms, which would minimize the effort required for learning them (see chapter 5).

While medical background knowledge thus may play an important part in the comprehension of medical English text, it is clear that it is not alone responsible for such comprehension. An indication of this is the preference of many Dutch medical students for Dutch medical texts over English medical texts. It seems useful to keep in mind that for the comprehension of English medical text a basic level of English is needed which involves knowledge of the linguistic items other than medical terms which occur in such text. This level of English may not have been attained by beginning medical students if their reading problems also concern such non-term linguistic items. If conclusions based on data gathered with respect to the status of medical English in the F.R.G. in Stephens (1986) have any validity in The Netherlands, reading problems at the lexical level are also caused by the non-term words which typically appear in English medical texts (see 2.3 for further discussion of lexical items of this type, and 4.7 for some possibly relevant experimental results). This dovetails with the experience of medical English teachers in Leiden.

In the Dutch situation, medical English language skills other than reading are required especially in the area of medical research. In this area, writing tends to be more problematic than reading, and spontaneous speaking, especially in presentations at conferences where one does not wish to stick to a written text, can be even more problematic (to the point of an incomprehensible mix of intonation, pronunciation, grammatical and lexical errors). Lexical errors essentially involve the non-term words, while grammatical problems involve word order, nonfinite verbal structures, tense/aspect etc. Pronunciation errors typically involve medical terms as well as non-term vocabulary; intonation can be a problem because the general pitch range in most dialects of Eng-

lish is noticeably greater than in Dutch. Less language-specific matters such as structuring texts do not usually present any problems for Dutch medical experts. It is assumed here that these strong and weak points in English-language communication also hold for other disciplines.

The problems that this study deals with lie in the area of reading, specifically the effect of medical background knowledge (e.g. knowledge of medical terms) on reading comprehension. If it turns out that medical background knowledge is important for the comprehension of medical text by students, then the implication is that instruction in (L2) medical English should be closely integrated with other medical instruction.

Medical Language and Lexicon

2.0 Introduction

In this chapter the linguistic background for this study is set out. The place of this linguistic background in the overall scheme of this study is as follows. What this study aims at (see 1.0) is to determine whether, for Dutch readers of different medical backgrounds with varying medical expertise, the comprehensibility of English-language medical texts is affected if its medical terms are replaced by semantically equivalent common-language phrases. In 1.1 and 1.2 the two areas were set out in which the results of this study might make some contribution. One of these areas (see 1.1) was psycholinguistic theory. The psycholinguistic theory of this study is discussed in chapter 3. The other area (see 1.2) was practical application in Dutch medical education (which would include medical English) and English-language medical communication in the Dutch context.

One of the aims of this chapter is to provide a linguistic definition of the medical terms, the effect of which on comprehension is determined by way of the experiments reported in chapters 4-6. The other aim of this chapter is to provide an operational definition of medical terms which is consistent with the stated linguistic definition and which can be used to identify the medical terms in the texts used in the experiment of chapters 4-6.

In more detail, this chapter deals with the following items.

1. *A definition of medical language.* In this context, such a definition consists of the adoption of a linguistic frame of reference in terms of which medical language can be distinguished from other such language variants as well as from common or general language. It will be seen that in this study certain requirements are posed for linguistic description which limit the usefulness of various approaches which might serve as frame of reference for the definition of medical language.

The definition of medical language as a whole is useful for the consideration of the relation of medical terms to other lexical items in medical texts (e.g. the difference between terms and these lexical items) and for the consideration of the degree to which medical terms characterize medical language. The definition of medical language forms a frame of reference for the definition of types of medical lexical items and subsequently for the formulation of an operational procedure to identify terms in a text. The selection of lexical items in the experiments reported in chapter 4-6 depends on such an identification procedure.

2. A central assumption in this investigation is that a medical language can be so different from common or general language that it would have to be acquired or learnt (two interchangeable terms in here) by language users with only general language knowledge. The question is how different medical language is from common language or other language variants. This calls for *an investigation of the ways in which written English medical language differs on the various linguistic levels of analysis (discourse, syntax, semantics, lexicon and morphology) from other English written language variations*. The outcome of this investigation may indicate the linguistic relevance of the focus of the present research on the lexicon instead of on some other linguistic level of analysis.

3. *Definitions of the types of lexical items that appear in English-language medical texts*. These definitions are used to further narrow down criteria for the selection of medical terms used in the experiments reported in chapters 4-6. Also, these definitions can be employed to point out differences between medical terms and other types of lexical items.

4. *Establishment of a practical procedure for the identification of medical terms in a text*. This procedure is used to select the medical terms for the experiments reported below.

2.1 A Definition of Medical Language

In this section it is attempted to give a definition in linguistic terms of the notion medical language. Such a definition provides a frame of reference within which an understanding can be gained of what the medical lexicon is (the main linguistic object of study in this research) and how it differs from other lexicons. To this end, the following procedure has been adopted. First, a number of major

approaches to studying medical language is outlined, including the approaches which have their origins in the medical field itself. Of these approaches, the two main ways of studying medical language which have emerged from the traditional linguistic disciplines are then briefly contrasted. It will be seen that the usefulness of various approaches is limited by certain requirements which are posed in this study for linguistic description.

2.1.1 Major Approaches to Studying Medical Language

Recent studies of medical language can be classified under four major approaches. These are the **terminological, stylistic, educational and linguistic** approaches.

A. The Terminological Approach

This approach is pursued mostly by medical subject specialists. It investigates the nature of concepts and terms with the purpose of creating consistent intra- and interlinguistic terminologies (see for example Dirckx 1977, Maher 1986b or Tanay 1986). Medical terms are discussed below in two places: (i) medical terms are defined versus other lexical items in 2.3.2 and (ii) medical terms are discussed from the interlinguistic point of view in chapter 6.

B. The Stylistic Approach

What is termed the stylistic approach here is also the domain of medical specialists rather than linguists. In this context style refers to the effectiveness of a mode of expression (cf. Crystal and Davy 1969:10, also see the discussion on "national language" in 2.1.3). The stylistic approach differs from the terminological approach in that the main issue of discussion is comprehensibility and efficiency of communication rather than consistency in term formation. According to Maher (1986b:118-119), the majority of discussions within the medical profession on medical style are attempts to change it. According to Maher, such discussions frequently involve efforts to eliminate the features which define medical language with respect to common usage. The general complaint, Maher says, is the increasing specialization of medical language which, it is claimed, is becoming more and more isolated from traditional medical phraseology and general language (see for example Christy 1979a or 1979b).

The validity of this complaint is one of the items this study has bearing on: if the use of medical terms in a text is more conducive to its comprehension by

medical experts than the use of semantically equivalent terms which are more generally familiar, then there is a case for using such medical terms in texts meant for medical experts. If, however, the use of medical terms turns out to be less effective, there would be something to be said for using more generally familiar terms for the affected group of experts.

However, comprehensibility does not appear to be the sole criterion for the use of generally unfamiliar medical terms. The use of a professional code which is intended to be comprehensible only to members of that profession, perhaps for reasons of brevity and efficiency of communication, perhaps to exclude outsiders, seems to follow automatically in professional communication and the expertise which is usually involved in such communication (cf. Goetschalckx 1987 on computer language).

C. The Educational and Linguistic Approaches

The present study of medical language is undertaken from a linguistic point of view rather than from a medical professional point of view on medical communication. For this reason, the terminological and stylistic approaches seem to provide less appropriate frames of reference for the definition of medical language than what are termed the educational and linguistic approaches briefly described below.

Under these two approaches, medical language can be variously defined as a variant of **special language** (in for example Felber 1984), **language for special purposes** (see for example in Picht and Draskau 1985), **language for specific purposes** (as in Turner 1981) and the **scientific and technological register** (as in Ulijn 1985). English language-specific studies in this area usually refer to **English for science and technology** (as in Sager et al. 1980) or **English for specific purposes** (Robinson 1980).

Sometimes these appellations of language variants denote the curricular requirements for potential learners in language courses geared to a profession, a group of professions or an academic discipline (see for example Holden 1977 for an overview of various groups to which special-language courses can cater).

In other cases these terms are used in a linguistic description context to denote the particular language of a profession or groups of professions, or an academic discipline (as in for example Sager et al. 1980 or Ulijn 1978). It is expressly with a linguistic description of medical language, in particular the medi-

cal English lexicon, with which this study is concerned and in terms of which the "terminological" and "stylistic" topics mentioned above are discussed below.

Recent linguistic work in the area of medical language (and other professional or academic usage) can be subdivided into two major linguistic approaches.

1. the **quantitative** approach which defines language varieties in terms of frequency counts of linguistic items in texts and
2. the **(socio-)linguistic** approach which defines language varieties in terms of communicative situations.

Below, these two approaches are evaluated, providing arguments for the approach adopted in this study (see 2.1.3).

2.1.2 Quantitative Analysis

The linguistic point of view in the present study of medical language makes definition of medical language from a terminological or medical stylistic point of view less appropriate. It is a more purely linguistic viewpoint which is called for here. A definition in quantitative terms of medical language is usually given in terms of frequencies of occurrence of certain linguistic items in medical texts.

It is clear that texts can be attributed to particular subject fields in terms of frequency distributions of items which occur in them. Salager (1983:55) formulates the case for quantitative analysis in arguing that the peculiarities of languages for special purposes are first and foremost of quantitative nature and that it is the significantly frequent occurrence of certain speech elements, forms or structures that define scientific writings.

It thus seems justified to suppose that medical language can be defined in terms of the relatively frequent occurrence of certain linguistic items. The most obvious items in terms of which medical language can be so defined are medical terms such as *percutaneous angioplasty* or *antegrade pyelogram* (see 2.2). Such terms tend to occur only in medical language. The discovery of such lexical items by way of a quantitative analysis is vital to the validity of quantitative analysis and seems fairly easy, at least at first sight.

However, a weakness of the quantitative approach, according to Sager et al. (1980: 233-234) is that frequency counts are often limited to **words**. Let us be clear on what is meant by words. Cruse (1986:35) defines a word as typically the smallest element of a sentence which has positional mobility. The second major

characteristic of words according to Cruse is that they are typically the largest units which resist "interruption" by the insertion of new material between their constituent parts. By contrast, extended terms consist of more than one word. The lexicalization of extended terms refers to their being entered in the mental lexicon as a unit instead of as a number of separate items.

As frequency counts seldom cover extended terms and as there is no absolute agreement about lexicalized expressions, figures on the occurrence of terms tend to be of limited value. More reliable frequency counts would take terminological units into account, but such studies are rare (Sager et al. 1980: 235).

Salager (1984) is an exception in that it is concerned with the frequencies of complex nominal phrases. However, that study does not (apparently) distinguish between lexicalized nominal compounds and nominal compounds with no existence outside the text. For example, a nominal compound such as *acute tubular necrosis* would generally be recognized as a single, lexicalized expression, while other complex nominals occurring in a medical text such as *well-functioning transplant* or *changes in echogenicity* have no such independent existence.

Quantitative analyses of medical texts are hard put to distinguish between lexicalized compound expressions and other complex expressions. They are unable to distinguish between such expressions without having recourse to non-quantitative criteria such as familiarity of language users with the items in question. The introduction of such non-quantitative criteria, however, makes quantitative analysis unnecessary. A criterion like familiarity could be used by itself to identify complex lexicalized expressions, for example in terms of judgments of an expert in the field in question.

Note also that quantitative analysis by itself fails to bring out the distinction between lexical items (the general term) and more specifically defined **lexical units**. Characterization of a language variant in terms of the frequency of occurrence of the latter seems more useful than in terms of frequency of occurrence of lexical items in general, which may or may not derive from the same lexical unit. Cruse (1986:76-77) defines a lexical unit as the union of a **lexical form** and a single sense. A lexical form is the abstract unit of form realized in actual sentences as the appropriate member of a set of word forms differing only in respect of inflections.

These difficulties make a linguistic approach based on quantitative analysis unsuitable for this study, where a procedure is required for identifying medical terms in a text which, obviously, should be able to pick out one-word medical terms as well as the more complex ones. The question is whether such identification of medical terms is possible in the sociolinguistic alternative to the quantitative approach. This is discussed in 2.1.3.

Also note that adoption of a quantitative method would result in the definition of medical language in terms of a list of linguistic items. However, such a list would not bring out that lexical items are somehow typically medical in an intuitive sense by virtue of form or meaning features rather than because of their distribution.

Put slightly differently, many counts of lexical items in medical texts do not differentiate between items occurring in medical texts which also occur in common-language texts and specific items which (tend to) occur only in medical texts. An example of such a study is Salager (1983), where intuitively common-language words such as *presence* or *pattern* are classified as medical English nouns and where no further differentiation is made between types of medical lexical items which also tend to occur in common-language texts and those which tend not to. The same type of common-language words are also said to occur relatively frequently in subvariants of medical English such as "Basic Medical English" or "Specialized Medical English". The assignment of a word to one of these subdivisions says nothing, however, about how uniquely or specifically "medical" the distribution of a lexical item tends to be.

Proponents of quantitative analysis such as Sager et al. (1980) and Salager (1983) call statistical studies important for matters such as the compilation of glossaries, for information processing such as automatic indexing and retrieval and for the development of teaching materials. Where in teaching situations there is no need to distinguish between medical language and common language (perhaps because common language is not at issue), course materials could include certain readily identifiable linguistic items often occurring in medical texts which have been picked out by quantitative analysis.

Quantitative analysis does not, however, seem to meet the requirements for linguistic description posed by a study such as the present one.

2.1.3 The Sociolinguistic Approach

The best-known alternative to the quantitative approach is the sociolinguistic approach, where a linguistic definition of medical language is given mainly in terms of speakers and communication situations.

In terms of speakers and communicative situations, medical language is seen as a type of **register**. According to Hudson (1980:48f.), the term register is widely used to refer to varieties of language appropriate to different occasions and situations of use which are used by a single speaker.

Registers should not be confused with either region- or class-based dialects. Dialects are language varieties associated with different characteristics of users (e.g. age, class and regional affiliation), while registers are language varieties employed by a single speaker. This distinction is not meant to preclude the similarity, in terms of distribution of linguistic items, of a dialect and a register, e.g. when a speaker's informal register used with family and friends is linguistically similar to a dialect.

The analysis of medical language in terms of register which follows here is based on the analysis of register in Hudson (1980: 49) and on the analysis of language for special purposes in Picht and Draskau (1985: 3ff.). This analysis distinguishes three dimensions of variation:

A. medical specialism

B. manner of transmission of the medical message

C. relations between participants in the medical exchange

A. Medical Specialism

This dimension in the description of medical language orients the contents of the medical text in terms of medicine in general or the various fields of specialism. It is quite likely that the type of linguistic differences that exist between medical language and other language variations is also encountered when the language of one medical professional group or specialism is contrasted to those of other medical professional groups or specialisms. Medical specialism should be taken to include the various medical technical fields as well as the more traditional medical fields of research.

B. Oral vs. Written Transmission of the Medical Message

It is well known that, in general language usage, written language can differ from spoken language, the former often being associated with a more formal use of language. The manner of transmission of a linguistic message is often termed its **mode**.

In medical communication this can also be the case; the use of medical slang, for example, will not extend to medical research papers in respectable journals.

Depending on the manner of transmission, then, medical registers can be distinguished such as spoken medical language, written medical language, or more specifically written medical language for research reports or medical language in equipment manuals (see for example Master 1986 or Bouwman et al. 1985 respectively for language usage in those areas).

C. Relations between Participants in the Medical Exchange

This dimension (also referred to as **tenor**) covers language characteristics which mark different relations between participants in a linguistic exchange. These may depend on a number of factors such as: roles defined by situation (doctor/patient, doctor/doctor, nurse/doctor, or equipment manufacturer/doctor, equipment manufacturer/nurse etc.), degree of familiarity, and so on.

The language used for medical instruction (the doctor/student relation) may differ notably from the language used for medical exposition (doctor/doctor). Medical students in various stages of their schooling, physicians in various medical specializations, nursing staff, medical informatics specialists each share certain language characteristics.

This means that, from the intralinguistic point of view, medical language is by no means linguistically homogeneous; we can distinguish the following major variants of medical language:

1. the language of medical education (e.g. textbooks, lectures),
2. the language of medical occupation (for example medical journal articles, oral papers)
3. the language of medical journalism (popular medicine, medical encyclopedias) and

4. doctor-patient language (including written items such as the language of medical instructions or commercial brochures)
5. medical technical language (e.g. manuals).

From the above it is clear that medical language can be easily defined as a type of register. There are, however, some features of medical language (and scientific language in general) which distinguish it from other registers and which do not fit in any of the three aforementioned categories of professional group, mode or tenor. These additional parameters are **communicative purpose** and **national language**.

D. Communicative Purpose

An important distinction between a register, in a general sense, and a language for special purposes-type register such as medical language is the function of a language for special purposes-type register to communicate information of a specialist nature at any level of complexity in the most economic, precise and unambiguous terms possible, i.e. as efficiently as possible, especially in the expert-to-expert tenor (see Sager et al. 1980: 290-291). Medical language, as well as scientific or technological language, traditionally requires precise nonambiguous and preferably nonsynonymous language items to express relevant concepts, especially in the expert-to-expert tenor. Such language items are generally systematically organized in **terminologies** (see 2.3).

E. National Language

It is clear that, apart from specialism, transmission-type and text-type, medical language is differentiated according to specific national languages expressing international medical concepts. In this dimension, medical language is differentiated in medical Dutch, medical English, medical French etc. (see chapter 6 for a cross-linguistic view of medical language).

2.1.4 Conclusion

The definition of medical (or scientific or technological) language in terms of the five dimensions given above should explain the linguistic diversity, even within one language, of medical texts. Each medical field of research has its own terminology, oral communication differs from written communication; in doc-

tor-to-doctor communication more special medical language is used than in doctor-to-patient communication. The technical language of hospital equipment manuals has features of its own distinguishing it from other varieties of medical language.

Even within the relatively restricted field of written doctor-to-doctor communication there will be variation between the various medical specialisms and between types of texts, e.g. research reports vs. feasibility studies. In addition, writing conventions for such types of texts may not be wholly homogeneous - for, say, research reports in medical journals there are the different editorial requirements imposed by the various journals, to say nothing of local and individual writing conventions.

If we assume that scientific language in general is subject to even more variety than medical language, it would explain why Porter (1976:86) was unable to find evidence of a "relatively homogeneous" scientific English style, the homogeneity of scientific language being found in terms of speakers and communicative situations rather than in terms of style (in this case referring to the set of linguistic conventions adhered to by a language user - as distinct from the more evaluative sense of "style" used in discussing the medical stylistic approach in 2.1.1).

The definition of medical language in terms of register, i.e. in terms of varieties of language used by a single speaker is also compatible with the idea of a **mental lexicon**, or the lexical competence of a single language user in the psycholinguistic model outlined in chapter 3.

Also, such a definition in terms of register allows a simple procedure for identifying medical-register lexical items in a text by elicitation of judgments of native-speaker medical experts, who may be assumed to be conversant in the relevant medical register. This line of thought is further pursued in 2.4.

2.2 The Role of Linguistic Levels of Analysis in the Definition of Written Medical Language

In this section the role played by the lexicon and the other linguistic levels of analysis in the differentiation between medical language, specifically medical English, and other English language variations is investigated.

The analysis given below of the role of the different linguistic levels of analysis in defining medical English does not include items which medical English

shares with other English language variations. In this analysis medical English is not only contrasted with common everyday English, but also with other, related science and technology English language variations. Medical English is usually taken to be a subvariant of a wider science and technology register - Sager et al. (1980) for example, do not distinguish between medical English and other science and technology English language variants. From the point of view of a language user, the unique characterization of medical language or parts of medical language may seem somewhat artificial. In medical communication, language items which might be considered uniquely medical are obviously mixed with items which are clearly not uniquely medical. Typically medical terms are used in sentences which also contain common-language words. Still, an analysis that shows which linguistic levels of analysis are needed to define unique features of medical English has the advantage that it shows in an efficient way how medical English differs from other English language variants.

The reasons for defining medical English uniquely in this sense are:

1. linguistic characteristics of the group of science and technology English-language variations (which are shared to some degree by medical English) are already extensively documented elsewhere (in for example Sager et al. 1980),
2. formulation of unique characteristics of medical English helps determine what aspects of a special English-language course for a medical public can be combined with or are identical to more general English-language courses for a science and/or technology public.

Accordingly, below the linguistic characteristics of medical English are investigated in the exclusive sense defined above in terms of the discourse, syntactic, semantic, morphological and lexical levels of analysis.

A. Discourse Analysis

What is usually referred to as "discourse" has three distinct senses (cf. Robinson 1980:20ff. for a similar distinction):

- a. spoken interaction, analyzed in terms of units of meaning, organized into a hierarchy employing some or all of the terms **act**, **move**, **exchange**, **transaction** and others. The term used in Levinson (1983:286ff.) for analysis of this type is **conversation analysis**.

- b. the consideration of rhetorical functions (communicative purposes) and of information constituents of various types of texts. This is what is termed **discourse analysis** here.
- c. a stretch of spoken or written language analysis which considers aspects of sentence connection, or cohesion. This type of analysis is termed **text analysis** in Widdowson 1979.

In the context of medical English research, conversation analysis and discourse analysis have often been applied to interactional processes which occur in communication in medical contexts, especially doctor-patient interaction. Such analyses tend to highlight inequalities in the consultation procedure, in the form of asymmetrical discourse patterns between the client and the physician. Examples of such studies are Bruton et al. (1976), Candlin et al. (1977) and (1978), Cicourel (1981) and (1983), Hein and Wodak (1987) and Pomerantz et al. (1987).

Analyses of written medical English tend to concentrate on discourse-level items which medical English shares with science and technology English, such as the textualization of the author's point of view (Adams-Smith 1984) or the use of various indefinite constructions (Pettinari 1983).

Aspects of other typically medical discourse, such as case conferences, tend to be described in accounts of medical English syllabus design (see for example Allwright and Allwright 1977).

B. Syntax

On the syntactic level of analysis, medical English and science and technology English share a tendency for a more frequent occurrence of syntactic structures such as passives and non-finite structures than in common English (see Sager et al. 1980 for a discussion of the syntax of science and technology registers, also see 3.2). There are, however, no syntactic structures which are particular to medical English and which (generally) do not occur in other English language variants.

C. Semantics

At the truth-conditional semantic level there is no way to distinguish medical language from common language or special-purpose languages. Obviously, lan-

guage variation is not a factor in truth-conditional representations of meaning; such representations of meaning are given in terms of propositions which are true or false relative to some state of affairs and not to the way (language variation) in which these propositions are expressed.

D. Morphology

Medical English shares with other science and technology English language variants a more frequent occurrence of certain morphological items. Some of these items are syllabic contraction (*urinalysis/urinoanalysis*), affixes such as *hyper-* (*hyperactive*), *-ize* (*adrenalize*), nominalization of verbs (*dilatation*) and a more frequent occurrence of compound nominal phrases (*plaque forming cell*) - see for example Maher (1986a), Salager (1984), Sager et al. (1980: 257ff) or Ulijn (1985) for more details.

However, certain morphological items do tend to occur solely in medical English texts and not in general English texts or in English-language texts in other fields of science or technology. These are various Graeco-Latinate suffixes such as *-asis* (*elephantiasis*), *-itis* (*bronchitis*), *-oma* (*carcinoma*), *-osis* (*neurosis*) and *-ectomy* (*appendectomy*).

E. Lexicon

Intuitively, it is clear that medical English is characterized most uniquely in terms of lexical items. Lexical items such as *percutaneous angioplasty* or *antegrade pyelogram* and many others tend to occur only in medical English texts.

Conclusion

Concluding, it is clear that the contrasts between medical English and other English language variations are to a large extent determined lexically. However, contrasts between medical English and other English language variations can also be discerned on the discourse (doctor/patient communication) and morphological (some suffixes) levels of analysis.

2.3 The Intralinguistic Definition of the Medical English Lexicon

In this section definitions are provided of the types of lexical items that appear in English-language medical texts. These definitions are used to further narrow down the selection of medical terms to be used for the experiment reported in chapter 4. In this experiment, the comprehensibility of medical terms is compared with semantically equivalent common-language words and phrases. The definitions of the types of lexical items given below are such that they illustrate types of oppositions between medical terms and the common-language items into which they can be rewritten.

As in all texts, words in medical texts can be defined as either **function words** or as **content words**. Content words are the principal meaning-bearing elements in a sentence, typically denoting objects or concepts. Function words are words such as articles, conjunctions, prepositions and so on, a major part of whose linguistic function is to signal the grammatical organization of sentences. The rest of this account is solely concerned with content words, the comprehension of function words not being at issue here.

2.3.1 The Definition of Content Words in Medical Texts in Terms of Lexicon and Register

Content words in medical texts are defined according to two parameters: a **lexical** parameter and a **register** parameter.

A. The Lexical Parameter

In the lexical parameter, a distinction is made between **terms** and **lexical items in general**.

A lexical item is an entry in a speaker's **mental lexicon**. The mental lexicon, as opposed to a linguistic lexicon, is an attribute of the individual language user. Terms are a type of lexical item which

- a. may consist of a single word or more than one word, such as compound nominal phrases which have independent existence (in the mental lexicon) outside the texts in which they occur and

- b. which are specific to a scientific register and are typically only used by specialists.

The meanings of such terms are the concepts which form a system in the scientific field in question (see for example Picht and Draskau 1985:62ff. for more discussion). The creation of new terms is a deliberate and conscious process, under criteria such as appropriateness of the form for the meaning it conveys, efficiency, precision of meaning and economy of expression (see Sager et al. 1980:288ff. for a detailed account of the criteria used in term formation).

B. The Register Parameter

Register is the second parameter according to which content words in medical texts are defined. In this parameter, content words form either medical-register lexical items, or not. Medical-register lexical items are lexical items which are selected when a medical register is used.

Following Hudson (1980:52-53), there are two types of linguistic choice which can be distinguished in this context:

1. a choice is made by **convention** when another form is available, but not felt to be suitable in the particular register being used. An example is the medical term *pyelogram* with its common-language counterpart *kidney X-ray*. In contexts where *pyelogram* and *kidney X-ray* are interchangeable from the point of view of meaning, one of the two may be felt to be more suitable than the other (also see chapter 6 for some data on choices of this kind). Note incidentally that *pyelogram* and *kidney X-ray* do not cover precisely the same concept; a *renogram* is a kidney X-ray which is not a *pyelogram*.
2. a choice is made out of **necessity** when there is no alternative form available. An example is a medical term such as *frank cortical necrosis* which has no counterpart in another register.

It is therefore by no means rare for the same referent to have different names on different occasions; *kidney X-ray* will probably be used less often in the physician-to-physician medical register than its semantic equivalent *pyelogram*. In this way the semantic suitability of words and phrases can be determined, not so much by syntactic and semantic factors, as by their appropriateness in various communicative situations.

Items such as *kidney X-ray* and its medical-term counterpart *pyelogram* are not quite **cognitive synonyms** (since a renogram can also be a kidney X-ray). According to Cruse (1986: 88), *X* is a cognitive synonym of *Y* if (i) *X* and *Y* are syntactically identical and (ii) any grammatical declarative sentence *S* containing *X* has equivalent truth-conditions to another sentence *S*¹, which is identical to *S* except that *X* is replaced by *Y*.

It is clear that some content lexical items are, either by necessity or by convention, confined to a single register. In the case of a medical register, the most obvious candidates are medical terms like *pyelogram* which are generally unfamiliar.

2.3.2 Types of Lexical Items in Medical Texts

The lexical and register parameters define the types of lexical items in medical texts which are illustrated in table 2.1. These types of lexical items are further discussed below. The EST acronym in Table 2.1 stands for "English for Science and Technology".

Table 2.1 Content Lexical Items in Medical Texts

Register	Lexical item type	
	Terms	Non-terms
medical only	specialist medical terms	-
medical/common language	common medical terms	submedical items
medical/other EST or common-language registers	other specialist or common terms	submedical items

A. Specialist and common medical terms

Medical terms are the dominant markers of register in medical texts. According to Table 2.1 there are two main types of medical terms: specialist medical terms and common medical terms. Specialist medical terms are less generally familiar medical terms, while common medical terms (such as *transplantation* or *AIDS*) are for some reason more generally familiar (although such familiarity need not include thorough knowledge of the medical concepts involved).

The extent to which common or specialist medical terms are used clearly indicates which medical topic or specialism is involved, as well as the level of specialism or tenor (see 2.1.3).

Following Sager et al. (1980:231ff.), it may be assumed that the creation of the vast medical terminology which has accompanied the extension of knowledge in medicine has been necessary to describe the discoveries made and to express the concepts evolved in the course of this development. The meanings of medical terms are the concepts which form a system in the medical field in question. Recent technological advances in medical equipment have resulted in the formation of new specifically medical technical terms.

A term may have several expression forms according to the different text types in which it occurs. In medicine and pharmacology there are schedules which list the nationally or internationally agreed and accepted designations of parts of the body, diseases, medicaments and treatments. But at the same time and parallel to this terminology there often exist, at least in English and in Dutch, the common-language names for the concepts expressed by various medical terms (e.g. *kidney X-ray* for *pyelogram*).

Medical terms are

1. either created for a particular subject or
2. created by using existing lexical forms in other registers (see Sager et al. 1980: 252ff. for a more extensive discussion of what is briefly summarized below).

1. Medical terms created for a particular subject

Medical terms which are created for a particular subject are

- a. either borrowed from other languages, or
- b. they are neologisms.

For example, some terms in medical Dutch, such as *scan* are borrowed from medical English.

However, many more medical terms in Dutch as well as in English are borrowed from classical Latin. Classical Latin is also the source of most neologisms in medical terminology, since many of the borrowed forms (e.g. *camera*, *sinus*) are assigned other meanings. Note that such borrowings/neologisms were not

always necessary in the sense that the language lacked the means to express the concept in question, for example Latinate *fracture* vs. *break* (a bone).

Many Latinate medical terms were formed when Latin was the predominant language of medicine in Europe. Today Latin is still influential at the morphological level in the formation of standard international medical terms, witness a recent term such as *foetor hepaticus* (see 6.1 for discussion of Latinate term formation from the cross-linguistic point of view).

Another way in which medical neologisms can be created is by way of **eponyms**. Eponyms are terms consisting of personal names followed by various headwords - see for example Tanay (1986) for further classification of medical eponyms. Some examples of eponyms are *Sertoli cells*, *Brun's syndrome*, *Esser's graft*. Terms are also often formed as **acronyms** of longer terms, such as *ATN* for *acute tubular necrosis*.

2. Creation of medical terms from existing lexical forms

Medical terms are created from existing lexical forms in other registers by adding a sense to the sense or senses already associated with a particular lexical form. In this respect, following Cruse (1986:50ff.) a distinction is made here between **modulation** and **contextual selection** of lexical meaning. Modulation is a matter of contextual modification of a single sense, while contextual selection involves the selection, by the context, of different units of sense. Usually a new sense of an existing lexical item which refers to a medical concept is based in some way on one of the existing senses. In medical English, this is for example a metaphorical relation, e.g. *branch* (as in branch of the aorta), *graft* (organ transplant), *platelet* (in the blood) or *pyramid* (in the kidney).

In other cases, a new sense is a reduction of the extension of an existing sense, as in *invasive* (restricted to a medical physical sense), *rejection* (of transplants) or *scan* (by instruments).

B. Other common or specialist terms

Medical texts may also contain terms from other scientific or technical registers. For example, statistical terms are frequently used in reports on medical research.

C. Submedical items

A submedical item is simply any content word in a medical text which is not a term of some kind (see A. and B. above). Obviously, the usage of the lexical items termed submedical items is not restricted to the medical field, although in medical contexts they may take on extended meanings (medical, or specialized in some fashion) without a new sense unit being created (cf. Trimble 1985:128-129 on what he calls subtechnical items). Examples of such lexical items are the euphemisms sometimes used in medical texts, such as *expire* (for *die*), *demise* (for *death*) or *respire* (for *breathe*). Note that the distinction between submedical lexical items and medical terms of which the forms have been borrowed from other registers is a distinction between modulation (meaning dependent on context) and contextual sense selection (meaning independent of context). See Cruse (1986:58ff.) for tests to distinguish between these two phenomena.

D. Relations between types of lexical items in a medical text

In Table 2.1 the various types of lexical items in medical texts are either unique to the medical registers or they are used across various registers. It is clear that the contents of these registers are not fixed or unchanging. They may vary from language user to language user, lexical knowledge not being necessarily identical between any two language users. For a single language user, they may change over time. For example, for most people the acronym *AIDS* will have become part of their common-language lexicon; in terms of the grid in Table 2.1 it has developed from a specialist medical terms to a common medical term.

2.4 Operational Definition of Medical Terms

In this section the practical procedure is established for the identification of medical terms in a text, which is used in chapter 4 to select the medical terms which are rewritten into common-language terms. The adopted identification procedure is consistent with the approach to defining medical terms in 2.3. The register approach to medical language of 2.3 implies **expert judgments** as the criterion for medical term identification, register being defined as the language variation of individuals, in this case experts in the area of the relevant medical register (cf. Huckin and Olsen 1983 on the usability of informants in special-

register teaching or research). Many such judgments are of course available in the form of terminology lists. The identification of medical terms by means of frequency lists is expressly not compatible with the register-based approach adopted here.

2.5 Summary and Conclusions

In this chapter linguistic information was provided about the types of lexical items which are involved in the experiments on the effect of medical terms on the comprehensibility of medical texts reported in chapters 4-6. Also, this chapter is to provide a way to identify medical terms in texts to be used in those experiments.

First, a definition in linguistic terms was given of the notion medical language in order to provide a frame of reference for an understanding of what the medical lexicon is and how it differs from other lexicons. To this end, a number of major approaches to studying medical language were outlined. Two approaches have emerged from the medical discipline itself: the terminological approach (concerned with the formation of medical terms) and the stylistic approach (concerned with the comprehensibility of medical text).

It was then pointed out that since this study adopts the linguistic point of view on medical communication rather than a medical professional point of view, the medical terminological and stylistic approaches seem less appropriate. The linguistic approach was considered to consist of two other main approaches: the quantitative approach (defining language varieties in terms of frequency counts) and the (socio-)linguistic approach (defining language varieties in terms of communicative situations).

The quantitative approach proved to have the following drawbacks:

1. quantitative analyses of medical texts cannot distinguish between lexicalized (i.e. terms) and non-lexicalized complex expressions;
2. many counts of lexical items in medical texts do not differentiate between items occurring in medical texts which also occur in common-language texts and specific items which (tend to) occur only in medical texts.

In the sociolinguistic approach, medical language is seen as a type of register, definable in the following dimensions: medical specialism, manner of trans-

mission of the medical message, relations between participants in the medical exchange, communicative purpose and national language. The definition of medical (or scientific or technological) language in terms of these five dimensions was held to explain the linguistic diversity, even within one language, of medical texts.

The practical advantage of a definition of medical language in terms of register was that it allows a simple procedure for identifying medical-register lexical items in a text by elicitation of judgments of native-speaker medical experts, who may be assumed to be conversant in the relevant medical register. After the adoption of a particular linguistic approach for the definition of medical language, the second main topic of this chapter was an investigation into the role played by the lexicon and the other linguistic levels of analysis in the differentiation between medical language, specifically medical English, and other English language variations. Uniquely medical items were encountered on the discourse level (e.g. case conferences), morphology (certain affixation such as *-asis*, *-itis*, *-oma*, *-osis* *-ectomy*) and on the lexical level (medical terms). No such items were encountered on the syntactic and semantic levels of analysis.

The third main topic of this chapter was stating definitions of the types of lexical items that appear in English-language medical texts. Content words in medical texts were defined according to a lexical parameter and a register parameter.

This resulted in the definitions of the following types of lexical items in medical texts: specialist medical terms, common medical terms, other common or specialist terms and submedical items. Common and specialist medical terms were further subdivided into those created for a particular subject and those employing existing lexical forms in other registers.

After thus having provided a linguistic definition of medical terms, the last topic of this chapter was the provision of an operational definition of medical terms. This operational definition is subsequently used for the identification of medical terms in the experiments in chapters 4-6 on the effect of medical terms on the comprehensibility of medical texts. It was concluded that the register approach to medical language of 2.3 implies expert judgments as the criterion for medical term identification, noting that many such judgments available in the form of terminology lists.

A Reading Comprehension Model

3.0 Introduction

The aim of this study is, as stated in 1.0, to ascertain whether, for Dutch readers of varying medical expertise, the comprehensibility of English-language medical texts is affected if its medical terms are replaced by semantically equivalent common-language phrases. In 1.1 and 1.2 the two areas were described in which the results of this study might make some contribution. One of these two areas was practical application in Dutch medical education (including the teaching of medical English), and English-language medical communication in the Dutch context. In this practical application area, the results of the present study may indicate

1. whether special attention should be given to the acquisition of English medical terms by Dutch medical students (i.e. if medical terms turn out to impede comprehension as compared to their common-language semantic equivalents) and
2. under what circumstances it makes sense to use medical terms in English medical texts aimed at Dutch readers of varying levels of medical expertise.

The other area in which the results of this study might make some contribution was that of psycholinguistic theory. In this area, the results of the present study may contribute to further understanding of the effect on comprehension of language processing on the various linguistic levels of analysis, supported by linguistic knowledge and conceptual familiarity. The focus of the present study on medical terms and their effect on reading comprehension entails emphasis on the lexical level of analysis.

While chapter 2 provided the linguistic background of this study, culminating in a linguistic definition of medical terms as well as an operational definition of medical terms which is consistent with the stated linguistic definition, this chapter deals with the psycholinguistic theory in which this study is em-

bedded. The aim of this chapter is the formulation of a psycholinguistic hypothesis on the effect of medical terms on reading comprehension. This hypothesis is subsequently tested in an experiment described in chapter 4, where the medical terms in question are identified by way of the operational definition developed in chapter 2. Chapters 5 and 6 subsequently deal with the specifically second-language dimension of the effect of medical terms on reading comprehension.

In this chapter, the formulation of the hypothesis on the effect of medical terms on reading comprehension is arrived at in two stages. First, some background is provided on the notion of reading comprehension from the psycholinguistic perspective. Next, a model of reading comprehension is introduced and then discussed in some detail. Finally, the hypothesis on the effect of medical terms on reading comprehension is developed in terms of this reading comprehension model.

This research dealing with comprehension on the lexical and conceptual levels is analogous to research on the effect of syntactic structures which typically occur in scientific and technical texts on the comprehension of such texts (see e.g. Strother and Ulijn 1987). Briefly, the result of this syntactic research is that for writers of scientific-register texts it makes no difference whether in conveying a certain message syntactic structures are used which are typical of common-language texts, or syntactic structures which are more typical of scientific texts. There is, then, no need to avoid structures like the passive in texts of the latter type. The question to be dealt with here is whether this also holds for scientific (in this case medical) terms.

3.1 Psycholinguistics and Reading Comprehension

The first topic of discussion here is psycholinguistics and reading comprehension .

Psycholinguistics can be defined as the branch of psychology concerned with the mental processes engaged in language use, aimed at an understanding of the cognitive systems at work during this process. Psycholinguistics covers how people listen, speak, read and write in native as well as non-native languages and how they acquire these abilities.

Reading comprehension is related to various subjects and specific purposes for reading, as well as to various native and non-native languages. Physicians, for example, are trained to use medical linguistic conventions and terminology, i.e. to use a specific register, in order to be able to communicate effectively (see 2.1). Reading material of a particular medical subject area can, depending on the reader, prove difficult because of the high number of specialized technical terms. Such difficulty can be compounded if the text to be read is in a non-native language.

Below, a psycholinguistic approach is discussed which can be employed to describe the reading comprehension process for medical texts in a foreign language, specifically English-language medical texts for Dutch readers. The question here, from the psycholinguistic point of view, is what the processes are which are engaged in reading comprehension and what strategies or types of analyses readers employ as they attempt more or less successfully to extract meaning from written texts. In this chapter, the main topic of discussion is the type of analyses or strategies employed for reading in a non-native language (L2) which do not differ from those employed in reading in the native language (L1), i.e. what could be termed the "reading universals".

Other approaches to reading exist apart from the psycholinguistic approach (the more literary views on reading are clearly beyond the scope of the present study). The so-called skills approach to reading, for example, looks upon reading ability as composed of different subskills that may relate to one another within a hierarchy of skills. The scope of the skills approach does not so much encompass the cognitive processes used by readers as the reader's ability to understand the text at various levels corresponding to various skills, such as literal comprehension, reorganization of the ideas in the text, inferential ability, evaluation and appreciation (see for example Alderson & Urquhart 1984, or Davies & Widdowson 1974 for detailed discussion).

The skills approach to reading is not concerned with the process of reading comprehension as much as with the product of reading comprehension, with what the reader has "got out" of the text, rather than how the reader arrived at a certain interpretation. For this reason the skills approach has always been of pedagogic interest. It enables teachers to design reading comprehension questions (direct reference questions, inference, supposition and evaluation questions), which aim at testing the learner's ability to understand the text at various

levels corresponding to various skills. Through such comprehension exercises, learners are also assumed to improve their reading skills.

Knowing what learners have understood, however, does not help decide how they have understood and does not provide information on how learners may be helped to understand at a certain previously unattained level. This lack of attention for what is obviously the main question in reading, namely the comprehension of text, is an important disadvantage of the skills approach in the context of the present study. By way of contrast, the present psycholinguistically oriented research aims at showing how knowledge of words and of the concepts denoted by those words, rather than, say, grammar, is a fundamental aid in reading comprehension.

3.2 A Partial Parallel Reading Comprehension Model

In 3.0 and 3.1 the aim of this chapter was discussed, i.e. the formulation of a hypothesis on the effect of medical terms on reading comprehension (specifically L2 English texts for L1 Dutch readers). Below the psycholinguistic model of reading is discussed in terms of which this hypothesis is stated. This is the reading model developed in Ulijn (1987), consisting of a minimal set of items needed for successful reading. These items and their interaction are illustrated in Figure 3.1

Fig. 3.1 A Reading Comprehension Model (Ulijn 1987)

What is shown in Fig. 3.1 is that reading is based on a cognitive system requiring a minimal set of interacting mechanisms, subsystems or knowledge sources. In Fig. 3.1 the interaction between these mechanisms, subsystems and knowledge sources is represented by lines and arrows, where for the sake of visual clarity the various types of interaction are represented by solid or dotted lines. This model of reading comprehension consists of two tiers. The top tier of boxes in Fig. 3.1, labelled as the **conceptual system**, the **monitor** and the **mental lexicon**, represent knowledge and control subsystems which support the cognitive mechanisms represented in the bottom tier of boxes (the **visual system**, the **phonological feedback circuit**, the **script recognizer** and the **text and sentence parser**).

One of the main features by which this model differs from other cognitive approaches to reading is the partially parallel strategy of the text and sentence parser of syntactic, lexical and conceptual analyses of input from a written text (see 3.4). The division of labor within this partially parallel organization is superficial syntactic analysis followed by parallel conceptual and lexical analyses followed by (if necessary) thorough syntactic analysis (see 3.4 for more discussion on syntactic analysis). Below, each of the interacting items represented in Fig. 3.1 is discussed one by one.

The function of the monitor represented in Fig.3.1, i.e. the overall coordinating and controlling mechanism in the reading comprehension process, has no specific relevance for the lexical matters with which this research is mainly concerned, which is why it is not further discussed below.

3.3 From the Visual System to the Script Recognizer

The lower tier of boxes in the reading comprehension model in Figure 3.1 represent, from left to right, stages in the reading comprehension process. Not all of these stages in reading comprehension, especially the earlier ones, are directly relevant to the purpose of this discussion, the formulation of the hypothesis on the effect of medical terms on reading comprehension. Still, for the sake of completeness, it seems in order to briefly discuss below the earlier stages in reading comprehension which are not directly related to our hypothesis. The earliest stage in reading comprehension represented in Fig. 3.1 consists of the sensory perception of certain marks and blank spaces by the visual system. This process helps the recognition of lexical forms, which are the main concern of this research. Marks can be identified by the script recognizer as a certain script, i.e. as a certain set of graphemic conventions. Thus, the script recognizer is a mechanism which can identify the scripts or script features particular to various languages, based on knowledge in the conceptual system (see 3.6-3.8 for a discussion of the conceptual system).

According to the representation in Fig. 3.1, the link between the visual system to the script recognizer is not always direct; the step from the visual system to the script recognizer may (also) be taken by way of the phonological feedback circuit.

3.3.1 The Phonological Feedback Circuit

The operation of the phonological feedback circuit cannot be described as easily as that of the visual system and script recognizer components in the reading model illustrated in Figure 3.1. The reason is that a phonological component would seem to be geared to auditory rather than to visual perception; therefore its presence in the reading comprehension process needs some explaining, since most reading is done silently. For reading aloud, the operation of the phonological feedback circuit is more obvious.

In language acquisition, listening normally precedes reading. Reading is first exercised out loud, i.e. a relation is established between graphemes and pronunciation. A **grapheme** is a letter or a group of letters which corresponds to a single sound segment, but not necessarily always the same sound segment. For example, in English <ea> is a grapheme which can correspond to three different sound segments, as in *fear*, *bear* or *heart*; <p> is a grapheme which corresponds only to /p/.

Originally, of course, English orthography was essentially phonemic notation. Changes in pronunciation, accidental spelling errors and orthographic innovations have all changed the phonemic nature of script. Such recognition of graphemes through their pronunciation is the task of the phonological feedback circuit. Phonological segments (phonemes) and suprasegmental features (stress patterns, intonation) are identified by the phonological feedback circuit. The interaction of the phonological feedback circuit with the visual system and the script recognizer is represented in Fig. 3.2.

Fig. 3.2 Script Recognition

3.3.2 Script Recognition Strategies

In Figure 3.2, the interaction between the visual system, the script recognizer and the phonological feedback circuit consists of two possible routes between the visual system and the script recognizer (see for example Brooks 1984, Leong 1984 or Meara 1984 for more detailed discussion):

1. **direct visual access**, i.e. the direct route between the visual system and the script recognizer and
2. **phonological coding**, i.e. the indirect route between the visual system and the script recognizer by way of the phonological feedback circuit.

In case of direct visual access there is direct recognition of graphemes without phonological intervention. In this case input from the script recognizer for word

recognition (at a later stage in the reading comprehension process) is just the spelling of that word.

In case of phonological coding the recognition of graphemes is preceded by information on how they are pronounced, for example the identification of a <ph> grapheme through its pronunciation as an allophone of /f/. In such cases word recognition depends on its pronunciation (as assessed by the reader) as well as on its spelling. Reading aloud is perhaps the most familiar instance of phonological coding in reading.

3.3.3 The Application of Script Recognition Strategies

The representation in Figure 3.2 entails three possible types of strategies for script recognition: direct visual access, phonological coding and both phonological coding and direct visual access. In recent reading comprehension research (see for example Nas 1983 or Brooks 1984) there is more or less a consensus about the conditions which prompt either direct visual access or phonological coding. These conditions relate to different levels of fluency of the reader, or different levels of difficulty of the text, or to different stages between first learning to read and becoming fluent.

Nas (1983), in a study on L2 English reading comprehension by L1 Dutch readers, provides experimental evidence (which is not repeated in detail here) that certain circumstances dictate which possibility in Fig. 3.2 is actually employed in reading. According to this view, readers are capable of employing more than just one strategy; usually readers continue employing whatever strategy they started out with in reading the text, the choice of strategy very much depending on the reading task (i.e. reading for full comprehension, or searching out certain items in the text, etc.). Possibly this is not limited to reading English: Leong (1984) cites evidence showing that phonological coding in Chinese may be possible. According to Nas (1983), L2 readers usually make use of both visual and phonological information.

Pure phonological coding, according to Nas (1983:99), would for example take place in case of a conscious effort to detect Dutch/English homophones (say, *fray* and *vrij*). In this case, script recognition would always be phonologically coded because of the need to recognize phonological similarity across possible graphemic dissimilarity.

As for "pure" direct visual access, Leong (1984) makes a case for it for skilled readers who are able to extract meaning from text without a prior stage

of phonological coding when textual materials are simple, processing speed is important and when familiarity is high and memory demands are low. In addition, Nehr (1984), reports an investigation on whether it was possible to learn to read a foreign language (specifically Japanese and Serbo-Croatian in Cyrillic and Roman script) without recourse to phonological coding. This investigation resulted in some evidence that beginning L2 learners may comprehend written L2 texts without recourse to phonological coding.

Related to the topic of the present study, this would mean that Dutch medical students and other learners of medical English may comprehend English medical terms in written text without having any information as to their English pronunciation, be it a "correct" pronunciation or not. This issue is not further discussed here.

3.4 The Text and Sentence Parser

The operation of the text and sentence parser constitutes the stage which follows script recognition in the reading comprehension model of Figure 3.1. This text and sentence parsing component includes the lexical aspects of reading comprehension and as such this part of the reading comprehension model is more relevant to the aim of this chapter than the stages of reading comprehension discussed so far (although a brief discussion of these was included for the sake of completeness).

The aim of this chapter was the formulation of a hypothesis on the effect of medical terms on reading comprehension. The relevance of the text and sentence parsing stage of reading comprehension for this hypothesis can, at this point in the discussion, be stated as follows. It is the task of the text and sentence parser to detect the conceptualization underlying each sentence of an input text, including of course sentences with medical terms. A description of the effect of medical terms on reading comprehension should therefore be given in terms of the text and sentence parsing stage of reading comprehension. Such a description can only be given if it is understood how the text and sentence parser works. This is discussed below.

The text and sentence parser starts out with the results obtained by the script recognizer and has access to the conceptual system and the (mental) lexicon for the information relevant to its task. This part of the reading comprehension model introduced in 3.2 is represented in Fig. 3.3.

Fig. 3.3 The Text and Sentence Parser

Operations in the text and sentence parser include **formal processing** (supported by syntactic analysis and lexical analysis) and **conceptual processing** (supported by lexical analysis and conceptual analysis).

Figures 3.4 - 3.8 show some possible temporal orderings of conceptual analysis, lexical analysis and syntactic analysis within the text and sentence parser.

Fig. 3.4 Serial Bottom-Up Processing

Fig. 3.5 Serial Top-Down Processing

Fig. 3.6 Parallel Processing

Fig. 3.7 Partial Parallel Processing (i)

Fig. 3.8 Partial Parallel Processing (ii)

Figures 3.4 - 3.8 contain three main types of ordering: serial (3.4 and 3.5), parallel (3.6) and partial parallel (3.7 and 3.8). Serial ordering can be "bottom-up", as in 3.5, or "top-down" as in 3.6. In Fig. 3.7 partial parallel ordering involves syntactic analysis followed by lexical analysis and conceptual analysis operating in parallel. By contrast, in Fig. 3.8 partial parallel ordering involves superficial syntactic analysis followed by lexical analysis and conceptual analysis operating in parallel, which in turn are followed by optional thorough syntactic analysis. These different possible strategies of the text and sentence parser are discussed more extensively below.

3.4.1 Top-Down and Bottom-Up Processing

In the bottom-up metaphor, the "bottom" consists of small-scale formal analytic units such as lexical items and syntactic structures, while "up" consists of a wider context into which the meaning elements of the "bottom" are integrated into a coherent whole (by way of conceptual analysis). In this approach, then, the smaller units are analyzed first and then as it were fitted together to form the overall meaning representation.

Conversely, top-down processing of a text consists of the construction of an overall semantic representation into which the meaning contributions of lexical items and syntactic structures are subsequently integrated. A pioneer in the top-down approach to reading comprehension is Goodman (1967, 1971 and 1974).

In the Goodman approach, the basic reading strategies are:

prediction of what the next chunk of language will be on the basis of sampling;

sampling, i.e. selection of the minimum information from text consistent with the prediction;

confirming, i.e. testing the prediction against the sample and previous information extracted from the text or from the store of information in long-term memory dealing with the topic in question and

correction, i.e. if the prediction is not confirmed, another prediction is generated.

A contribution from this influential approach to reading comprehension is the idea that fluent, efficient readers do not process a text by identifying and interpreting each and every letter and word sequence in the text. They extract only

part of the graphic material and set up hypotheses about text meaning while reconstructing the whole. In this approach, efficient readers approach a text with expectancies based on knowledge of the subject. As they progress into the material, these expectations are confirmed or revised and further interpretation is built on the basis of what has been read so far. This confirmation of expectancy is achieved through the extraction of minimal syntactic and semantic clues from the written text.

Coady (1969) contains a similar approach, where fluent readers take advantage of what are termed more abstract process strategies, i.e. lexical information and contextual meaning. Eskey (1969) also stresses that fluent reading depends more on higher-level semantic clues and is mainly concerned with vocabulary in context.

By contrast, poor readers tend to employ the bottom-up approach more often than fluent readers. According to Weiss (1985), for example, when (specifically L2) readers with a limited vocabulary and lack of general language proficiency confront an L2 text, they will typically rely on the word-by-word "bottom-up" approach. This is inefficient; since such readers perceive just letters and possibly words, they fail to grasp the main points of the text.

However, in more recent research it is argued that the top-down approach to fluent reading (and the bottom-up approach to poor reading) is incorrect if the various levels of analysis are processed in series. According to Ulijn (1987), for example, serial bottom-up or top-down approaches are time-consuming and inefficient. It is more in line with current experimental evidence to suppose a simultaneous and interdependent interaction between the different analyses of the text and sentence parser. In particular, it is held that the lexical and conceptual analyses involved in reading operate interdependently and in parallel (see 3.4.2, 3.6-3.9 and 4.7 for more discussion).

In this respect, the research of Schouten-van Parreren (1985) into strategies readers employ in guessing unfamiliar words has provided some interesting results. The analysis of data from Dutch subjects' performance on filling in blanks in a Dutch cloze text while thinking aloud as well as data from the performance of Dutch learners of Russian in guessing unfamiliar Russian words led Schouten-Van Parreren to conclude that subjects operated on the levels illustrated in Fig. 3.9.

Fig. 3.9 A Hierarchical Non-Serial Model

The stylistic level in this analysis is concerned with stylistic use of a lexical item; on the lexical level word forms are inspected to derive meaning; on the semantic level the context of unknown lexical items is inspected; on the morpho-syntactic level grammatical structure is analyzed.

The hierarchical order of the levels in Figure 3.9 indicates whether such word-guessing strategies operate top-down or bottom-up. In a wider perspective, the hierarchical order of the levels of analysis in Fig. 3.9 indicate whether readers construct their meaning hypotheses about a text in a top-down or bottom-up fashion, given that words are the prime carriers of such meaning. The evidence in Schouten-Van Parreren indicates a top-down processing mode for expert readers. Accordingly, in Fig. 3.9 the levels of analysis are hierarchically organized so that the syntactic level is lowest in the hierarchy and the stylistic level is highest, in the sense that a reader can only act correctly at a certain level after having successfully acted on the levels below.

However, analysis of the data also indicated that expert readers avoid the time-consuming process of running through the entire hierarchy every time the meaning of a word needed to be guessed. Expert behavior in this respect consisted of the ability to estimate what difficulties (on what level of analysis) the guessing of a certain word would present. These subjects then made their guess at the appropriate level. In Fig. 3.9 the levels at which readers make their guesses are termed "entry" levels. Mistaken estimates about appropriate entry levels can be compensated by re-entering at another level in the hierarchy.

If we accept that such guessing strategies form part of broader comprehension strategies, then these results would indicate that for top-down processing it is not necessary to activate each level of analysis, i.e. that it is possible to skip lower levels of analysis in the reading comprehension process, the levels at which no impediments for reading comprehension are encountered. When such impediments are encountered, the appropriate lower levels of analysis are activated.

3.4.2 Parallel and Partial-Parallel Processing

In parallel processing (Fig. 3.6) there is no top or bottom - each level of analysis does its work simultaneously. Bottom-up serial processing is rejected by for example De Beaugrande (1984) for somewhat different reasons than this type of processing was rejected in 3.4.1. The premise in this approach is that

reading tasks which are focussed on the "bottom" levels (such as spelling or the occurrence of stipulated sounds and letters) result in poorer learning for the "top" levels of content organization. This implies that during normal communication the various levels are processed in parallel, not in series, because the demands of the "top" and "bottom" levels evidently compete. However, De Beaugrande allows for processing dominance of one level over another, in the sense that when one level is allotted processing dominance the others are not fully shut down, but receive fuzzy processing, i.e. partial, provisional, and approximative. Another possibility besides fuzzy processing is automatic processing where little or no use is made of the processing results (also see 3.5).

In Dijkstra and Kempen (1984) an approach is given where syntactic and conceptual parsing do not work sequentially but simultaneously. It is, however, conceded that unambiguous interpretation can be arrived at by way of what is termed conceptual parsing, aided by a bare minimum of syntactic parsing.

It is clear from the above that at least some of the "parallel processing" approaches to reading comprehension also allow for sequential processing in some way. Two reasons (given in Ulijn 1987) are:

1. In parallel processing the special role of conceptual and lexical analysis in normal comprehension-oriented reading would be ignored - in a completely parallel operation, these levels of analysis would compete on an equal basis with syntactic analysis (see 3.4.1).
2. A completely parallel operation of levels of analysis in the text and sentence parser would put heavy constraints on short term memory (in reading, short-term memory is defined as where the graphemic/phonological form of words and isolated constituents of sentences are placed; it is generally felt to have a very limited capacity; the contents pass very rapidly into long-term memory, cf. Clark and Clark 1977: 135).

In other words, the Ulijn (1987) approach assigns processing dominance to parallel (lower level) lexical analysis and conceptual (higher level) analysis, i.e. in this approach, in efficient reading for full comprehension it is conceptual (semantic) processing which takes precedence over formal processing. Ulijn (1987) mentions the following evidence delivered on this point by Thibadeau, Just and Carpenter (1982). A successful computer simulation of reading which was strongly driven by eye fixation data from human readers was done. It ap-

peared that in the semantic and syntactic analyses of sentences, gaze duration was more strongly influenced by semantic aspects, such as ambiguity, novelty and repetition throughout the text than by formal perceptual aspects such as length and frequency. Readers of scientific texts fixated 83% of the content words needed for a conceptual analysis and only 38% of the function words needed for a syntactic analysis.

The prominence of lexical and conceptual analysis is reflected in the adoption in Ulijn (1987) of partial parallel processing in the model of the text and sentence parser, as illustrated in Figure 3.8. Note that the alternative partial-parallel model in Fig. 3.7 gives equal prominence to the syntactic level of analysis, which can be rejected here for the same reason as serial bottom-up processing: thorough syntactic analysis is not efficient in reading for normal comprehension. In the organization of levels of analysis in the text and sentence parser of Figure 3.8, syntactic analysis does not need to be thorough, just providing enough input for lexical analysis and conceptual analysis (see 3.6-3.9).

The parser makes a superficial syntactic analysis, focuses on conceptual analysis supported mainly by lexical analysis and only reverts to a thorough syntactic analysis if comprehension is still incomplete. Note that it does not seem difficult to map the partial-parallel approach of Fig. 3.8 onto the Schouten-Van Parreren (1985) analysis of Fig. 3.9 as a constraint on the movement from level to level within that model. The constraint in question (in terms of the Schouten-Van Parreren 1985 model represented in Fig. 3.9) is that the reader starts out, superficially, at the syntactic level and progresses upwards from there, only returning if necessary to the syntactic level for complete analysis at that level.

Perhaps obviously, the validity of the partial-parallel organization of levels of analysis in the text and sentence parser is restricted to reading for full comprehension of a text, as for example university students read to prepare for exams. In case of other tasks, as for example conscious syntactic parsing during translation, complete syntactic analysis is required from the outset. The degree of thoroughness of lexical and conceptual analysis can be affected by reading tasks as well: in skim-reading, for example, lexical analysis of a text will not be as thorough as in reading for full comprehension.

3.5 Syntactic Analysis

Syntactic analysis, together with lexical analysis, is involved in the formal processing task in the text and sentence parser, as illustrated in Figure 3.10.

Fig. 3.10 Formal Processing

As its name implies, formal processing is concerned with the identification of forms, with both the formal features of lexical items (graphemic form and syntactic category) as well as with sentence structures. Formal processing is therefore not directly involved in the comprehension of medical terms (our prime concern here) but in their recognition as such.

It is assumed here that syntactic analysis consists of the isolation and identification of syntactic structures in input from the script recognizer, with the goal of assigning a meaning to those structures. The importance of lexical analysis for syntactic analysis is obvious: the textual information used for inferring syntactic structures is mainly lexical, such as word order (which presupposes word recognition), the nature of various function words and content words and morphological features. In comprehension-oriented reading, syntactic analysis tends to be fuzzy and approximative, or automatic, just sufficient to be able to assign a meaning. This analysis is based on syntactic knowledge stored in the conceptual system (see 3.6).

What consequences does this assumption have for the reading of scientific texts? In scientific-language texts a number of syntactic structures tend to occur more frequently than in other types of texts (passives, nominalizations, participial structures). With a view to this, the question could be asked whether knowledge of these structures improves the reading comprehensibility of these structures. According to the representation in Fig. 3.10 this would not necessarily be the case; complete syntactic analysis is an option reserved for cases where conceptual processing after approximative syntactic analysis fails to yield an acceptable result.

For the reading of common-language texts, various sources, such as Alderson and Richards (1977) or Flores d'Arcais (1981), provide evidence that thorough syntactic analysis is not always necessary.

Flores d'Arcais (1981) differentiates between continuous automatic computation at a certain level, i.e. the availability of an analysis, and the actual use of the processor of such an analysis. The evidence brought forward in Flores d'Arcais (1981) is used to conclude that the fine details of automatic syntactic computation might not be used by the processor in understanding a piece of spoken or written language.

In this approach, the results of syntactic computation are not entirely and consistently used, and have a relatively minor importance when the reader can

rely on information from more readily available levels. In the situations, however, in which input is more complex, difficult or inconsistent, the information available at the syntactic level becomes necessary for comprehension, and the processor "switches" to this information and uses it more efficiently.

The effect of syntactic complexity in communication is discussed for example in Charrow and Charrow (1979), where it is reported that certain syntactic structures such as subordinate clause passives and nominalizations caused problems in instructions to juries.

According to experimental evidence presented in Weiss (1985), grammar is less closely related to reading skill than vocabulary and cohesion. The evidence for this statement was based on the performance of Israeli students with different levels of English-language proficiency on multiple-choice English reading tests. Vocabulary recognition seemed to be the factor which differentiated the most between the performance of the more and less proficient groups of subjects.

For the reading of English scientific texts, Strother and Ulijn (1987) have recently provided evidence for the often relatively minor role of syntactic analysis in reading. In this study passives, nominalizations and participial constructions occurring in a computer science text were rewritten as actives, verb phrases and subordinate finite constructions etc. (i.e. structures occurring more frequently in common-language texts). No significant differences in scores were obtained by university students who read a simplified text and those who read an authentic computer journal article. The conclusion was that syntactic simplification does not necessarily improve reading comprehension of a scientific text and that subjects employed a conceptual strategy which aimed at content words and therefore tended to overlook the syntactic variants. This conclusion is consistent with other findings (as reported in e.g. Clark and Clark 1977: 105-106) that difference in syntactic structures need not lead to difference in level of processing difficulty.

Similar evidence in the cross-linguistic dimension is provided in Ulijn (1981), where an experiment involving a reading task with Dutch and French university students resulted in no significant L1/L2 transfer of syntactic structures.

Note that this approach to syntactic analysis has the advantage that it accounts for certain difficulties that arise from syntactic sources such as self-embedding structures and discontinuous constituents as well as for the use of

surface clues such as function words. If necessary, the text and sentence parser can revert to thorough syntactic analysis. Also, this approach has the advantage that it advocates not more than superficial syntactic analysis at an early stage in the reading comprehension process (as in Fig. 3.7). In this approach conceptual processing begins at a later stage in the reading comprehension process, which is consistent with the available evidence (Clark and Clark 1977: 71ff.).

For writers of scientific-register texts the approach to syntactic analysis outlined here entails that, purely from the point of view of comprehension, it makes no difference whether in conveying a certain message syntactic structures are used which are typical of common-language texts, or syntactic structures which are more typical of scientific texts. There is, then, no need to avoid structures like the passive in texts of the latter type.

We conclude that there is evidence on which the view can be based that formal processing, in particular syntactic analysis, need not be thorough for reading comprehension. In the rest of this chapter, the role is discussed of the other processing level in the text and sentence parser, i.e. conceptual processing.

3.6 Conceptual Analysis

The goal of conceptual analysis is the construction of the meaning of a text. The conceptual analysis sub-mechanism in the text and sentence parser is thus involved in measuring the effect of medical terms on the comprehensibility of the text in which they occur.

The goal of conceptual analysis is achieved by relating the information contained in the text to the reader's prior knowledge. The knowledge stored in the reader's memory is organized in **schemata** (or related concepts such as scripts or frames, see for example Rumelhart et al. 1986 for more discussion). There is a two-way relation between these schemata and the text. On the one hand, there is a top-down movement which is knowledge-based and in which the schemata explain the text. On the other hand, there is a bottom-up movement which is text-based and through which the text modifies the schemata (Baten and Cornu 1984:190).

While syntactic analysis in the text and sentence parser is concerned with formal properties of textual items, conceptual analysis is more concerned with meaning. The role of conceptual analysis in the text and sentence parser is graphically illustrated in Figure 3.11.

The following characteristics of conceptual analysis can be summarized.

1. Together with lexical analysis, conceptual analysis makes up the conceptual processing component of the text and sentence parser. Note that lexical analysis also plays a role in formal processing (see Fig. 3.10; lexical analysis is

Fig. 3.11 Conceptual Processing

discussed in 3.7.; the interaction between conceptual analysis and lexical analysis in 3.9).

2. Like syntactic analysis, conceptual analysis is supported by knowledge stored in the conceptual system.

According to Ulijn et al. (1981:11), conceptual analysis operates in a linguistic as well as in a nonlinguistic dimension. In the linguistic dimension, conceptual analysis operates on the suprasentential, discourse level of analysis. In the nonlinguistic dimension, conceptual analysis applies to nonlinguistic context, in terms of what is known to the reader about these contexts.

Conceptual analysis is important for lexical analysis in that it allows the reader to infer the meaning of a given word from the context in which the word occurs. In so far as context relates to the inner knowledge of the human being, it is included in the the conceptual system.

3.7 Lexical Analysis

The other sub-mechanism in conceptual processing besides conceptual analysis is lexical analysis. The discussion below on lexical analysis forms the next step towards the formulation of our hypothesis on the effect of medical terms on comprehensibility. The goal of lexical analysis is relating words to concepts in the reading comprehension process. A relation between words and concepts is achieved by the construction or retrieval of entries in the mental lexicon, which match lexical items isolated in the text. The process of lexical analysis consists of the following three stages (cf. Nas 1983):

1. input from the script recognizer and syntactic analysis,
2. scanning of this input for information on which to base the decision to mentally represent one lexical item rather than another,
3. the mental representation of a lexical item in working memory.

Following Ulijn et al. (1981:10f.), it is held that four types of variables relating to the reading comprehension process affect the efficacy with which lexical analysis attains its goal of relating words to concepts:

1. variables relating to ease of retrieval from the mental lexicon, such as familiarity or recent usage of a lexical item,
2. variables relating to interaction with conceptual analysis, i.e. the role of context,
3. variables relating to the support of lexical analysis by conceptual information, i.e. semantic relations with other known concepts and conceptual lexical knowledge,
4. variables relating to form and senses of isolated lexical items, i.e. homonymy/homography and polysemy.

Apart from matters relating to L2 lexical analysis discussed in 5.1-5.3, the present research is most concerned with the third type of variable, specifically the effect of conceptual lexical knowledge in reading comprehension (see 3.9 for further discussion). Conceptual lexical knowledge covers knowledge of the concepts denoted by lexical terms.

One of the main points of the approach to reading comprehension adopted here is that conceptual analysis and lexical analysis are essential for full reading comprehension, in contrast to syntactic analysis which, as discussed above, need not be thorough. In this discussion the focus is on the effect of lexical analysis. The importance of lexical analysis in reading comprehension finds support in e.g. Williams and Dallas (1984), where it was found that vocabulary is of crucial importance in L2 reading. According to Cooper (1984), practised readers are distinguished from unpractised readers by their relatively superior lexical competence. Similarly, according to Farr (1971), vocabulary scores provide teachers with diagnostic insight into reading ability.

The effect of lexical analysis of the reading comprehension process is of particular importance to reading in a foreign language. If, in reading, syntactic analysis is not necessarily thorough, then obviously the basic difference between L1 and L2 reading at lexical and sentence level is the difference between L1 and L2 vocabulary, although syntax may present additional problems in some cases, such as in translation (see for example Ulijn and Kempen 1976).

3.8 The Mental Lexicon vs. the Conceptual System in Lexical Analysis

As illustrated in Fig. 3.12, it is held here that lexical analysis in reading is supported by two knowledge sources: the mental lexicon and the conceptual system.

Fig. 3.12 The Knowledge Support of Lexical Analysis

As will be shown below, the nature of the knowledge support of lexical analysis has major implications for our hypothesis on the effect of medical terms on reading comprehension. Support of lexical analysis by both the conceptual system and the mental lexicon means that, roughly, not just bare vocabulary knowledge is involved in lexical analysis, but that conceptual familiarity is involved as well. This is further discussed below.

The position taken here that lexical analysis is supported by two sources is fairly traditional. According to Clark and Clark (1977), for example, lexical

knowledge is divided into (in terms of Fig. 3.1) the mental lexicon and the conceptual system, by analogy with dictionaries (mental lexicon) versus encyclopedias (conceptual lexical knowledge). In this approach, little semantic weight is assigned to entries in the mental lexicon; such a minimal meaning component of a lexical item consists of just the category of things it denotes (cf. Clark and Clark 1977:412f.). The "knowledge of the world" component of lexical knowledge is stored separately in the conceptual system. This is the situation illustrated in Figure 3.12.

In another approach to the knowledge support of lexical analysis, the mental lexicon contains much if not all of the conceptual, i.e. knowledge of the world, aspect of lexical meaning. It would be fair to say that according to this approach physicians' lexical entries for a word like *analysis* would contain semantic information based on their usage of the denoted process which would be different from the semantic information coupled with *analysis* in the mental lexicons of, say, linguists, who perform different types of analysis. The difference is that physicians would be more involved with analysis of substances whereas linguists are concerned with the analysis of speech sounds and/or writing.

This approach is defended e.g. in De Beaugrande (1984:15). According to De Beaugrande, the segregation of conceptual and lexical knowledge would not be efficient for discourse processing, which depends on a (conceptually generated) context to guide ongoing lexical analysis. More likely, De Beaugrande says, a person's vocabulary is stored within a much more elaborate network of world knowledge, so that words and concepts immediately activate each other without the necessity of moving around or converting among distinct memory stores. For example, if a certain register is desired, unified lexical and conceptual knowledge prevents having to consider obviously inappropriate items.

Two of the arguments sometimes used to defend the mode illustrated in Fig. 3.12 (see for example Clark and Clark 1977) are easily rebutted. One negative argument for this approach would be that a more extended semantic component of lexical items would run counter to intuitions that word meanings are the same for most speakers even though they possess different knowledge about the things referred to by the lexical items in question (as the case would be with *analysis* for physicians vs. linguists). However, a counter-argument here is that different extended meanings (for different language users) for the same lexical

item usually have a semantic element in common, which would account for the sameness of meaning across contexts and language users.

A second weak argument in favor of the approach of Fig. 3.12 is that a more extended semantic component of lexical items would run counter to the observation that many language users are not able to go into detail about the meanings of lexical items they profess to know. A counter-argument here is not hard to find: such language users simply do not possess much semantic information coupled to the relevant lexical items. Familiarity with a lexical item does not necessarily entail much elaboration on its semantic (or syntactic or graphemic/phonological) features in the mental lexicon.

A stronger argument in favor of the division of lexical knowledge across two sources is that an extended semantic component of lexical items could put a great, and often unnecessary and time-consuming burden on lexical analysis, since the entire world knowledge that goes with a word need not be recovered every time that word is encountered. A second, and in this case crucial, argument in favor of the configuration of Fig. 3.12 is that through this configuration it is possible to make a clear division between the two types of lexical knowledge; as it is shown below such a division proves necessary in the discussion on the scope of lexical analysis.

Note that it is possible for a conflation of "bare" lexical knowledge and conceptual knowledge to take place in the process of lexical analysis rather than in a knowledge source (De Beaugrande (1984) appears to suggest the latter possibility).

For these reasons, the minimal semantics approach to the contents of the mental lexicon is adopted here. According to this approach, appropriacy of lexical items in certain linguistic contexts is a matter for the conceptual system rather than for the mental lexicon.

One implication of this approach to lexical analysis is that reading comprehension at the lexical level is affected by the vocabulary knowledge of the mental lexicon as well as by the conceptual familiarity, i.e. lexical conceptual knowledge, of the conceptual system. This point of view is corroborated in for example Adams (1982), where experimental evidence based on L2 reading tasks (French with English as L1) indicates that, along with vocabulary, a reader's conceptual familiarity has been shown to be an important component of reading comprehension. Many other investigations have had similar results. For example, based on data from an experiment involving students in Singapore

with varying English language proficiency whose reading comprehension of different English business, science and nonspecialist texts was tested, Koh Moy Yin (1985) concludes that knowledge of the language is a necessary but insufficient condition for reading comprehension, which needs to be supplemented by conceptual familiarity (examples of other research with such outcomes are Ulijn 1978 and Vendel 1982). This is of particular importance to the study of the effect of medical terms on reading comprehension.

Evidence for what has been held to be correct so far, for the support of lexical analysis by two sources, the mental lexicon and the conceptual system, would follow if it can be shown that neither of these two knowledge sources under consideration can affect the level of reading comprehension independently. That is to say, data would be required indicating similar effects on levels of reading comprehension coupled with variation of both the content of the "semantically bare" mental lexicon and lexical conceptual knowledge, and not just one of these. Specifically, such evidence would be given if

- a. for readers with a certain level of conceptual familiarity, the level of reading comprehension of a text relating to that field is not affected by lexical choice,
- b. for readers with a certain level of familiarity with certain lexical items, the level of their reading comprehension of a text in a certain field which employs those lexical items is not affected by their level of familiarity with that field.

It is at this point that we begin to arrive at the formulation of our hypothesis on the effect of medical terms on reading comprehension. The factors involved are given in Table 3.1.

Table 3.1 Medical lexical and conceptual familiarity

Lexical item type	Degree of expertise	
	medical experts	nonexperts
Specialist medical terms		
form	+	-
concept	+	-
Common Lang. items		
form	+	+
concept	+	-

The + and - symbols in Table 3.1 indicate familiarity or lack of it with certain items. For example, lay readers are not familiar with the concepts underlying specialist medical terms (see 2.3.2; they would probably be more familiar with common medical terms). The hypothesis on the effect of medical terms on reading comprehension comes in two parts. First, there is the notion that lexical analysis is essential in normal reading comprehension. Next, crucially, there is the notion that lexical analysis is supported by both the mental lexicon (in our case familiarity with medical terms and common-language items) and by the conceptual system (in our case specifically medical expertise, or the lack of it).

The importance of lexical analysis can only be demonstrated by lexical and conceptual familiarity versus lack of both lexical and conceptual familiarity. In terms of our topic here, then, the importance of lexical analysis can only be demonstrated by medical lexical and conceptual familiarity versus the lack of both. In other words, our hypothesis on the effect of medical terms on reading comprehension derives from a more general hypothesis on lexical analysis.

In terms of the four blocks represented in Table 3.1, our hypothesis would thus state that differences between blocks in reading comprehension are only attained in case of differences in both form and concept. No differences in reading comprehension are thus expected for experts/medical terms vs. experts/common-language items vs. lay/common-language items. Differences in reading comprehension are expected, however, for experts/medical terms and experts/common-language items vs. lay/medical terms. Note that common medical terms roughly fall into the same category as common-language lexical

items, which is why they are not discussed separately here (see Table 2.1). Experimental testing of this hypothesis is reported in chapter 4.

Contradiction or non-contradiction of this hypothesis has wider implications for the main psycholinguistic theme of this study, the question of the importance of lexical analysis in reading comprehension and the definition of the scope of such lexical analysis. Given lexical analysis supported by two sources of lexical knowledge, evidence for the importance of such lexical analysis in reading comprehension would follow from data indicating a significant effect on the level of reading comprehension of lexical knowledge combined with conceptual familiarity, versus the absence of lexical knowledge combined with conceptual familiarity. Such data are analyzed in 4.7.

3.9 Interaction of Lexical Analysis and Conceptual Analysis

At this point, some clarification seems in order of the interaction of lexical analysis and conceptual analysis in the text and sentence parser (Fig. 3.11), which is not to be confused with the interaction of the mental lexicon with the conceptual system in support of lexical analysis. In much of the literature on the interaction of lexical analysis/lexical knowledge with conceptual analysis/conceptual knowledge it is not clear which of the two processes is referred to. Possibly the lack of clarity on this point has given rise to seeming contradictions, such as

1. Baten and Cornu (1984), who found that readers can compensate poor vocabulary knowledge in reading by successful conceptual analysis, or Adams (1982), where conceptual familiarity was found to facilitate learning new words (background knowledge possibly being more beneficial to low L2 proficiency than high L2 proficiency), versus for example
2. Freebody and Anderson (1983), who found no support for a hypothesis that when vocabulary difficulty increased, conceptual familiarity compensated and provided alternate ways of determining meaning.

The source of this contradiction could turn out to be the difference between

- a. the interaction of lexical analysis with conceptual analysis in the text and sentence parser, where conceptual analysis creates a linguistic as well as a non-linguistic context (see 3.6) which could prompt the storage of new lexical

items in working memory - in other words, at this level compensation of poor lexical knowledge by conceptual knowledge should be possible,

- b. the support of lexical analysis by the conceptual system and the mental lexicon where, clearly, the lack of lexical knowledge cannot be compensated by conceptual knowledge which is coupled to it.

The first possibility most typically represents the intensively researched role of **context** in lexical analysis (see for example Bensoussan and Laufer 1984, Car-nine et al. 1984, Perkins and Brutton 1983, Schouten-van Parreren 1985). The second possibility is covered by this present research.

3.10 Summary and Conclusions

The discussion of this chapter was the second step towards gaining an understanding of the effect of medical terms on the reading comprehension of the texts in which they occur, specifically medical English texts involving Dutch readers. The first step was taken in chapter 2, where the lexical items types (common and specialist medical terms, common-language lexical items etc.) were defined that are involved in this study. The aim of the present chapter was the formulation of a psycholinguistic hypothesis on the effect of medical terms on the reading comprehension of the texts in which they occur. This hypothesis was formulated in terms of the reading comprehension model developed in Ulijn (1987).

One of the main features by which this model differs from other cognitive approaches to reading is the partially parallel operation of the text and sentence parser of syntactic, lexical and conceptual analyses of input from a written text. The division of labor within this partially parallel organization is superficial syntactic analysis followed by parallel conceptual and lexical analyses followed by (if necessary) thorough syntactic analysis.

The hypothesis on the effect of medical terms on reading comprehension was derived from a broader hypothesis on the effect of lexical analysis on reading comprehension and the knowledge support of lexical analysis. This hypothesis states that lexical analysis involving content lexical items (as opposed to function lexical items) is essential for comprehension, given that such lexical analysis is supported by both the mental lexicon (vocabulary knowledge) and the conceptual system (conceptual familiarity). This is demonstrable by differ-

ent levels of reading comprehension for readers with different levels of both vocabulary knowledge and conceptual familiarity. Differences between readers on just one of these levels do not result in differences in level of reading comprehension.

This hypothesis on lexical analysis is contrasted with work on the effect of syntactic analysis (e.g. Strother and Ulijn 1987), which appeared not to have any decisive effect on reading comprehension was found.

Translated into factors involving the effect of medical terms on reading comprehension, the hypothesis developed here states that specialist medical terms have a decisive effect on the level of reading comprehension of medical experts (familiar with both the terms and the concepts they convey) versus that of medical laity (unfamiliar with the terms and the concepts they convey). As to the question whether rewriting medical terms as common-language items aids reading comprehension, the hypothesis states that this is not the case, because rewriting would only cater to readers' lexical knowledge, while leaving the issue of conceptual familiarity unchanged.

The Effect on Comprehensibility of Medical Terms and their Common-Language Counterparts

4.0 Introduction

In chapter 3, the main hypothesis for the first part of this study was formulated. In the present chapter, this hypothesis is tested experimentally. What this hypothesis says is that the selection of specialist medical terms or their common-language equivalents in a text does not affect the reading comprehension of that text for any group of readers. Specialist medical terms and common-language lexical items were defined in chapter 2.

According to the hypothesis discussed in chapter 3, the factor affecting the level of reading comprehension is the type of reader rather than the type of lexical item deployed. That is to say, significant differences in level of reading comprehension between readers are only achieved when these readers differ in vocabulary knowledge as well as in background knowledge (in this case medical expertise). A difference between readers in just one of these areas will, according to our hypothesis, not lead to significant differences between them in reading comprehension.

The psycholinguistic implication of this hypothesis follows from its relation to the reading comprehension model introduced in 3.2. Our hypothesis is a statement about the effect of the conceptual component of lexical analysis (i.e. recognition of content lexical items and their meanings) on reading comprehension. This effect, as discussed in 3.6-3.9, follows from the support of lexical analysis by the mental lexicon (i.e. knowledge of mainly formal aspects of medical terms and other lexical items) as well as the conceptual system (including medical and other background knowledge). This relation of our hypothesis to the reading comprehension model used here entails that the testing of the hypothesis in this chapter has implications for the validity of the relevant part of the lexical analysis component of that reading comprehension model.

There are also practical implications, besides the psycholinguistic ones. Support for the hypothesis is an indication that a question whether or not to use specialist medical terms in a written text can be disregarded, since it makes no difference for its comprehension whether or not specialist medical terms are used. The reading comprehension of medical text, whatever lexical items are deployed in it, is mainly enhanced by medical expertise of the readers together with their knowledge of the lexical items involved.

In this study it is Dutch readers of English medical texts we are concerned with. The question is, then, what the effect is of English language knowledge on reading comprehension of L2 English medical/scientific texts. Interestingly enough, there are some research results which seem to indicate that the level of reading comprehension does not, in an absolute sense, derive from problems with English. Vendel (1982) reports an experiment with Dutch first-year psychology and physics students, where it turned out that these students were better at reading English texts in their own field than Dutch texts in the field of the other group. The conclusion was that subjects' English reading proficiency was linked to their knowledge of the subject matter dealt with in the texts.

This suggests that reading problems with foreign-language scientific/technical texts can (partly) be solved by familiarizing students beforehand with the relevant subject matter (and thus also with the relevant technical terms). Assuming that these research results are applicable to Dutch medical students' reading problems, this would mean that, at least at first sight, the solution should be sought in adapting medical teaching rather than teaching English, assuming that students have a sufficient basic knowledge of English.

This conclusion does not wholly tie in with a practical implication of the hypothesis this chapter is dealing with, namely that medical background knowledge plus knowledge of the lexical items involved is more important for understanding medical text than knowledge of lexical items alone, or medical background knowledge alone. For teaching, this would mean that teaching medical concepts is just as important as teaching the vocabulary that goes with these concepts.

It may be that the different (possible) implications of the present research and of Vendel (1982) are due to differences in focus: the present research is concerned with medical terms, while Vendel (1982) was concerned with language as a whole. Moreover, reading a technical or scientific text in a foreign

language seems to be a complex proficiency, so that it is improbable that solutions such as the one by Vendel (more emphasis on the teaching of concepts) would cover every difficulty. It is, for example, obvious that Dutch medical students are better at reading medical texts in Dutch than in English. Seen from that angle, the reading problems we are discussing are language-specific rather than conceptual, so that they come under the teaching of English rather than under medical teaching.

4.1 Hypotheses

In the reading comprehension model of chapter 3, lexical analysis is supported by both the conceptual system and the mental lexicon. Evidence for such lexical analysis in reading comprehension would follow from data indicating a significant effect on the level of reading comprehension of "bare" lexical knowledge (mental lexicon) combined with lexical conceptual knowledge (conceptual system), versus the absence of either type of knowledge. For the experiment presented below (from here on referred to as Experiment 1), this translates into Hypothesis A:

A. Medical students will achieve higher scores on a reading comprehension test involving either specialist medical terms or their common-language rewrites than other students with no medical expertise on the same reading comprehension test involving just specialist medical terms.

In Hypothesis A it is assumed that Dutch medical students know specialist medical terms occurring in a text and that they also know the common-language equivalents of such terms. Different scores are predicted only for differences of both lexical conceptual knowledge and bare vocabulary knowledge. The other students with no medical expertise differ from the medical students in lexical conceptual knowledge of specialist medical terms. To obtain lower scores on a reading comprehension test involving a medical text, these other students would also have to differ in bare vocabulary knowledge. With respect to such vocabulary knowledge, the other students are assumed to differ from medical students in their (lack of) knowledge of specialist medical terms, and not in their lack of knowledge of common-language items. Therefore, it is only on reading comprehension tests involving specialist medical terms that the non-medical group achieves lower scores.

Hypothesis A expressly does not have implications for the interaction of conceptual analysis and lexical analysis in the text and sentence parser, i.e. the effect of context on lexical analysis - see 3.9 for further discussion.

If it can be shown that Hypothesis A describes the sole condition for different levels of reading comprehension on the lexical level, then that can be construed as evidence for the support of lexical analysis by both the mental lexicon and the conceptual system. Such evidence would also follow from support for Hypotheses B and C.

B. Subjects with similar levels of medical knowledge will not achieve significantly different scores on a reading comprehension test involving specialist medical terms as compared to an identical reading comprehension test involving common-language equivalents of those terms;

C. Subjects with similar levels of lexical knowledge will not achieve significantly different scores on a reading comprehension test involving specialist medical terms as compared to an identical reading comprehension test involving common-language equivalents of those terms.

In Hypothesis C it is assumed that all subjects minimally possess a basic vocabulary (i.e. have a basic lexical knowledge) to which their medical conceptual knowledge at the lexical level is linked.

In the present study, hypotheses A, B and C are tested only in an L2 setting (English texts for Dutch readers). The reason for the L2 (rather than L1) point of departure is that it is L2 reading which seems to cause problems that need looking into; besides, for Dutch medical students understanding the English of their medical texts is important in view of the preponderance of English-language texts on their reading lists.

Clearly, however, the above hypotheses are also of importance for an understanding of the effect of specialist medical terms on reading comprehension in an L1 setting, and, more broadly speaking, the nature of lexical analysis in an L1 setting. Interesting results in future research could therefore be obtained by replicating this study in an L1 setting. Note that a comparison of the results of L1 and L2 research in this area entails the formulation of a theory (an extension of the text and sentence parser as described in 3.4-3.9) in terms of which the implications of such research can be stated.

4.2 Subjects and Material

Experiment 1 involved the four groups of subjects given in Table 4.1.

Table 4.1 Number and distribution of subjects over experimental conditions

N	Group	Medical Knowledge	English Language Knowledge
28	4th year Health Sciences and medical students	expert	nonexpert
28	2nd year Health Sciences students	beginner	nonexpert
26	3rd/4th year students of English	nonexpert	expert
24	other students (Dutch, French etc.)	nonexpert	nonexpert

The most medically expert group, that of 4th year Health Sciences and medical students, consisted of 23 4th year Health Sciences, 4 4th year medical and 5 4th year pharmacy students.

The material for the reading test was an editorial taken from *The Lancet* 1986, Vol.1, pp. 781-783, titled "Imaging the Transplanted Kidney" (see Appendix A). This text was chosen because

1. its length seemed appropriate for the duration of the experiment,
2. it lacked meaningful nonlinguistic material, such as illustrations,
3. it exhibited an appropriate density of specialist medical terms,
4. it was oriented towards a broad medical public - *The Lancet* is not a specialist journal.

4.3 Rewriting

A number of specialist medical terms in the text were rewritten as semantically equivalent common-language phrases. Such "simplification" of generally inaccessible medical terms and the research on its effects on comprehension can be contrasted as follows to other research dealing with language simplification.

4.3.1 "Simplification" Research

There are three main areas of research dealing with simplification:

1. the field of research which dealt with lexical simplification as a speaking or writing strategy in second-language acquisition, as for example in Levenston and Blum or Jarujumpol (1983);
2. the field of research, also geared to language production rather than to comprehension, dealing mainly with instructions for technical writers on how to achieve maximum comprehensibility for the widest range of readers (see for example Gingras 1987); in this area, it is generally assumed (correctly or incorrectly) that certain language items such as passive constructions and multi-syllable words offer more difficulty to the reader than, say, active constructions and shorter words;
3. the field of research in which the comprehension is compared at various linguistic levels of analysis of scientific/technical language items vs. semantically equivalent common-language ("simplified") items. This area includes research on the effect on reading comprehension of "simplified" syntactic structures vs. syntactic structures (such as passives, nominalizations) which are typical of scientific or technical texts (e.g. Strother and Ulijn 1987) as well as the present research on specialist medical terms. The results of this type of

research can be at odds with what is generally assumed in the second field of research mentioned as second point above. That is to say, according to Strother and Ulijn comprehensibility is not enhanced if "simplified" syntactic structures are employed, nor, according to the hypotheses of the present research, does simplified lexical usage replacing specialist terms aid reading comprehension.

4.3.2 The Replacement of Specialist Medical Terms

Let us return to the organization of Experiment 1. For this experiment, medical terms were replaced by common-language forms constituent for constituent. Otherwise the word-order in the rewritten parts of the text has been left unchanged.

The twelve specialist medical terms which met the criteria given below were selected for rewriting. The selection criteria were as follows.

1. Selected terms occurred once in the text - this avoided any "learning effect" distortion; once-only occurrence extended to single words within a term; if these occurred more than once the whole term was disqualified. For example, the word *renal* occurs in both *renal artery* and *renal pyramids*; the occurrence of *renal* in both phrases disqualified these phrases for the experiment (but not single words in those phrases, e.g. *pyramids* by itself was not disqualified).
2. Selected terms were all NPs (nominal phrases, roughly akin to the traditional category of nouns) - this avoided (possible) different effects of the various lexical categories; most eligible terms were NPs anyway. In other words, adjectives such as *ischaemic* or verbs such as *perfuse* were excluded, but not an NP such as *cyclosporin immunosuppression*.
3. Selected terms all had grammatical heads which were also specialist medical terms. The term **grammatical head** is defined as follows. If phrases consisting of more than one word are analyzed as consisting of two constituents, then, roughly, the constituent which is the grammatical head is the one which is of the same class as the whole phrase. For example, in the NP *green leaves* the NP *leaves* is the head. An example of a head of a specialist medical term which is not itself a specialist medical term is the head *damage* of *ischaemic damage*. This excluded the phrase from the experiment. On the other hand,

the head *angioplasty of percutaneous angioplasty* is a specialist medical term, which is why it qualified.

Each term had two rewrites: one in the text (see Table 4.2) and one in the test (see Table 4.3). The test rewrites in Table 4.3 are either true or false (see 4.4. for discussion of the test format). In view of the test procedure employed here, the rewrite in the text was the most accurate synonym of the two rewrites. The rewrite in the test was the least accurate. The two types of rewrites are compared in Table 4.4. The meaning of the authentic terms was changed as little as possible. To enhance the validity of the tests, the (degree of) semantic equivalence of both types of rewrites was checked by medical experts. Line references in the following tables refer to the text in Appendix A.

Table 4.2 Rewrites of terms in text

No.	Authentic term	Line ref.	Rewrite
1.	cyclosporin immunosuppression	6	treatment with cyclosporin to prevent or diminish rejection
2.	antegrade pyelogram	15	X-ray of contrast material excreted into urine passageways
3.	pyramids	24	conical masses
4.	haematomas	59	internal outpourings of blood
5.	urography	63	imaging of the urinary tract
6.	percutaneous angioplasty	78	blood-vessel repair by means of a balloon catheter
7.	vasculature	79	blood-vessel system
8.	inferior vena cava	81	lower venous trunk
9.	hypertension	84	continual elevated arterial blood-pressure
10.	parenchyma	85	functional tissue
11.	(needle) biopsy	91	removal (by needle) of a tissue sample
12.	fine-needle aspiration cytology	92	studies of cells obtained through a fine needle

Note that the rewrites tend to be longer than the authentic terms. This did not seem problematic inasmuch as the effect was evenly distributed.

Table 4.3 Test rewrites of authentic items (* = FALSE)

No.	Authentic term	Line ref.	Rewrite
1.	cyclosporin immunosuppression	6	suppression of rejection with cyclosporin
2.	antegrade pyelogram	15	kidney X-ray with contrast material
3.	pyramids	24	the tissue masses that make up the inner part of the kidney
4.	haematomas	59	*breaks in the walls of capillary arteries
5.	urography	63	X-raying the urinary tract
6.	percutaneous angioplasty	78	*injections of isotope
7.	vasculature	79	*shape
8.	inferior vena cava	81	*the venous trunk of the lower kidney
9.	hypertension	84	high blood-pressure in the arteries
10.	parenchyma	85	*the outer layer of the kidney
11.	(needle) biopsy	91	tissue sampling by needle
12.	fine-needle aspiration cytology	92	*examinations of the kidney pelvis with a fine needle

Table 4.4 Test rewrites of text rewrites (* = FALSE)

No.	Text rewrite	Line ref.	Test rewrite
1.	treatment with cyclosporin to prevent or diminish rejection	6	suppression of rejection with cyclosporin
2.	X-ray of contrast material excreted into urine passage-ways	15	kidney X-ray with contrast material
3.	conical masses	24	the tissue masses that make up the inner part of the kidney
4.	internal outpourings of blood	59	*breaks in the walls of capillary arteries
5.	imaging of the urinary tract	63	X-raying the urinary tract
6.	blood vessel repair by means of a balloon catheter	78	*injections of isotope
7.	blood-vessel system	79	*shape
8.	lower venous trunk	81	*the venous trunk of the lower kidney
9.	continual elevated arterial blood-pressure	84	high blood-pressure in the arteries
10.	functional tissue	85	*the outer layer of the kidney
11.	removal by needle of a tissue sample	91	tissue sampling by needle
12.	studies of cells obtained through a fine needle	92	*examinations of the kidney pelvis with a fine needle

4.4 Design and Procedure

Reading comprehension was operationally defined as comprehension which enables the reader to distinguish between correct and incorrect paraphrases and inferences of passages of the text. The simplest question format consistent with this definition is true/false statements.

There were 12 such true/false statements, i.e. one for each selected phrase. The wording of these one-sentence true-false statements differs from the test-text in two ways:

1. the target medical NPs have been "simplified" (Table 4.3),
2. the word-order has been changed.

In other respects (especially lexically) the true/false statements follow the test-text as closely as possible to avoid differences in level of comprehension difficulty between true/false statements and the text.

Two versions of this text were prepared. In Text A, every other test passage contains a rewritten term. Text B contains the other half of the rewritten terms. The distribution of authentic and rewritten items is given in Table 4.5.

Table 4.5 Distribution of Authentic and Rewritten Items over Texts A and B

Item no.	Text A	Text B
1.	rewritten	authentic
2.	authentic	rewritten
3.	rewritten	authentic
4.	authentic	rewritten
5.	rewritten	authentic
6.	authentic	rewritten
7.	rewritten	authentic
8.	authentic	rewritten
9.	rewritten	authentic
10.	authentic	rewritten
11.	rewritten	authentic
12.	authentic	rewritten

Distribution of rewritten terms over two texts limited the odd impression these rewritten terms might have made on medically knowledgeable subjects. Half of each group of subjects was randomly assigned a reading comprehension test on Text A, while the other half was assigned a test on Text B. The procedure was that, in chronological order, every other student who came in to do a test was given Text A, while the others were given Text B. Both tests use the same 12 true-false statements about the sentences containing the terms earmarked for rewriting. Copies of Texts A and B and the twelve true-false statements are provided in Appendix B.

In addition, subjects were asked to fill in reading times three times: before beginning the test, at their completion of reading the text and finally at completion of the twelve true/false statements. It was thought that any significant correlation between test scores and reading times might give an indication of the difficulty of the task; the more difficult the task, it was assumed, the longer it would take.

A oneway analysis of variance was used with the independent variables and conditions given in Table 4.6.

Table 4.6 Independent variables and conditions of Experiment 1

	English Language Knowledge	Medical Knowledge
experts	3rd/4th year English students	4th year Health Sciences students
beginners		2nd year Health Sciences students
nonexpert	other 3rd/4th year students	other 3rd/4th year students

The dependent variables were:

1. scores on true/false statements pertaining to authentic items and
2. scores on true/false statements pertaining to equivalent common-language items as well as
3. reading times for the text and
4. reading times for completion of the test (exclusive of reading time of the text).

The significance of score differences for various conditions of independent variables was computed with a Student-Newman-Keuls multiple-range test.

4.5 Results

For each subject in the four groups, the total test score was split in two, resulting in one score for authentic items and another score for rewritten items. This resulted in eight groups of scores. The significance of the differences between the mean scores of these groups was computed by way of a multiple-range test

(Student-Keuls-Newman procedure). Below the results of this test are presented in terms of the two independent variables of table 4.6: the effect of medical knowledge on the scores and, secondly, the effect of knowledge of general English.

4.5.1 The Effect of Medical Knowledge

Below, the mean scores are given first (Tables 4.7 and 4.8; Figure 4.1)), followed by a calculation of any significant differences between these mean scores (Table 4.9). These results are then interpreted with respect to hypotheses A, B and C.

A. Mean Scores

The effect of medical knowledge on the comprehension, by Dutch readers, of English medical terms vs. the English common-language equivalents of these terms is measured by comparing the mean scores for such medical terms and their common-language equivalents of the two groups of medical students and the group not studying a medicine-related field nor English. These six mean scores are given in Table 4.7 and graphically represented in Fig. 4.1. Table 4.8 gives the mean scores on individual terms and rewrites.

The following abbreviations are used:

MT = mean scores on medical terms

CLE = mean scores on common-language English rewrites

Du4 = 3rd/4th year students of neither the medical faculty nor of English (mainly students of Dutch)

HS2 = 2nd year Health Sciences students

HS4 = 4th year Health Sciences and medicine students

En4 = 3rd/4th year students of English

Table 4.7 Mean Scores on Authentic and Rewritten Terms (0-100)

Group	MT		CLE		
	Mean score	Standard deviation	Mean score	Standard deviation	N
Du4	50.0	25.5	59.7	20.8	24
HS2	60.1	17.8	73.8	19.4	28
HS4	68.4	17.8	67.3	21.5	28

For the sake of completeness, percentages of correct responses on individual items are given in Table 4.8.

Figure 4.1 gives mean scores on terms and rewrite per group, illustrating the relatively divergent performance of the different groups.

Fig. 4.1 The effect of medical knowledge

Table 4.8 Percentages of Correct Responses on Individual Items

Group		HS2	HS4	En4	Du4
Task No.1					
Term	cyclosporin immunosuppression	100	93	85	92
Rewrite	treatment with cyclosporin to prevent or diminish rejection	100	93	92	83
Task No.2					
Term	antegrade pyelogram	0	57	31	8
Rewrite	X-ray of contrast material excreted into urine passageways	43	43	54	25
Task No.3					
Term	pyramids	43	79	69	42
Rewrite	conical masses	86	93	69	75
Task No.4					
Term	haematomas	7	29	62	33
Rewrite	internal outpourings of blood	14	43	54	33
Task No.5					
Term	urography	71	50	92	58
Rewrite	imaging of the urinary tract	71	57	69	75
Task No.6					
Term	percutaneous angioplasty	100	93	77	58
Rewrite	blood-vessel repair by means of a balloon catheter	100	100	85	100
Task No.7					
Term	vasculature	79	100	15	33
Rewrite	blood-vessel system	79	86	46	17
Task No.8					
Term	inferior vena cava	79	64	23	33
Rewrite	lower venous trunk	43	57	62	75

(continued)

Table 4.8 (cont.)

Group		HS2	HS4	En4	Du4
Task No.9					
Term	hypertension	36	43	38	58
Rewrite	continual elevated arterial blood-pressure	79	64	54	58
Task No.10					
Term	parenchyma	14	36	15	42
Rewrite	functional tissue	57	29	46	25
Task No.11					
Term	(needle) biopsy	100	93	92	92
Rewrite	removal (by needle) of a tissue sample	100	100	100	92
Task No.12					
Term	fine-needle aspiration cytology	93	86	62	58
Rewrite	studies of cells obtained through a fine needle	86	71	54	58

The *En4* scores referred to in Table 4.8 are further discussed in 4.5.2.

B. Significance of differences between mean scores

Table 4.9 gives subsets of mean scores (calculated for $p < .05$ with the Student-Newman-Keuls procedure) where within each subset the highest and the lowest means do not differ by more than the shortest significant range for a subset of that size. In other words, mean scores that occur in the same subset do not differ significantly for $p < .05$. In Table 4.9 there are two such subsets.

Table 4.9 Homogeneous subsets, medical knowledge

Group/MT or CLE = mean score	Occurs in Subset 1	Occurs in Subset 2
Du4/MT = 50.0	yes	no
Du4/CLE = 59.7	yes	yes
HS2/MT = 60.1	yes	yes
HS2/CLE = 73.8	no	yes
HS4/MT = 68.4	no	yes
HS4/CLE = 67.3	no	yes

The scores in Table 4.9 which are unique to a subset are the first (in Subset 1) and the three last ones (in Subset 2). According to the procedure followed here, there is a significant difference between the mean scores occurring only in Subset 1 on the one hand and the mean scores unique to Subset 2 on the other.

Table 4.9 accordingly shows that there are significant differences between on the one hand the mean score of non-medical students on medical terms (subset 1) and on the other hand mean scores for rewritten items by both groups of Health Sciences students as well as mean scores for rewritten items for second-year Health Sciences students (subset 2).

C. Hypothesis A

The results of Table 4.9 are evidence for Hypothesis A, which stated that medical students will achieve higher scores on a reading comprehension tests involving either medical terms or their common-language rewrites than other students with no medical expertise on the same reading comprehension test involving just medical terms.

Hypothesis A is supported in Table 4.9, in that mean scores for both authentic and rewritten items for the group of fourth-year Health Sciences and other medical students are significantly higher than the mean score on authentic items for the nonmedical group.

It is also evident from Table 4.9 that Hypothesis A does not work for mean scores for second-year Health Sciences students on authentic terms versus the mean score of the nonmedical group on authentic medical terms. There is only a significant difference for the scores on rewritten items by second-year Health Sciences students.

D. Hypothesis B

According to Hypothesis B, subjects with roughly the same level of medical knowledge will not achieve significantly different scores on a reading comprehension test involving medical terms as compared to an identical reading comprehension test involving common-language equivalents of those terms. Assuming that for any group of subjects the level of medical conceptual knowledge is the same, Hypothesis B in fact says that for any group of subjects there is no significant difference between mean scores for authentic medical terms and mean scores for the common-language counterparts of those terms.

Hypothesis B is supported by what is shown in Table 4.9; authentic and rewritten scores for the nonmedical group both occur in the leftmost subset, while the other mean scores, for the medically knowledgeable groups, occur in the rightmost subset.

Although the difference between mean scores on authentic versus rewritten items of second-year Health Sciences students does not show up as significant in terms of the multiple range test subsets of Table 4.9, a t-test for this group does show a significant effect of rewriting at $p < 0.05$ ($t = 2.75$). In this respect then, Hypothesis B is contradicted, but only for the second-year Health Sciences students; t-tests for the other groups show no significant differences between scores on authentic and rewritten items. At this point it is not clear whether the results for second-year Health Sciences students should be attributed to chance or not, as the analysis of variance discussed above did not come up with any significant differences for that group.

E. Hypothesis C

According to Hypothesis C, subjects with similar levels of lexical knowledge (assuming educational backgrounds with similar levels of English in this respect) will not achieve significantly different scores on a reading comprehension test involving medical terms as compared to an identical reading comprehension test involving common-language equivalents of those terms.

In other words, all mean scores on rewritten items should not differ significantly, assuming that all groups involved here have no greatly different knowledge on that score. This is borne out in Table 4.9, where all mean scores on rewritten items form part of subset 2 and hence do not differ significantly. For medically knowledgeable groups, whose lexical knowledge of terms should

equal their knowledge of common-language counterparts of these terms (and, by extension, the knowledge of rewritten terms by nonmedical students), there should be no significant differences between scores on medical terms and on rewritten items. Table 4.9 shows that all scores for both second- and fourth-year Health Sciences/medical students form part of subset 2.

4.5.2 The Effect of General English Knowledge

The effect of general English knowledge on the comprehension, by Dutch readers, of English medical terms vs. the English common-language equivalents of these terms is measured as follows. A comparison is made of the mean scores for medical terms and their common-language equivalents of the group of students of English and the group not studying a medicine-related field nor English. These four mean scores are given in Table 4.10 and in Figure 4.2.

Table 4.10 Effect of English language knowledge, mean scores

Group	MT		CLE		N
	Mean score	Standard deviation	Mean score	Standard Deviation	
Du4	50.0	25.5	59.7	20.8	24
En4	55.1	21.5	65.4	21.6	26

Figure 4.2 further illustrates the relatively divergent performance within groups and the overlap of performance between groups.

Fig. 4.2 The effect of English-language knowledge

According to the same multiple-range test conducted for the data shown in Figure 4.1, there is no significant difference between the mean scores in Figure 4.2. This again supports Hypothesis B, according to which subjects with the same level of medical knowledge (or in this case the lack of it) will not achieve significantly different scores on a reading comprehension test involving medical terms as compared to an identical reading comprehension test involving common-language equivalents of those terms.

4.5.3 Reading Times

Two task completion times were recorded: one for reading the text and the other for completing the true/false statements (exclusive of text reading time).

A. Reading time of text

The mean text reading times for the four groups of subjects are given in Table 4.11.

Table 4.11 also gives subsets of mean text reading times (calculated for $p < .05$ with the Student-Newman-Keuls procedure) where mean scores that occur in the same subset do not differ significantly for $p < .05$. In Table 4.11 there are three such subsets.

Table 4.11 Homogeneous subsets, reading times of text

Group = mean score	Occurs in Subset 1	Occurs in Subset 2	Occurs in Subset 3
Du4 = 13.75	no	no	yes
En4 = 9.92	yes	no	no
HS2 = 11.75	no	yes	no
HS4 = 9.46	yes	no	no

For all groups, there was in addition a significant negative correlation of individual scores and text reading times; the correlation coefficient (r) of $-.14$, significant at $p < .05$, was calculated by means of an analysis of variance with covariates. By means of the same analysis a regression coefficient of $-.642$ was calculated, meaning that every minute of text reading time cost an average $.642\%$ of the score. Roughly, then, the longer it took to read the text, the lower the score.

B. Completion time of the true/false statements

The second task completion time was for completing the true/false statements (exclusive of text reading time). The mean reading times for completing the true/false statements for the four groups of subjects are given in Table 4.12.

In addition, Table 4.12 shows subsets of mean test completion times (calculated for $p < .05$ with the Student-Newman-Keuls procedure) where mean scores that occur in the same subset do not differ significantly for $p < .05$. In Table 4.12 there are two such subsets.

Table 4.12 Homogeneous subsets, completion times of true/false statements (exclusive of text reading times)

Grop = mean score	Occurs in Subset 1	Occurs in Subset 2
Du4 = 20.83	no	yes
En4 = 20.35	no	yes
HS2 = 16.39	yes	no
HS4 = 16.29	yes	no

However, no significant correlation was found between scores and test completion times.

4.6 Discussion

The results of Experiment 1 are discussed below in terms of psycholinguistic as well as practical, applicational aspects.

4.6.1 Psycholinguistic Aspects

1. Hypothesis A

The support for Hypothesis A provides evidence for lexical analysis supported by the mental lexicon as well as by the conceptual system. This result is not to be construed as effect of conceptual analysis (context) along with lexical analysis, since the true/false task of subjects involved only lexical meaning and previous knowledge of such lexical meaning. In any case, if conceptual analysis were involved to any extent, knowledge of the English language could have helped boost the scores of students of English on rewritten items, which it clearly did not.

A possible weak point in the design could be the non-lexical character of many common-language constituents which were used to replace medical terms. However, if this is a weak point it does not apply throughout all the results. Specifically, evidence for Hypothesis A only concerns medical terms, and not their rewrites.

2. *Hypotheses B and C*

The data of Experiment 1 generally supported Hypotheses B and C, which state that for subjects with no difference in medical conceptual knowledge and/or lexical knowledge about medical terms or their common-language counterparts, the level of reading comprehension involving either medical or their common-language counterparts will not differ significantly.

The apparent exception (albeit according to a less stringent test of significance) to Hypotheses B and C lies in the difference, for second-year Health Sciences students, between their scores on medical terms versus common-language equivalents of those terms. This result seems to contradict Hypotheses B and C. Still assuming that the level of medical knowledge within the group of second-year Health Sciences students is more or less the same for all students, it might prove possible to interpret the results of this group in terms of Hypothesis A. Hypothesis A maintains that subjects with different levels of lexical and other linguistic knowledge as well as different levels of medical knowledge will achieve significantly different scores on a reading comprehension test involving medical terms as compared to an identical reading comprehension test involving common-language equivalents of those terms.

In the case of the second-year Health Sciences students, the difference observed between scores on medical terms and scores on semantically equivalent common-language items may be interpreted as the same kind of difference as the one observed between the scores of lay subjects on medical terms versus the scores of fourth-year medical students on equivalent common-language items.

That is to say, speculatively, second-year Health Sciences students behave as nonexperts when it comes to medical terms, but as medical experts in the case of common-language term equivalents. One possible explanation for this phenomenon is that the relatively low scores on medical terms by this group are due to relative ignorance of medical terms, while the higher scores on rewritten items may reflect knowledge of the concepts underlying medical terms, or at least familiarity with related concepts. Clearly more research in this area is necessary.

3. Reading Times

While for Hypotheses B and C the level of comprehension generally did not differ significantly, it became apparent during Experiment 1 that reading times of the text to be tested did differ significantly, in the sense that the group of subjects with the least medical (and general English) knowledge took the longest to read the text. As discussed in 4.5.3, longer reading times correlated with lower scores. In view of the negative correlation between reading times and scores, these reading times may be interpreted as a rough measure of difficulty. In that light, then, lay subjects, although scoring on the same level as medically knowledgeable subjects, found the task significantly more difficult.

The nature of this difficulty in terms of reading times and its implications for the theory of reading L2 scientific texts are as yet unclear. In Experiment 1 it was not possible to distinguish times relating to specialist medical terms vs. times relating to their rewrites. It is thus, for example, not clear whether or not this measure of difficulty found in reading times applies equally to medical terms and their semantically equivalent common-language equivalents. It is also not clear whether or not the observed differences in reading times would apply to other types of lexical items occurring in medical texts.

4.6.2 Application

In the area of application, the question is for what group of readers medical terms, or else common-language equivalents should be used in written texts. The data of Experiment 1 indicate that, per group, it does not matter whether medical terms are used or common-language equivalents (except perhaps beginning learners such as the second-year Health Sciences students); for each group the (higher or lower) level of reading comprehension will not differ significantly.

The data of Experiment 1 also indicate that common language equivalents can be used for all group with results that do not differ significantly.

As for medical education, the data of Experiment 1 show no dramatic (albeit statistically significant) difference in the comprehensibility of English specialist medical terms for 4th year Dutch medical/Health Sciences students (mean score 68.4%) vs. both groups of lay subjects (mean scores 50% and 55.1%). The score for 4th year Health Sciences/medical students is lower than

expected (although students were in the beginning of their 4th year at the time of the experiment; all subjects were interviewed in September-November 1987).

A medical English course on English medical terms may improve the performance of the medical/Health Sciences students involved. As concluded in 4.6.1, however, the comprehensibility of specialist medical terms is linked to medical background knowledge. Therefore, any effort of a medical English course in this direction should be closely integrated into medical education as a whole.

4.7 Specialist Medical Terms vs. Other Lexical Items

In 4.5.1 and 4.5.2 we have seen data indicating that for any of the groups of subjects involved it does not matter whether specialist medical terms in an English medical text are rewritten as common-language items - the effect on comprehension is the same (see 2.3.2 for definitions of the types of lexical items mentioned here).

The question arising here relates to the scope of this result. Does it just include specialist medical terms and their common-language equivalents, i.e. lexical items denoting a specialized medical concept, or does it also include specialist medical terms and submedical items which are not semantic equivalents of these terms and which hence do not denote specialized medical concepts? In other words, are the specialist medical terms of an English medical text just as easy (or as difficult) to comprehend as its submedical items and other not specifically medical lexical items? Below, an answer to this question is sought in a discussion on the effect of the two independent variables of Experiment 1, namely medical knowledge and knowledge of common-language English. Subsequently, the predictions arising from this discussion are tested experimentally.

4.7.1 The Effect of Medical Knowledge and Knowledge of Common-Language English

A. The Effect of Medical Knowledge

In general, according to the model of lexical analysis developed in 3.7-3.9, submedical items, common medical terms and the like should be easier to comprehend for medical nonexperts than specialist medical terms. In our model, lexical

analysis is supported by the mental lexicon (mainly knowledge of lexical forms) and the conceptual system (meanings of lexical items, background information). Full comprehension of a lexical item implies the accessibility of information about that lexical item in the mental lexicon as well as the conceptual system. For example, specialist medical terms are best comprehended by medical experts who are familiar with their form as well as their meanings. Table 4.13 summarizes this information with respect to the various types of content lexical items appearing in medical texts.

Table 4.13 Comprehensibility of Content Lexical Items in Medical Texts

	Common medical terms	Specialist medical terms	Submedical items	Other terms
Medical experts	+	+	+	+
Nonexperts	+	-	+	?

The + symbol in Table 4.13 means that the lexical items in question are generally comprehended by the expert or nonexpert group in question; the - symbol means that this is not the case. The ? symbol simply means that it is not certain whether + or - is the case.

B. The Effect of Knowledge of Common-Language English

It should be borne in mind that what we are dealing with here are L2 English items for L1 Dutch readers. What is the effect of common-language English knowledge on the types of lexical items in Table 4.13? In 4.5.2 we have seen that knowledge of common-language English (from Dutch secondary school level onwards) has no effect on the comprehension of medical terms or their common-language rewrites. The reason for this is that knowledge of common-language English does not imply knowledge of the medical concepts which both the specialist medical terms and their rewrites convey (also see the discussion in 4.6).

What about the effect of knowledge of common-language English on submedical items, common medical terms and other terms? Since no uniquely specifically medical concepts are involved here, one would expect that the higher the knowledge of English, the better the submedical items, the common medical terms and perhaps also the other terms are comprehended.

4.7.2 Predictions, Experimental Method and Results

A. Hypotheses

From the above discussion, we derive two hypotheses.

Hypothesis 1 is about the effect of medical knowledge. It states that specialist medical terms are best comprehended by medical experts, and that medical nonexperts comprehend specialist medical terms less well than other content lexical items in medical texts.

Hypothesis 2 refers to the effect of knowledge of common-language English. It states that knowledge of common-language English enhances comprehension of content lexical items in medical texts other than specialist medical terms.

B. Subjects, Material and Method

The experiment reported below (henceforth referred to as Experiment 2) involved the four groups of subjects given in Table 4.14.

Table 4.14 Number and distribution of subjects over experimental conditions

N	Group	Medical Knowledge	English Language Knowledge
9	2nd year medical students	beginner	nonexpert
9	4th year medical students	expert	nonexpert
11	2nd year students of English	nonexpert	beginner
10	4th year students of English	nonexpert	expert

The experts of Table 4.14 are of course only experts in relation to other less knowledgeable subjects.

The text involved was the same as that used in Experiment 1, i.e. "Imaging the Transplanted Kidney", in *The Lancet* 1986 Vol.1 pp. 781-783 (see Appendix A). The task orally assigned to all subjects was to underline in the text the lexical items which were semantically unfamiliar.

C. Results

The results are given per group of subjects in Table 4.15 and in Fig. 4.3.

Comprehensibility of Medical Terms

The abbreviations used are:

- En2* = 2nd year students of English
- En4* = 4th year students of English
- Me2* = 2nd year medical students
- Me4* = 4th year medical students
- SMT* = specialist medical terms
- OT* = other specialist and common terms
- CMT* = common medical terms
- SMI* = submedical items

Table 4.15 Mean Scores on Lexical Difficulty

Groups	SMT	OT	CMT	SMI
En2	30.36	5.82	6.73	1.09
En4	23.60	5.70	4.30	.4
Me2	4.00	2.00	1.33	4.67
Me4	1.00	.11	0.00	1.67

Fig. 4.3 Underlined lexical item types per group

Let us consider the various types of lexical items that were underlined (these types of lexical items were defined according to the criteria of 2.3).

1. Underlined *specialist medical terms*. These were identified according to the operational definition of 2.4. Specialist medical terms were identified as lexical items occurring as entries in medical dictionaries which do not also appear as common-language items in purely common-language dictionaries (such as Longman's Dictionary of Contemporary English or another "core vocabulary" dictionary).

Underlined specialist medical terms included compound Latinate items such as *acute tubular necrosis*, *in-oxine autologous platelets* or *renal artery stenosis* as well as single words such as *arteriography*, *bolus*, *corticomedullary* and *echogenicity*. This category also included items which are reminiscent of formally similar common-language items, such as *dilatation*, *imaging*, *invasive*, *perfused* and *uptake*.

2. Underlined *common medical terms*. These were lexical items identified as occurring both in medical dictionaries as well as in purely common-language dictionaries. Mostly these had some kind of medical denotation, such as *bladder*, *clot*, *cortical*, *excretion*, *tenderness*. Note that all of the lexical forms involved also include purely common-language senses. Common medical terms also included less specifically medical lexical items such as *focal*, *formula* and *image*.

3. *Other terms* were identified as items not occurring in either medical or purely common-language dictionaries. Mostly these were radiological technical terms such as *dynamic isotope scanning*, *gamma camera* and *pulsed doppler techniques*. They also included names of substances, such as *tc diethylenetriaminopenta-acetic acid*.

4. *Submedical items* were identified as content words in medical texts which do not appear in medical dictionaries but which can be found in a purely common-language dictionary. These included words such as *accumulate*, *convenient*, *delineated*, *features*, *impaired*, *opt for*, *seeking*, *troublesome*, *unrewarding*.

D. Significance of Differences Between Mean Scores

1. Hypothesis 1 states that specialist medical terms are best comprehended by medical experts, and that medical nonexperts comprehend specialist medical

terms less well than other content lexical items in medical texts. Accordingly, hypothesis 1 refers to the difference between mean scores on specialist medical terms per group.

As represented in Fig. 4.3, it is clear that medical knowledge is the relevant factor here. The significance of the differences between these figures is confirmed by an analysis of variance and subsequent t-tests (at $p < .05$). These data are consequently evidence for the correctness of Hypothesis 1.

2. Hypothesis 2 states that knowledge of common-language English enhances comprehension of content lexical items in medical texts other than specialist medical terms. This refers to the difference between the results per group on the non uniquely medical lexical items.

Common medical terms. According to the data of Figure 4.3, there is no clear decrease in difficulty with common medical terms as the knowledge of English increases. In fact, difficulty with these lexical items decreases more dramatically with the increase of medical knowledge. The significance of the differences between scores is confirmed by an analysis of variance and t-tests ($p < .05$). For common medical terms, then, Hypothesis 2 is contradicted.

Other terms. According to the data of Table 4.15, Hypothesis 2 is also contradicted for the category "other terms". There is again no decrease in difficulty with the increase of English-language knowledge. Again, such decrease in difficulty is observable with the increase of medical knowledge (Fig. 4.3). The significance of the difference between the figures involved in Fig. 4.3 is confirmed by an analysis of variance and t-tests ($p < .05$).

Submedical items. The only lexical item type for which Hypothesis 2 seems confirmed is submedical items. Students of English have less difficulty with these items than medical students. This is clear from the figures in Fig. 4.3 The significance of the differences between mean results is confirmed by an analysis of variance ($p < .05$); t-tests give a significant difference for the mean underlinings between 2nd year medical and 2nd year English students, but not between 2nd and 4th year students of English (again at $p < .05$).

Such a significant difference according to a t-test is also observable on the mean underlinings of 2nd and 4th year medical students.

4.7.3 Discussion

In Experiment 1 (4.5-4.6) it was concluded that knowledge of common-language English (from Dutch secondary-school level onwards) has no effect on the comprehensibility, for Dutch readers with varying medical expertise, of specialist medical terms or their common-language rewrites. This is in agreement with the result of Experiment 3 (see Fig. 4.3) where it appears that difficulties with specialist medical terms lessen with increasing medical knowledge (which in itself is hardly surprising). The differences in the results of the groups involved are much more dramatic here than they were in Experiment 1. This is probably due to the differences in the number of linguistic items involved: twelve in Experiment 1 vs. no limit within the text in Experiment 2.

The data of Experiment 2 also indicate that the comprehensibility (or more strictly speaking the familiarity) of common medical terms and other medical terms increase with medical knowledge rather than with knowledge of common-language English. The only category of lexical items where knowledge of common-language English has any effect is submedical items. But even there, the increase in medical knowledge from the 2nd year of medical study to the 4th year also results in a significant decrease of difficulties with these submedical items.

What are the implications of these results? First, they confirm that lexical knowledge is not only a matter of "bare" vocabulary knowledge, but essentially also a matter of conceptual background knowledge. According to the results of Experiment 2, this is not only the case for specialist medical terms or their rewrites, but also for the other types of content lexical items occurring in medical texts. The notable exception is submedical items. Medical knowledge has proved to be the most effective factor as it produced significant results for all the lexical item types involved. English language knowledge limits itself as an effective factor to the submedical items.

The more practical implications of these results seem to extend most to the role of L2 medical English in medical education. As medical knowledge seems to be a significant factor for comprehending even non uniquely medical English lexical items, it seems inadvisable to teach medical students the L2 common-language English they need for reading (submedical items) in a way which is wholly divorced from the rest of the medical curriculum. Integration with the

other subjects in medical education seems essential. Regrettably, this study cannot provide any workable way of achieving this.

4.8 Summary and Conclusions

In this chapter, the hypothesis developed in chapter 3 was tested experimentally. This hypothesis states that the selection of specialist medical terms or their common-language equivalents in a text does not affect the reading comprehension of that text for any group of readers. The types of lexical items involved were defined in chapter 2.

The experimental hypotheses (based on the hypothesis of chapter 3) to be tested in Experiment 1 were:

Hypothesis A: Medical students will achieve higher scores on a reading comprehension test involving either specialist medical terms or their common-language rewrites than other students with no medical expertise on the same reading comprehension test involving just specialist medical terms.

Hypothesis B: Subjects with similar levels of medical knowledge will not achieve significantly different scores on a reading comprehension test involving specialist medical terms as compared to an identical reading comprehension test involving common-language equivalents of those terms.

Hypothesis C: Subjects with similar levels of lexical knowledge will not achieve significantly different scores on a reading comprehension test involving specialist medical terms as compared to an identical reading comprehension test involving common-language equivalents of those terms.

Generally speaking, evidence was found in the data of Experiment 1 which supported all three hypotheses, and by extension the hypothesis of chapter 3. We thus have evidence that the selection of specialist medical terms or their common-language equivalents in a text does not affect the reading comprehension of that text for any group of readers.

An apparent exception, albeit according to a less stringent test of significance, to Hypotheses B and C lay in the difference, for second-year Health Sciences students, between their scores on medical terms versus common-language equivalents of those terms. A possible explanation (if this exception is judged significant) is that the relatively low scores on medical terms by this group are

due to relative ignorance of medical terms, while the higher scores on rewritten items may reflect knowledge of the concepts underlying medical terms, or at least familiarity with related concepts. Whether this is the case may be indicated by further research.

Reading times of the text to be tested did differ significantly, in the sense that the group of subjects with the least medical (and general English) knowledge took the longest to read the text, i.e. longer reading times correlated with lower scores. In view of this, it was supposed that these reading times could be interpreted as a rough measure of difficulty. In that light, then, lay subjects, although scoring on the same level as medically knowledgeable subjects, found the task significantly more difficult, as their reading times were longer. As the nature of such difficulty is not clear, more research in this area is required as well.

In the area of application, the data of Experiment 1 indicated that, generally, it does not make a difference for reading comprehension whether medical terms are used or common-language equivalents (except perhaps for beginning learners such as the second-year Health Sciences students); for each group the (higher or lower) level of reading comprehension will not differ significantly.

As for medical education, the data of Experiment 1 showed relatively low scores on comprehension involving comprehensibility of English specialist medical terms for 4th year Dutch medical/Health Sciences students. This may be remedied by a medical English course, but as the comprehensibility of specialist medical terms is linked to medical background knowledge, such a course should be closely integrated into medical education as a whole.

Experiment 2 dealt with the question whether the results of Experiment 1 are limited to specialist medical terms and their common-language equivalents, or whether these results extend to specialist medical terms and submedical items which are not semantic equivalents of these terms and which hence do not denote specialized medical concepts.

Two experimental hypotheses were formulated in the light of the theory in chapter 3.

Hypothesis 1 stated that specialist medical terms are best comprehended by medical experts, and that medical nonexperts comprehend specialist medical terms less well than other content lexical items in medical texts.

Hypothesis 2 stated that knowledge of common-language English enhances comprehension of content lexical items in medical texts other than specialist medical terms.

The data of experiment 2 provided evidence for Hypothesis 1. Evidence for Hypothesis 2 was only found in the area of submedical items; comprehensibility of common medical terms and other terms was linked to medical knowledge rather than to knowledge of English. These results can be interpreted as pointing out that lexical knowledge is not only a matter of "bare" vocabulary knowledge, but essentially also a matter of conceptual background knowledge, even when the lexical items in question are not specialist terms.

The more practical implications of these results extend mostly to the role of L2 medical English in medical education. As medical knowledge seems to be a significant factor in comprehending even non uniquely medical English lexical items, it seems advisable to integrate as much as possible the teaching of L2 common-language English (submedical items) to medical students in the rest of the medical curriculum. This dovetails with the conclusion of Experiment 1 with regard to medical English; it was concluded that any teaching of medical terms in a medical English course should be closely integrated with what is being taught in the more properly medical sphere.

The Comprehension of Cognate Medical Terms

5.0 Introduction

In the three preceding chapters, the topic of discussion was the effect of certain lexical and knowledge factors on the comprehensibility by Dutch readers of medical concepts in English-language texts. The lexical factors were medical terms vs. synonymous common-language expressions. The knowledge factors (conceptual system) were medical knowledge and English language knowledge. It was found that, for university-level Dutch readers, it is medical knowledge which helps understand medical concepts in the guise of either English medical terms or synonymous English common-language expressions. Knowledge of the English language or differentiation between terms and common-language expressions had no significant effect on reading comprehension.

The next two chapters of this study are concerned with the effect of interference (i.e. transfer of linguistic items) from Dutch on the comprehensibility (in a wide sense) of English medical terms for medically knowledgeable speakers of Dutch. Thus, these two chapters cover the second-language dimension of this study. The present chapter deals with the following topics. First, the differences and similarities of Dutch and English medical terms are discussed. Next, a hypothesis is stated through which the formal similarities between Dutch and English medical terms can aid (or hinder) comprehension of the latter by Dutch readers. This hypothesis is subsequently tested experimentally.

5.1 Cross-Linguistic Differences and Similarities between Dutch- and English-Language Medical Terms

In this section a brief outline is given of the differences and similarities between Dutch and English medical terms. This outline is based on the types of cross-linguistic contrasts discussed in Ulijn (1978:50ff.).

5.1.1 Similarities between Dutch and English Medical Terms

Below, the cross-linguistic similarities of Dutch and English medical terms are outlined in terms of

- A. shared medical concepts and
- B. similarities between forms used to convey such concepts.

A. Shared Medical Concepts

Medical Dutch and medical English tend not to differ from each other in the medical concepts which are denoted by the medical terms in either language (by contrast, some auxiliary concepts such as units of measurement may vary). Today, medical concepts are part of a cultural system of medical procedures and inquiry which is independent of cultural systems associated with different societies and different languages. This does not mean, of course, that all societies use the same medical concepts. This type of internationalism does not hold for all special languages either. Concepts in other special languages, such as legal language, are typically dependent to a great extent on certain cultural systems, cf. the differences between continental West European legal concepts and British-American legal concepts.

B. Similarity of Medical Terms

Many of the lexical forms which have been chosen to communicate medical concepts are similar in Dutch and English. Many medical Dutch and medical English terms are **cognates**, and many are borrowings from Latin (see 2.3.2). Roughly, these cross-linguistically related terms have similar (*necrosis/necrose*) or identical (*subileus/subileus*) forms and denote identical concepts (see 5.2 for a more detailed characterization of cognates). In the present study, similarity between cognates refers to the similarity of their written forms.

L1 and L2 common-language lexical items which are similar in form may convey different senses, such as Dutch and English *college* (which in Dutch can have the sense of *lecture*), or English *boot* vs. Dutch *boot* (*boat*). Cross-linguistic similarities in form between medical terms, however, almost always imply identical senses. For example, terms such as *acute tubular necrosis* (Dutch *acute tubulaire necrose*) or *inferior vena cava* (Dutch *vena cava inferior*) will normally have the same senses in both Dutch and English. The question as to how readers

recognize L1/L2 cognates is discussed in 5.2-5.3 and to a lesser extent in chapter 6.

The cognate status of many medical terms is not limited to Dutch and English - most medical terms are cognates internationally. This is due in part to international employment of Latin forms and assignment of (often metaphorical) new senses to these forms for the creation of medical terms (see 2.3 for a discussion of intralinguistic term formation). For the other part, it is due to other languages' borrowing from each other, mostly from English (e.g. medical Dutch words like *scan*). Note that the various national trends or policies on international vs. language-specific terms formation are not dealt with at length here - see chapter 6 for a short discussion on term formation from a cross-linguistic point of view.

As discussed in 2.3, in a number of cases the lexical forms used to create medical terms are drawn from other registers of the same language rather than from Greek-Latin words or phrases. In such cases, any cross-linguistic similarity in form is obviously coincidental. In many languages this type of medical term formation consists of the addition of a new, often metaphorical, sense to the lexical forms terms drawn from other registers. Such non-cognate medical terms are, however, increasingly scarce.

5.1.2 Differences between Dutch and English Medical Terms

Two types of contrasts between Dutch and English medical terms are discussed here:

- A. **lexical** contrasts between content words making up a medical term and
- B. **derivational and inflectional** contrasts (affixes) in cognate content words making up medical terms (function words are not discussed here).

A. *Lexical Contrasts*

The types of differences found within the category of lexical differences are **formal contrasts**, **misleading cognates**, and **register mismatches** of cognate terms (see Ulijn 1978: 77-79 or Ulijn et al. 1985: 114f for further discussion of the first two terms).

1. *Formal contrasts*. Dutch and English medical terms are formally contrasted when their lexical forms are unrelated but employed to convey the same sense, e.g. English *vasculature* vs. Dutch *vaatsysteem*.

2. *Misleading cognates*. Dutch and English medical terms are misleading cognates when they employ the same lexical form but have different senses. According to Ulijn et al. (1985: 115), misleading cognates often originate when borrowed lexical forms acquire an additional sense which is different from its original sense or senses. An example is Dutch *tijd* (*time*) vs. English *tide*. The original sense or senses may subsequently disappear. There are not many medical terms that are misleading cognates; the reason seems to be the possible misunderstandings they can generate. An example of a possible misleading cognate is Dutch *mazelen* (*measles*) vs. English *German measles*, which are of course not measles at all (the correct Dutch translation is *rode hond*).

3. *Register mismatches*. Register mismatches occur in the case of cognate lexical items, one of which is a specialist medical term in one language while the other is a submedical lexical item or common medical term in another language. Register mismatches tend to occur in Dutch and in English as a result of each of these two languages being able to have two (or more) lexical forms to cover the same sense. One of these lexical items is typically Latin-derived, while the other is of Germanic origin (Ulijn 1985). A pair of such lexical items which share the same sense is commonly called a **doublet** if one item is a medical term and the other its common-language or submedical counterpart. Register mismatches can occur when one language can deploy a doublet to cover a medical concept, while the other language only has one lexical item to cover the same concept, usually a cognate of the Latinate half of the doublet. For example, Dutch can deploy the doublet *blindedarmontsteking/appendicitis* where English only has *appendicitis*. There is a register mismatch between the Dutch and English forms inasmuch as the English word *appendicitis* is taken to be a common-language form, while the Dutch word *appendicitis* is used as a specialist medical term.

Other examples are Dutch *slagader/arterie* vs. English *artery*, Dutch *ontsteking/infectie* vs. English *infection*.

B. Derivational and Inflectional Differences

Cognate words in medical terms in two languages may differ in language-specific affixation. Examples of such differences between Dutch and English are: *tubulAIR/tubulAR*; *stenoSE/stenoSIS*; *percutAAN/percutANEIOUS*.

5.1.3 Conclusion

From the above it may be concluded that, generally, there are more similarities than differences between Dutch and English medical terms. In the area of medical concepts, medical Dutch and medical English tend not to differ in medical concepts which are denoted by the medical terms in either language. As for similarity of form, it is probably the case that many Dutch and English terms are cognates (see chapter 6 for more discussion on this point).

Differences of form between Dutch and English medical terms are generally classified as either formal contrasts, register mismatches or derivational and inflectional contrasts. There are not many medical terms that are Dutch-English misleading cognates.

5.2 L1-L2 Transfer of Medical Terms

Two questions arise at this point in connection with the comprehensibility of English medical terms for Dutch readers:

1. can the above similarities between Dutch and English medical terms somehow aid the comprehension of English-language medical terms by Dutch readers?
2. can differences between Dutch and English medical terms impede such comprehension?

Obviously, answers to these questions have implications for the teaching of English specialist terms in Dutch medical education (recall that it was concluded in 4.7.3 that 4th year Health Sciences and medical students scored relatively low on reading comprehension involving English specialist medical terms).

Below, our two questions are first investigated in terms of recent thinking on the role of L1 in L2 comprehension. Subsequently a hypothesis is stated under which similarities and differences between L1 and L2 lexical items can

affect the reading comprehension of the L2 items. Predictions derived from this hypothesis are tested in 5.3. These predictions involve Dutch-English transfer of medical terms.

5.2.1 The Contrastive Analysis Hypothesis

Dutch readers of English texts often semantically associate unfamiliar words with Dutch words which seem similar or sometimes identical in form (unless stated otherwise, all words or lexical items discussed here are content words or content lexical items). In the case of closely related languages, such as Spanish and Portuguese, lexical similarity in written language allows for high interlingual comprehensibility of written text. At the lexical level this process is referred to as **L1-L2 lexical transfer**. The present study is specifically concerned with the transfer of L1 Dutch medical terms to L2 English. As a simple example of common-language L1-L2 lexical transfer, the English word *book* can be assigned the meaning of its Dutch cognate counterpart *boek*. Unfortunately, this tendency can extend to cases of formal similarity where there is no corresponding semantic similarity, as in the form *college*, which is also the Dutch word for *lecture*.

Such experiences have led to the formulation of the Contrastive Analysis Hypothesis in the middle fifties (see for example Lado 1957). Roughly, this hypothesis stated that problems of L2 learners were predictable from the differences between L1 and L2. Conversely, L2 learners would have least difficulty in the areas in which L1 and L2 were similar. The Contrastive Analysis Hypothesis was not restricted to L1-L2 lexical transfer. It covered L1-L2 transfer on other linguistic levels of analysis as well. In the case of L2 reading vocabulary, then, the hypothesis predicted less difficulty in the cases of similarity between L1 and L2 words. Conversely, it predicted more difficulty in the case of a lack of such similarity.

However, the Contrastive Analysis Hypothesis soon ran into difficulties. An extensive account of the objections which were raised against it is not given here - sufficient detailed accounts are provided elsewhere, e.g. in Ellis (1986), Van Els et al. (1984) or Kellerman (1987). However, these criticisms of the Contrastive Analysis Hypothesis do not specifically deal with reading. For reading, the criticism covers the following items.

1. Learners simply do not always associate unfamiliar L2 forms with formally similar L1 lexical forms. This is a phenomenon known as **transfer avoidance** (see Færch and Kasper 1987 for more discussion, cf. also Ellis 1986 and Kellerman 1987). Transfer avoidance has been most often discussed in terms of language production; there is however no reason to suppose it does not also occur during reading comprehension.
2. Learners can confuse unfamiliar L2 forms with other, formally similar, L2 forms they already know. Possibly this occurs by the same cognitive mechanism which allows L1-L2 lexical transfer. However, such errors are not predicted by the Contrastive Analysis Hypothesis. An example is a learner semantically confusing unfamiliar *shrug* with familiar *rug*, or *stolid* with *solid*. Most experienced teachers of English as a foreign language will be familiar with errors of this type.
3. Many errors L2 users make do not appear to have their origin in any kind of transfer at all; many correct "guesses" of L2 word meanings appear to stem from an analysis of the context in which the word occurs (see e.g. Schouten-Van Parreren 1985 for more discussion).

In sum, it became clear that the Contrastive Analysis Hypothesis needed to be succeeded by a hypothesis which predicts L2 learner difficulties more accurately and which describes under what conditions L1 knowledge interferes in L2 language use.

The alternative approach to L1-L2 transfer discussed below is not so much based on comparisons of L1 and L2 forms but on the way in which readers process these forms (see Ulijn 1987 and Ulijn et al. 1985 for further discussion). Hence, the scope of the psycholinguistic version of the Cognitive Analysis Hypothesis discussed below is restricted to the reading of L2 texts.

5.2.2 The Organization of Lexical Knowledge in L2 Reading

What would a more accurate hypothesis on L1-L2 lexical transfer in reading than the Contrastive Analysis Hypothesis look like? Below, this question is dealt with in terms of the lexical analysis/mental lexicon framework introduced in 3.6-3.8. First, however, some clarification is necessary of the more general concept of L2 lexical knowledge.

In 3.6 lexical analysis in reading was supported by two knowledge sources: the mental lexicon and the conceptual system. This is illustrated in Fig. 3.12 (repeated here as Fig. 5.1).

Fig. 5.1 The Knowledge Support of Lexical Analysis

L1-L2 lexical transfer implies mutual accessibility of L1 and L2 lexical knowledge. This raises the question of how such mutual access is organized (a much researched field, some of the most influential works are Ervin and Osgood 1954 and Lambert 1969). Two possibilities for the organization of L2 lexical access come to mind:

1. all lexical knowledge is stored in a single mental lexicon, as in Fig. 5.1, or
2. L1 and L2 lexical knowledge are somehow stored separately.

The notion of **storage** is used here in an abstract sense. Separate storage of L1 and L2 lexical items refers to the assignment of language-specific information to the various features that distinguish lexical items from one another. The choice for one of the two possibilities given above over the other, or else for some compromise solution has implications for the ease with which L1-L2 lexical transfer occurs. Joint storage implies relative ease of transfer, there being nothing to bar it in the way of boundaries between L1 and L2. Conceivably, separate storage complicates transfer, as boundaries between L1 and L2 need to be negotiated in some way.

The argument for deciding that there is only one mental lexicon is a simple one. Given the ability of readers to transfer from L1 to L2, joint storage of L1 and L2 lexical items is the most obvious way in which lexical items of both types are accessible. In the absence of a better match in the mental lexicon, an L1 entry sufficiently matching the input data from L2 reading would automatically transfer as the appropriate L2 lexical item (see also the discussion on the **pseudo-transfer** phenomenon in 5.2.4, where the reader simply assumes that an appropriate L1 lexical item exists)

On the other hand, an argument for separate L1 and L2 mental lexicons is that such separation is needed in order to enable distinction between L1 and L2 lexical items in language production and comprehension. Joint storage of L1 and L2 lexical items would result in a mix-up between them in language production as well as comprehension. There would be no basis for deciding whether, say, a word was Dutch or English. Of course, such mix-ups in fact regularly occur for beginning L2 learners. This may indicate that there is some kind of dependence of the L2 lexicon of such beginners on their L1 lexicon. Such a dependence would be less evident in more proficient L2 users.

Since the argument in favor of separate storage of L1 and L2 lexical knowledge seems unanswerable, let us assume it is correct. Thus it is assumed that L1 and L2 lexical knowledge is stored separately.

At this point a brief discussion is in order on another aspect of the nature of L2 lexical knowledge. The position has been adopted here that L2 lexical knowledge is independent of L1. L2 lexical knowledge is also independent of

L2 as used by native speakers: for many language users their L2 lexical knowledge does not compare favorably with that of a competent native speaker of L2. Such an incomplete or interim state of language knowledge is termed an **interlanguage**. In the case of a specific L1 and L2 this is an L1-L2 interlanguage. The English of a Dutch speaker would thus be referred to as his/her Dutch-English interlanguage.

Interlanguage is a frequently recurring topic in recent research on L2 acquisition. Its attraction lies in notions such as the systematicity of a language user's L2, in roughly the same sense as natural languages of native speakers are generally assumed to be systematic. General introductions to the notion of interlanguage are provided in e.g. Selinker (1972), where the term is first introduced, or Ellis (1986). In this context the notion L2 lexical knowledge is defined as interlanguage lexical knowledge, specifically a stage in the development of a particular language user's Dutch-English interlanguage lexical knowledge.

5.2.3. L1 and L2 Lexical Knowledge vs. the Conceptual System

Having decided that L1 and L2 lexical knowledge are stored separately, it remains to be seen in what ways the L1 and L2 mental lexicons can interact to produce L1-L2 lexical transfer. Let us make two assumptions about the nature of L1-L2 lexical transfer:

1. cognate status of a pair of L1 and L2 lexical items can induce transfer (albeit not as automatically as the Contrastive Analysis Hypothesis would have it) and
2. the decision to transfer is taken on the basis of some kind of linguistic knowledge or knowledge of the world, i.e. in terms of our reading comprehension model the decision to transfer is taken on the basis of information in the conceptual system.

In view of these assumptions, the question in what ways the L1 and L2 mental lexicons can interact to produce L1-L2 lexical transfer can be approached in terms of various types of relations of pairs of cognate lexical items with the conceptual system (see 3.6-3.8 for a discussion of storage of semantic lexical knowledge in the conceptual system).

The various relations of this kind discussed below are inspired by models of **bilingualism**. Bilingualism is a wide field of research with a considerable history (see for example Ervin and Osgood 1954).

There are various basic approaches to models of bilingualism. Ulijn et al. (1981:13ff.) defines three types of bilingualism in terms of relations between L1 and L2 mental lexicons and the language user's conceptual system. By contrast, in Klein (1986:11), for example, bilingualism is defined in terms of the order in which languages are acquired.

The first type of relation between a pair of cognate lexical items and the conceptual system is given in Fig. 5.2.

Fig. 5.2 Cognate Lexical Items

In the case of the relation type of Fig. 5.2, there is a stronger direct relation between each of the cognate lexical items and the conceptual system than the lexical items have with each other. In this type of relation, the cognate status of the lexical items does not lead to any kind of mutual association. Such lexical relations will hold for many fluent L2 users who are not conscious of formal similarity of a pair of L1 and L2 words or phrases.

A different type of situation is illustrated in Fig. 5.3.

Fig. 5.3 "Translation"

Here we have a translation-type situation which might be found with beginning learners (in contrast to fluent learners to whom Fig. 5.2 applies). In the type of

relation illustrated in Fig. 5.3, the L2 lexical item is related to the conceptual system by way of the L1 lexical item. This is graphically illustrated in Fig. 5.3 by the link between the L2 lexical item and the L1 lexical item. The L1 lexical item, in its turn, links up with the conceptual system. Hence, the conceptual meaning of the L2 lexical item is derived from the conceptual meaning translation of the L1 lexical item. The L2 lexical item has no independent conceptual information associated with it.

The situation in Fig. 5.3 is consistent with what we might expect in L1-L2 lexical transfer, in the sense that an unfamiliar L2 lexical item being analyzed as a cognate of an L1 lexical item would have no independent conceptual information associated with it either.

The relations which can exist between the L1 mental lexicon, the L2 mental lexicon and the conceptual system which can be deduced from Figs. 5.2 and 5.3 are given in Fig. 5.4.

Fig. 5.4 Lexicon and Conceptual System

Given that lexical transfer is possible for all L2 users, a link-up should be possible (but not always necessarily present) between the L2 and L1 mental lexicons, as discussed with respect to Fig. 5.3. Obviously, not all L2 lexical knowledge is a result of transfer. Such L2 lexical knowledge would have its own link with the conceptual system.

5.2.4 The L1-L2 Lexical Transfer Hypothesis

Below an L1-L2 lexical transfer hypothesis for reading is stated in terms of the lexical analysis/lexical knowledge framework developed so far. Let us first consider the lexical analysis process in which a Fig. 5.3-like situation is embedded. Recall that the goal of lexical analysis is relating words to concepts in the reading comprehension process (see 3.6). Lexical analysis consisted of three stages:

1. input from the script recognizer and syntactic analysis,
2. scanning of this input for information on which to base the decision to mentally represent one lexical item rather than another,
3. the mental representation of a particular lexical item.

The reading comprehension mechanisms involved in these three steps are discussed in 3.3 (script recognition), 3.4-3.5 (syntactic analysis) and lexical analysis itself (3.7-3.9). It is probably axiomatic that L2-L1 lexical transfer does not occur if in stage 2 the L2 input matches an entry in the reader's L2 mental lexicon. The point of L1-L2 lexical transfer is precisely that the L2 input fails to find a matching L2 lexical entry and thus turns to the L1 (or another L_n) mental lexicon. A practical implication is that lack of L2 lexical knowledge aids L1-L2 lexical transfer. Another implication is that since no matching L2 lexical entry exists, there is no lexical or conceptual knowledge about the corresponding L2 lexical item. This is consistent with the situation in Fig. 5.3.

We now turn to the lexical analysis process during which L1-L2 lexical transfer occurs. L1-L2 lexical transfer is often described in terms of a number of stages (see e.g. Nas 1983). The first stages could be described as follows:

1. L2 input to L2 mental lexicon
2. failure to find a matching entry in the L2 mental lexicon

The next logical stage in the L1-L2 lexical transfer hypothesis for reading would be that the L2 input would search the L1 mental lexicon for a matching entry. Presumably, the L1 mental lexicon is not automatically accessible to L2 input. This issue is discussed at some length in Nas (1983). No further discussion of this issue will follow here, inasmuch as we are more concerned with properties of L1 lexical items that make them conducive to transfer rather than with the language-specificity of word recognition strategies.

The crucial question at this stage is what factors determine the matchability of the L2 input with the L1 lexical item. It is clear that perceived similarity of form in L2 input to an L1 lexical item is an important criterion for matching L2 input with an L1 lexical entry. Such a criterion for L1-L2 lexical transfer is more realistic than cognate status in an etymological sense (see 5.1). Many forms which are in fact etymologically Dutch/English cognates are not similar in form at all, such as *eye/oog* or *choice/keuze*. Such forms will only rarely be perceived as having any semantic relationship through common origins. Also, forms which are etymologically cognate may have lost much of their initial semantic similarity, as for example *tide/tijd* (Dutch *time*).

Only those learners who are experts in word etymology will associate such forms with each other. What is at issue is the tendency of learners to, mistakenly or not, associate unfamiliar L2 word forms with formally similar L1 words. Nas (1983) terms such pairs of formally similar L1 and L2 word forms **psychological cognates**. Psychological cognates which are semantically similar, such as *book* and *boek*, would be true cognates. Psychological cognates that are not true cognates, such as Dutch *college* and English *college* can be misleading cognates.

However, the notion of psychological cognates transcends perceived similarity of form. Perceived similarity of form alone is not a sufficient condition for matchability of L2 input with an L1 lexical entry. The main reason is that readers may decide not to transfer in spite of perceived similarity of form between an unknown L2 lexical item and an L1 lexical item (transfer avoidance). In its most extreme form, transfer avoidance would refer to a wary reader's refusal to transfer *because* the relevant L2 item resembles an L1 lexical item.

In other words, a more satisfactory characterization of psychological cognates is necessary. Such a characterization would have to include the notion that psychological cognates are in fact judged by readers to be susceptible to L1-L2 lexical transfer. This is clearly a better way of characterizing psychological cog-

nates than just in terms of formal similarity. So far, then, L1-L2 psychological cognates can be defined as pairs of lexical items in L1 and L2 which are judged to be transferable from L1 to L2. This is incorporated as the next L1-L2 lexical transfer stage.

1. L2 input to L2 mental lexicon
2. failure to find a matching entry in the L2 mental lexicon perceived to be sufficiently similar
3. L2 input to L1 mental lexicon
4. match of L2 input with L1 psychological cognate

The transferability of medical terms (or other terms) can be assessed through language users' linguistic knowledge of transferability features of formal properties of lexical items. In practice, transferability seems to be enhanced by the reader's perception of similarity between L1 and L2 (cf. Kellerman 1987). Specifically in the case of medical terms, a language user may be able to tell by the Latinate form of a medical term that it is transferable to a specific L2 (such as English), based on the knowledge that Latinate forms are in general transferable to that L2. A better definition of L1-L2 psychological cognates is therefore that these are pairs of lexical items in L1 and L2 which are judged to be transferable from L1 to L2 on the basis of the reader's linguistic knowledge.

It has been assumed implicitly that for L1-L2 lexical transfer to be able to occur, the relevant L1 lexical item needs to be a recoverable entry in the mental lexicon. In other words, for L1-L2 lexical transfer to take place, some familiarity with the L1 lexical item is necessary. The absence of such an L1 lexical item could result in L2-L1 lexical borrowing rather than transfer. L2-L1 lexical borrowing would occur when a hitherto unfamiliar medical term is first encountered in an L2 text, and then subsequently adopted for use in an L1 context, with the necessary morphosyntactic adaptations of form.

Such borrowing might actually occur under the assumption that the relevant L2 lexical item already has a psychological cognate in L1, with which the reader is however not familiar. For example, the Dutch reader first encountering the lexical item *necrosis* in an English text might guess, on the basis of linguistic knowledge concerning transferability of Greek-Latinate forms, and having analyzed *necrosis* as such, that Dutch has a cognate lexical item *necrosis* or, with a

Dutch morphological adaptation of the suffix, *necrose*. Such **pseudo-transfer** typically occurs for example in nonexpert medical translations (in the case of *necrosis/necrose* the translator would have guessed correctly).

The main difference between transfer and pseudo-transfer is that for the former some knowledge is needed of the relevant L1 lexical item. Depending on the attention the reader pays to the linguistic context of the lexical item in question, L1-L2 lexical transfer will not result in contextual anomaly. No lexical knowledge being necessary, such contextual anomaly is easily achieved in pseudo-transfer. The similarity between transfer and pseudo-transfer is that both processes involve psychological cognates, as defined above. However, since we are primarily interested in the reading comprehension of L2 medical terms by medical experts, it seems wise to defer further discussion of pseudo-transfer.

The conclusion that can be drawn from the above discussion is that L1-L2 lexical transfer involves the following addition to the L1-L2 lexical transfer process:

1. L2 input to L2 mental lexicon
2. failure to find a matching entry in the L2 mental lexicon
3. L2 input to L1 mental lexicon
4. match of L2 input with L1 psychological cognate (an entry in the L1 mental lexicon)

The hypothesis on L1-L2 lexical transfer adopted here focuses on the fourth stage of the process described above. It says that L1-L2 lexical transfer only takes place if the L1 and L2 lexical items are psychological cognates and the L1 lexical item constitutes an entry in the L1 mental lexicon. Note that the scope of this hypothesis is intended to be confined to reading.

5.3 L1-L2 Lexical Transfer and the Comprehension of L2 Medical Terms

What does the L1-L2 lexical transfer hypothesis for reading predict for the comprehension of English medical terms by Dutch readers? According to the hypothesis, transfer will only occur if

- A. the L1 and L2 items are psychological cognates and
- B. the L1 lexical item is recoverable from the mental lexicon

What these two parts of the hypothesis predict for transfer of medical terms is discussed below.

5.3.1 Prediction

A. L1-L2 Psychological Cognates

Here we will assume that formally similar or identical Dutch and English medical terms of Greek-Latin derivation are recognizable as psychological cognates (see 2.3 for types of derivation of medical terms). A basis for this assumption lies in the data of the experiment reported in 6.2.-6.4. In that experiment, medically knowledgeable Dutch subjects translated a significant number of English Greek-Latin derived medical terms as their Dutch cognate counterparts (see 6.2-6.4 for details).

A second assumption is that cognate status of Dutch and English medical terms implies synonymy of those terms (see 5.1).

B. L1 Lexical Knowledge

The second part of the L1-L2 lexical transfer hypothesis for reading specified that the L1 lexical item of the psychologically cognate pair should be recoverable from the mental lexicon. In other words, transfer can only take place if there is source lexical knowledge. Knowledge of medical terms implies medical conceptual knowledge. L1-L2 transfer of medical terms therefore only takes place for medically knowledgeable language users.

Conclusion

For the transferability of Dutch Greek-Latin derived medical terms, the L1-L2 lexical transfer hypothesis for reading thus predicts that medically knowledgeable groups of Dutch subjects score significantly higher on a reading comprehension test involving English Greek-Latin derived medical terms than medically less knowledgeable groups of Dutch subjects.

5.3.2 Experimental Verification of the L1-L2 Lexical Transfer Hypothesis for Reading

Below, the data of experiment 1 (see chapter 4) are used to test the L1-L2 lexical transfer hypothesis for reading. Recall that this experiment involved four groups of subjects:

1. 28 4th year Health Sciences or medical students,
2. 28 2nd year Health Sciences students,
3. 26 3rd and 4th year students of English and
4. 24 3rd or 4th year neither English nor medical students (mostly students of Dutch),

all from Leiden University. For the sake of simplicity, these groups will be referred to as 4th year Health Sciences students (1.), 2nd year Health Sciences students (2.), 3rd/4th English students (3.) and 4th year students of Dutch (4.) respectively.

The material for the reading test was an editorial taken from *The Lancet* 1986, Vol.1, pp. 781-783, titled "Imaging the Transplanted Kidney". Twelve medical terms in the text were rewritten into semantically equivalent common-language phrases. Otherwise the word-order in the rewritten parts of the text was left unchanged.

Table 5.1 contains the Dutch cognate translations of the authentic English terms (the line references relate to the text in Appendix A).

Table 5.1 Cognate forms of authentic terms (* = no cognate)

No.	Authentic term	Line ref.	Dutch counterpart
1.	cyclosporin immunosuppression	5	immunosuppressivum cyclosporine
2.	antegrade pyelogram	14	antegraad pyelogram
3.	pyramids	22	pyramiden
4.	haematomas	55	hematomen
5.	urography	58	urografie (*pyelografie)
6.	percutaneous angioplasty	72	percutane angioplastiek
7.	vasculature	72	vasculatuur (*vaatsysteem)
8.	inferior vena cava	74	vena cava inferior
9.	hypertension	77	hypertensie
10.	parenchyma	77	parenchym
11.	(needle) biopsy	82	naald biopsie
12.	fine-needle aspiration cytology	82	... naald aspiratie cytologie

Table 5.1 shows that the selected English medical terms tend to have Dutch cognate counterparts. The medical terms of Table 5.1 therefore seem suitable for use to verify the L1-L2 lexical transfer hypothesis for reading.

In experiment 1, reading comprehension was operationally defined as comprehension which enables the reader to distinguish between correct and incorrect paraphrases and inferences of passages of the text. The simplest question format consistent with this definition was true/false statements (see the appendix to chapter 4). Two versions of this text were prepared. In Text A, every other test passage contains a rewritten term. Text B contains the other half of the rewritten terms.

A oneway analysis of variance (with the Student-Keuls-Newman procedure) was used with medical knowledge as independent variable, with the following conditions:

- A. 3rd/4th year students of neither English nor a medical discipline (nonexperts)
- B. 2nd year Health Sciences students (beginners)
- C. 4th year students of Health Sciences and other medical disciplines (experts)

The dependent variables and conditions were scores on true/false statements pertaining to authentic (cognate) medical terms and scores on true/false statements pertaining to equivalent (non-cognate) common-language items.

Each subject received two test scores: one score for authentic items and another score for rewritten items. The significance of the differences between the mean scores was computed by means of a multiple range test (Student-Keuls-Newman procedure).

5.3.3 Results

Below, the results are first given for cognate medical items. Then, by way of contrast, scores on the rewrites are given.

A. Cognate Medical Terms

In this section, the mean scores per group of subjects on cognate medical terms are given first. These are followed by data on the significance of the differences between these mean scores as well as mean scores per individual cognate term.

1. *Mean scores.* The mean scores for each group of subjects on cognates (medical terms) is given in Table 5.2.

Table 5.2 Mean Scores on Cognate Items (0-100)

Group	Mean Score	N
4th year Dutch (nonexperts)	50.00	24
2nd year Health Sciences (beginners)	60.12	28
4th year Health Sciences (experts)	68.45	28

2. *Significance of differences between mean scores.* Table 5.3 gives the significance of the differences of the mean scores in terms of subsets of mean scores (calculated with the Student-Keuls-Newman procedure) where within each subset the highest and the lowest means do not differ by more than the shortest significant range for a subset of that size. In other words, mean scores that occur in the same subset do not differ significantly.

Table 5.3 Homogeneous subsets, cognate medical terms

Group = mean score	Occurs in Subset 1	Occurs in Subset 2
4th year Dutch = 50.0	yes	no
2nd year Health Sciences = 60.12	yes	yes
4th year Health Sciences = 68.45	no	yes

In Table 5.3, the mean score of 4th year Health Sciences students does not occur in the same subset with that of 3rd/4th year students of Dutch. Accordingly, these scores differ significantly ($p < .05$). This result is evidence for the L1-L2 lexical transfer hypothesis, which predicts that L1-L2 transfer of specialist medical terms only takes place for medically knowledgeable language users.

3. Mean scores on individual terms. In Table 5.4 the scores of the three groups on individual terms are given.

Table 5.4 Mean Scores on Individual Terms, 0-100

No.	Term	Mean score Du4	Mean score HS2	Mean score HS4
1.	cyclosporin im- munosuppress- ion	92	100	93
2.	antegrade pyelogram	8	0	57
3.	pyramids	42	43	79
4.	haematomas	33	7	29
5.	urography	58	71	50
6.	percutaneous angioplasty	58	100	93
7.	vasculature	33	79	100
8.	inferior vena cava	33	79	64
9.	hypertension	58	36	43
10.	parenchyma	42	14	36
11.	(needle) biopsy	92	100	93
12.	fine-needle as- piration cyto- logy	58	93	86

In most cases, 4th year Health Sciences students do not score highest. The non-expert students of Dutch scored best on *haematomas*, *hypertension* and *parenchyma*. This outcome was not cued by the test rewrites (which are distinct from the rewrites used in the text, see 4.3.2), respectively *breaks in the walls of capillary arteries* (false), *high blood-pressure in the arteries* and *the outer layer of the kidney* (false). The tendency seems to be that where the 4th year Dutch students score best, the overall scores are relatively low. Best scores for 2nd year Health Sciences students tend to be slightly higher than those for 4th year Health Sciences students.

B. Text Rewrites

Note, by way of contrast, that the scores for the generally non-cognate text rewrites (see 4.3) do not improve with increased medical knowledge. This is what was predicted by the L1-L2 lexical transfer hypothesis, i.e. that it is for medical terms that L1-L2 transfer takes place, and not for non-cognate rewrites of those terms. Below, the non-cognate status of the rewrites is first clarified. Then, mean

scores per group and the significance of the differences between these scores are discussed.

The degree to which text rewrites are cognate is shown in Table 5.5.

Table 5.5 Cognate forms of rewritten terms

No.	Rewritten term	Cognate forms
1.	Treatment with cyclosporin to prevent or diminish rejection	...cyclosporin...
2.	X-ray of contrast material discharged into urine passages	...contrastmateriaal... ...urine...
3.	conical masses	...massa's
4.	internal outpourings of blood	interne ... bloed
5.	imaging of the urinary tract	...urine...
6.	blood-vessel repair by means of a balloon catheter	bloed...reparatie... balloncatheter
7.	blood-vessel system	bloed ... systeem
8.	lower venous trunk	...
9.	continual elevated arterial blood-pressure	continu...bloed...
10.	functional tissue	...
11.	removal by needle of a tissue sample	...naald...
12.	studies of cells obtained through a fine needle	studies...cellen...naald

Mean score for rewritten items are given in Table 5.6.

Table 5.6 Mean Scores on Non-cognate Items (= rewritten)

Group	Mean Score	N
4th year Dutch	59.72	24
2nd year Health Sciences	73.81	28
4th year Health Sciences	67.26	28

An analysis of variance shows no significant difference between the scores in Table 5.6. at $p < 0.05$.

5.3.4 Discussion

For the transferability of Dutch Greek-Latin derived medical terms, the L1-L2 lexical transfer hypothesis for reading predicted that medically knowledgeable groups of Dutch subjects score significantly higher on a reading comprehension test involving English Greek-Latin derived medical terms than medically less knowledgeable groups of Dutch subjects.

This hypothesis is verified in view of the significant score differences of Fig. 5.3, where scores on cognate items by 4th year Health Sciences and medical students are significantly higher than those of 4th year students of Dutch, while scores of 2nd year Health Sciences students occupy a middle position. The picture of Table 5.4 regarding performance on individual terms is more subtle, but does not change the outcome. By contrast, the scores of Table 5.6 show no significant increase of scores on the mainly non-cognate rewritten items by medically knowledgeable groups compared to medically less knowledgeable groups. In other words, such increase is confined to specialist medical terms, as predicted by the L1-L2 lexical transfer hypothesis.

The main conclusion is that the Dutch-English cognate status of written English medical terms aids their comprehension by Dutch readers who are medically knowledgeable. A practical implication is that any difficulty medically knowledgeable Dutch readers have with English-language medical texts might not be due to the medical terms in those texts - most English medical terms formally resemble Dutch medical terms.

5.3.5 Summary and Conclusion

In chapter 4 evidence was presented indicating that the comprehensibility of medical concepts in written texts in another language is not enhanced by replacing the L2 medical terms which conventionally convey these concepts by "simplified" L2 common-language synonymous equivalents. For both L2 common-language phrases and medical terms, it was medical knowledge which facilitated reading comprehension.

In the present chapter, evidence has been provided that the psychologically cognate status of many Dutch and English medical terms aids the reading comprehension of the latter by medically knowledgeable speakers of Dutch.

The development of this hypothesis took the following steps. First, the similarities and differences between Dutch and English medical terms were touched

upon, roughly concluding that there are more similarities than differences in forms and meanings of Dutch and English medical terms. The next step was re-researching the effect of such similarity on reading comprehension. Arguments were provided for the rejection of a purely linguistic hypothesis which predicts automatic transfer from L1 lexical knowledge to L2 lexical knowledge in the case of formal similarity (the Contrastive Analysis Hypothesis).

The two following steps in the development of a more accurate hypothesis on L1-L2 lexical transfer in reading were: (i) establishment of the relation between L1 lexical knowledge and L2 lexical knowledge and (ii) the development of the notion psychological cognate. The resulting hypothesis was that L1-L2 lexical transfer in reading occurs if the L1 and L2 lexical items are psychological cognates and the L1 lexical item is recoverable from the L1 mental lexicon. Under the assumption that English medical terms are analyzed as psychological cognates by Dutch readers, the hypothesis predicted Dutch-English transfer of medical terms in reading for medically knowledgeable speakers of Dutch. This hypothesis was subsequently verified experimentally. Clearly, an implication for medical teaching/medical English teaching is that, for Dutch learners, cognate English medical terms do not need much attention where reading comprehension is concerned.

The Dutch Preference for Cognate Medical Terms

6.0 Introduction

This chapter is concerned with the preference in Dutch medical communication for language-specific vs. internationally cognate specialist medical terms. How does this topic relate to the rest of this study?

Chapter 5 was concerned with the effect of interference from Dutch on the use of English medical terms by medically knowledgeable Dutch readers. Roughly, it was concluded that since Dutch and English medical terms tend to be similar in form, such similarity can aid the comprehension of English medical terms by medically knowledgeable Dutch readers. More accurately, it is the knowledge of the Dutch half of a psychologically cognate pair of Dutch and English medical terms which facilitates comprehension of the English half. The degree to which knowledge of Dutch medical terms consists of such halves would correlate with the comprehension of English medical terms. Knowledge of Dutch medical terms as non psychologically cognate items would not aid the comprehension of English medical terms (psychological cognates are defined in chapter 5 as items which language users judge to be susceptible to language transfer; non psychological cognates are therefore items which are not judged to be susceptible to language transfer).

A question left unanswered was to what degree the cognate medical terms are accepted by Dutch medical experts. At least theoretically, there is a choice in Dutch medical term formation between cognate and language-specific forms for the expression of medical concepts (see 5.1 for a discussion of differences and similarities of Dutch and English medical terms). A preference for cognate terms would help enhance comprehension of English medical terms, as discussed in 5.3. A preference for language-specific forms would not enhance such comprehension. In this chapter, then, it is investigated to what degree Dutch medical experts prefer cognate terms. This is done as follows. First, the various

alternatives for cognate and language-specific term formation are discussed. Then an experiment is reported on the preference of Dutch physicians for cognate vs. language-specific terms.

6.1 Cross-Linguistic Alternatives for Medical Term Formation

There are three possibilities for medical term formation. Medical terms can be formed as **standard international medical terms**, i.e. internationally cognate terms, **borrowings from English** or **language-specific terms**.

A. Standard International Medical Terms

According to Ulijn (1985), the ideal cross-linguistic features of medical language would be:

1. the existence of as many internationalisms (= cognates) as possible in medical terminology,
2. the elimination of misleading cognates in medical terminology.

In other words, the cross-linguistic differences between medical terms should be as small as possible. The advantages of having as many standard international medical terms as possible can be expressed in terms of their **intelligibility** and their **appropriateness**.

As for the **intelligibility** of standard international medical terms, according to Ulijn and Gobits (1986) these would undoubtedly maximize international mutual understanding in the area of the dissemination of scientific and technical innovation. Data on the intelligibility of cognate terms is provided in 5.3.

Following Sager et al. (1980: 289), it is assumed that the **appropriateness** of standard international medical terms simply lies in the widespread use that is being made of them. The Latinate or eponymic forms of very many medical terms (see 2.3.2) are used internationally and are well established (see however the data in 6.3-6.4). For example, most of the medical terms that play a role in the Experiment 1 (reported in chapters 4 and 5) are such Latinate international forms.

The great extent of the use of standard international medical terms is important in this context because of the effect which existing terms have on the creation of new terms. This effect is summarized in terms of the following tenets.

1. Once a term has gained wide acceptance it should not be changed without compelling reasons (Sager et al. 1980:289).
2. New terms should be analogous with existing terms in the sense that the general meaning of the new term should be readily apparent to the professional reader (Dirckx 1977).
3. New terms should utilize stems and affixes already current in medical terminology.

There are also possible drawbacks to using standard international medical terms. One conceivable drawback is that the Latinate and other forms used for medical internationalisms are often unknown to the lay or novice medical language user. If so, the enhanced international mutual understanding referred to above only works for medical experts. However, on the basis of the data of chapter 4 it was concluded that lexical choice alone does not significantly affect comprehension; comprehension is enhanced by lexical choice in combination with the required background knowledge. That is to say, the introduction of more generally familiar forms as replacements for existing unfamiliar terms would not enhance comprehension by medical nonexperts.

B. Borrowing from Medical English

The second possibility for term formation, and the second possibility for having cognate medical terms, is simply to use medical terms current in English as the international standard. The most compelling argument for this option is that English is already widely used in professional medical communication, so that medical English terms tend to be internationally familiar.

The international standardization of medical English terms is a process that is taking place and which coincides with the increasing international standardization of Latinate terms. There already is little or no difference between many existing English-language medical terms and the medical terms in other languages such as Dutch.

C. Language-Specific Medical Terms

The institution of language-specific medical terms rather than a Latin or English international standard is motivated by

1. a desire to make medical communication as intelligible as possible for a wide public or
2. by a concern for the survival of a national-language dimension of medical register.

Note, however, that the findings in chapter 4 indicate that language-specific terms will not contribute more to the general comprehensibility of a medical text than the corresponding cognate forms. The sole valid reason for a preference for language-specific terms is therefore a concern for their survival. According to Picht and Draskau (1985), there exist counter-movements in some language communities (e.g. France, Quebec, Iceland) to internationalisms motivated by the desire to ensure professional communication in the mother tongue. Cultural and national aspects play a significant role here, with the fear that unless the scientific language registers of a given language community move with the times and keep abreast of developments, the language in question will soon find itself demoted to second-class status, incapable of fulfilling the communicative functions required of it in the world of today.

It is clear that such sentiments seem to be motivated culturally and politically rather than scientifically (there are no linguistic objections to loan-words). A choice for cognate terms can foster international understanding, while a choice for language-specific terms reflects a desire to avoid loan forms, which obviously does not always imply poor comprehension of L2 terms.

Having defined the various possible preferences for medical terms formation from the cross-linguistic point of view, we are now able to deal with the question as to the preference in this area of Dutch medical experts. In this respect, knowledge of Dutch medical terms can be described according to the following criteria.

1. *Necessarily cognate terms.* To start with, we must assume that at least part of the medical terms in the mental lexicon of Dutch medical experts has to consist of cognate "international" terms, i.e. the cognate terms which are the only

ones available to express a medical concept. There are clearly many of these, mainly Greek-Latin derivations.

2. *Necessarily language-specific terms.* These would cover the concepts for which there is only a language-specific term available. As discussed in 5.1, this should be a relative rarity in medical Dutch.
3. *Doublets of cognate and language-specific terms.* In this case, a choice is possible between a cognate and a language-specific term, depending on what is considered to be most suitable.

Clearly, the preference of Dutch medical experts for Dutch-English cognate medical terms can only be tested with respect to doublets of cognate and language-specific terms.

In the experiment reported below (Experiment 3) it is investigated to what degree English medical terms which are translatable as doublets in Dutch prompt either cognate or language-specific Dutch translations. It is assumed that such translation will bring out the preference for using either the cognate or the language-specific varieties of Dutch medical terms. The investigation is of course exploratory and does not test any hypothesis, since no existing linguistic or psycholinguistic theory is involved: we are exploring the preference of specifically *Dutch* physicians for cognate vs. language-specific medical terms.

6.2 Subjects, Materials and Procedure

The subjects for Experiment 3 were 27 Dutch physicians. These were: 2 specialists (radiology and neuro-radiology) and 25 trainee specialists in radiology, cardiology, surgery, urology, dermatology, neurology, gynaecology, social medicine, internal medicine and orthopedics.

The test material consisted of 19 sentences involving 31 common and specialist English medical terms (see the appendix to this chapter for a list of the sentences and terms involved). Common and specialist medical terms are defined in 2.3. Common medical terms are those which are generally familiar to the lay public, while specialist medical terms are the more unfamiliar ones.

The sentences are authentic items taken from various pharmaceutical brochures and medical research reports. A differentiation was made between general and specialist medical terms to see if this affected lexical choice one

way or another. The 31 terms involved are listed in Table 6.1 below. The help of medical experts (not involved in the experiment) was called in to ascertain whether the selected terms were generally familiar enough within the medical field to ensure that these were sufficiently familiar with the subjects (terms restricted to a specialist field may not be familiar to other specialists; obviously only the preference for *familiar* terms should be gauged).

Table 6.1 Medical Terms in Experiment 3

No.	Specialist medical terms	Common med. terms
1-1.	irradiation	
1-2.	mastectomy	
1-3.	lumpectomy	
2-1.		palpation
2-2.	mammography*	
3-1.	myelosuppression	
3-2.		hemorrhage
4-1.	tubular necrosis*	
4-2.		excretion
5.		rejection
6-1.	echography*	
6-2.		appendicitis
7-1.	coprostasis	
7-2.	subileus*	
8-1		pneumonia
8-2	tonsillectomy*	
9-1		benign
9-2		malignant
9-3	metastasising	
10	cystitis	
11		renal function
12		hemorrhoids
13	varices	
14		pelvis fractures
15	epistaxis	
16-1	verrucae	
16-2	auto-inoculation	
17	endoscopy*	
18-1		rubella
18-2	morbilli	
19	hirsutism	

Most of the terms in Table 6.1 have both Dutch cognate or language-specific translations. The specialist medical terms marked with an asterisk (*) are control items which are assumed to have only a cognate translation (this was checked with medical experts). The 31 terms of table 6.2 thus include 6 control items, 13 specialist terms translatable as doublets and 12 general terms translatable as doublets.

The test (see Appendix C) consisted of sentences in Dutch containing clozes with English prompts for translation. An example is:

12. *Wanneer (hemorrhoids) optreden tijdens de zwangerschap, verdwijnen deze meestal na de bevalling.*

Each sentence contained one to three of such clozes. The sentences and English prompts were obtained from original Dutch material which was translated into English or English-Dutch translations - in both cases translation was done by an expert translator. The task for subjects was to fill in the preferred translations of the English terms between brackets. No differentiation was made between correct and possibly erroneous translations. Of the 32 tests handed out to subjects, 27 were completed and returned.

6.3 Results

Below, the results of Experiment 3 are presented in terms of preference per medical term for cognate or non cognate (language-specific) translations. Preferred translations were given for three types of items: control items with cognate translations, common medical terms and specialist medical terms.

The translations of the control items are given in Table 6.2.

Table 6.2 Cognate Translations of English Medical Terms

No.	English term	Translation		%
		Cognate	Non cognate	
2-2	mammography	mammografie		96.3
	"idem"			3.7
4-1	tubular ne- crosis	tubulaire ne- crose		55.6
		tubulus ne- crose		33.3
		"idem"		3.7
		(no response)		7.4
6-1	echography	echografie		92.6
		echo		3.7
		"idem"		3.7
7-2	subileus	subileus		96.3
		ileus of sub- leus		3.7
8-2	tonsillectomy	tonsillectomie		96.3
		"idem"		3.7
17	endoscopy	endoscopie		92.6
			laparoscopie	3.7
		"idem"		3.7

One subject gave a number of translations as "idem", almost certainly indicating that the English translation was very similar to the Dutch term. For the sake of accuracy, these "idem" translations have been repeated as such in Table 6.2, as cognate translations.

As summarized in Table 6.3, the control items were mostly given cognate translations.

Table 6.3 Cognate Translations of English Medical Terms (totals)

No.	English term	Translation	
		% cognate	% other
2-2	mammography	100.0	
4-1	tubular necrosis	96.3	3.7
6-1	echography	100.0	
7-2	subileus	98.1	1.9
8-2	tonsillectomy	100.0	
17	endoscopy	96.3	3.7

The translations of the common medical terms are given in Table 6.4.

Table 6.4 Translations of Common Medical Terms

No.	English term	Translation		%
		Cognate	Non cognate	
2-1	palpation	palpatie		100
3-2	hemorrhage		bloedingen	55.6
			bloeding	29.6
			verhoogde bloedingsneig- ing	3.7
		haemorrhage		7.4
		hemorrhage		3.7
4-2	excretion	excretie		63.0
			uitscheiding	37.0
5	rejection		afstoting	85.2
		rejectie		11.1
		rejectie/	afstoting	3.7
6-2	appendicitis	appendicitis		96.3
			blindedarmont- steking	3.7
8-1	pneumonia	pneumonie		92.6
			longontsteking	7.4
9-1	benign	benigne		70.4
			goedaardig	25.9
		benigne/	goedaardig	3.7
9-2	malignant	maligne		81.5
			kwaadaardig	11.1
		maligne/	goedaardig	3.7
		maligne/	kwaadaardig	3.7
11	renal function		nierfunctie	96.3
		renale functie		3.7
12	hemorrhoids		aambeien	44.4
		haemoroiden		3.7
		haemorrhoiden		11.1
		hemorrhoiden		33.3
		hemorroiden		7.4
14	pelvis fractures		bekkenfrac- turen	92.6
			heupfracturen	7.4
18-1	rubella	rubella		63.0
			rode hond	37.0

In Table 6.4 some subjects gave two translations: a cognate translation and its non-cognate counterpart (e.g. *rejection/afstoting*). The figures of Table 6.4 are summarized in table 6.5.

Table 6.5 Translations of Common Medical Terms (totals)

No.	English term	Translation % Cognate	% Non cognate
2-1	palpation	100.0	
3-2	hemorrhage	22.2	77.8
4-2	excretion	63.0	37.0
5	rejection	14.8	85.2
6-2	appendicitis	96.3	3.7
8-1	pneumonia	92.6	7.4
9-1	benign	72.2	27.8
9-2	malignant	85.2	14.8
11	renal function	3.7	96.3
12	hemorrhoids	55.6	44.4
14	pelvis fractures		100.0
18-1	rubella	63.0	37.0

Note that there seem to be great differences in the conventions regarding cognate/non cognate translations per item. An item such as *palpation*, scored 100% cognate translations, while *pelvis fracturesd* scored zero cognate translations. This is further illustrated in Fig. 6.1.

Fig. 6.1 Translations of Common Medical Terms

Two groups can be discerned here:

- I. Mostly (more than half) cognate translations: *palpation*, *excretion*, *appendicitis*, *pneumonia*, *benign*, *hemorrhoids*, *malignant* and *rubella*. Note that the cognate translations invariably involve what have been termed *register mismatches* in 5.1. That is to say, while the English terms are classed common medical terms, their Dutch cognate counterparts are less generally familiar specialized medical terms.
- II. Mostly language-specific translations: *hemorrhage*, *rejection*, *renal function*, *pelvis fractures*. For most of the common medical terms cognate translations seem to be preferred (mean number of cognate translations was 56%; standard deviation 36.7%) A t-test did not show up a significant difference between the means for cognate and non-cognate common medical terms.

Note that for 3-2 and 12 (Table 6.5) more than one cognate translation is given. One of the differences between cognates seems to be American vs. British spelling conventions, as in *haemorrhage* (American spelling) vs. *hemorrhage* (British spelling).

C. Specialist Medical Terms

Translations of the specialist medical terms are given in Table 6.6. The totals of cognate and non cognate translations are given in Table 6.7.

Table 6.6 Translations of Specialist Medical Terms

No.	English term	Translation		%
		Cognate	Non cognate	
1-1	irradiation		bestraling	74.1
			nabestraling	3.7
			locale	3.7
			radiotherapie	
			radiodiagnos- tiek	3.7
			radiotherapie	11.1
1-2	mastectomy	irradiatie		3.7
		mastectomie		77.8
		"idem"		3.7
			mamma ampu- tatie	11.1
1-3	lumpectomy		borstamputatie	3.7
		(no	response)	3.7
			mamma- sparende oper- atie	14.8
		lumpectomie		51.2
		"idem"		3.7
			verwijdering van een knob- bel/nodus	3.7
			verwijdering van een tumor	3.7
			tumorresectie	3.7
			radicale mas- tectomie	3.7
			partiële tumor- extirpatie	3.7
3-1	myelosup- pression	(no	response)	11.1
		myelosup- pressie		37.0
			beenmergde- pressie	25.9
			beenmergsup- pressie	18.5
			immunosup- pressie	3.7
			beenmerg- remming	11.1
		(no	response)	3.7

Table 6.6 (cont.)

No.	English term	Translation Cognate	Non cognate	%
7-1	coprostasis		obstipatie	18.5
		coprostasis		48.1
		coprostase		22.2
			faeces ophoping	3.7
			faecale impac-tie	7.4
9-3	metastasising	metastasering		85.2
		"idem"		3.7
			uitzaaiing	11.1
10	cystitis	cystitis		81.5
			blaasontsteking	18.5
13	varices	varices		88.9
			spataderen	11.1
15	epistaxis		bloedneuzen	11.1
			neusbloeding-en	22.2
			neusbloeding	14.8
			bloedneus/een	3.7
			neusbloeding	
			bloedneus	7.4
		epistaxis		33.3
16-1	verrucae		wratten	55.6
			wrat	3.7
		verrucae		40.7
16-2	auto-inoculation	auto-inoculatie		33.3
			zelfbesmetting	51.9
			zelfverspreiding	3.7
		"idem"		3.7
		(no	response)	7.4
18-2	morbilli		mazelen	70.4
			waterpokken	11.1
		morbilli		11.1
		(no	response)	7.4
19	hirsutism	hirsutisme		92.6
		"idem"		3.7
			overmatige beharing	3.7

Note that a number of non-cognate translations in Table 6.6 (e.g. translations of *irradiation*) are sometimes not exactly language-specific. However, they are not cognates of the English term either. Since the aim of this investigation is to gauge the extent to which Dutch physicians employ cognate terms, it does not seem useful to distinguish between more and less language specific non-cognate items.

Table 6.7 Translations of Specialist Medical Terms (totals)

No.	English term	Translation		No response
		% Cognate	% Non cognate	
1-1	irradiation	3.7	96.3	
1-2	mastectomy	81.5	14.8	3.7
1-3	lumpectomy	55.6	33.3	11.1
3-1	myelosuppression	37.0	59.3	3.7
7-1	coprostasis	70.4	29.6	
9-3	metastasising	88.9	11.1	
10	cystitis	81.5	18.5	
13	varices	24	88.9	11.1
15	epistaxis	33.3	66.7	
16-1	verrucae	40.7	59.3	
16-2	auto-inoculation	37.0	55.6	7.4
18-2	morbilli	74.1	18.5	7.4
19	hirsutism	96.3	3.7	

Similarly to common medical terms, there seem to be great differences in the conventions regarding translations of English specialist terms as cognate/non cognate items. This is further illustrated in Fig. 6.2

Fig. 6.2 Translations of Specialist Medical Terms

Two groups can be discerned:

- I. Mostly cognate translations *mastectomy, lumpectomy, coprostasis, metastasising, cystitis, varices, morbilli* and *hirsutism*. In a number of cases (but not all) the non-cognate translations involve register mismatches: language-specific translations of specialist English terms are classed common medical terms.
- II. Mostly language-specific translations: *irradiation, myelosuppression, epistaxis, verrucae* and *auto-inoculation*.

For most of the specialized medical terms, cognate translations are preferred (mean percentage of cognate translations was 60.7; standard deviation 28.1 %). A t-test did not show up a significant difference with non-cognate translations (mean 36.7%, standard deviation 28%). Again, as for translations of common medical terms, more than one cognate translation is sometimes possible, e.g. the cognate translations *coprostase* and *coprostasis* for English *coprostasis* (7-

1). The difference seems to be that one cognate translation is simply identical to the English form, while the other preserves a language-specific *-ase* suffix.

The mean number of cognate translations for common medical terms was 55.7%. A t-test does not indicate any significant difference between the exact means for cognate specialist and common medical term translations (see above for standard deviations).

So far, the discussion has concerned data per medical term for cognate or non cognate (language-specific) translations. These data can also be looked at per subject. Per subject, the mean percentage per subject of common medical terms given a cognate translation was 52.47, versus 55.27% for specialist medical terms.

6.4 Discussion

The main conclusion to be drawn from the results in 6.3 is that, when there is a choice between a non-cognate term and an international cognate term, the chance whether Dutch medical select either possibility is about even, depending on both the medical terms involved (demonstrated in Figs. 6.1 and 6.2) and personal inclination.

It seems that there is almost no doublet of which only one possibility has wide acceptance in medical circles. Many terms turn out to have more than one language-specific form, such as *zelfbesmetting* and *zelfverspreiding* (translations of *auto-inoculation*). Similarly, cognates can have different forms, such as *tubulusnecrose* and *tubulaire necrose* (for *tubular necrosis*). In this area, standardization of medical terms clearly has some way to go.

From a linguistic point of view, it cannot be predicted which type of term gains wider acceptance in its language-specific form vs. a cognate form. As to the non-linguistic considerations guiding the choices made in 6.3, it is of course not clear whether the choice for a non-cognate item was consciously motivated by any desire to preserve it in the face of the growing number of international cognate terms.

What is clear is that a deliberate policy aimed at the preservation of language-specific specialist terms is misguided if it is motivated by a desire for wider understanding. Such language-specific terms tend to be common rather than specialist medical terms, thus being more generally familiar. However, as the data of chapter 4 indicate, understanding of medical texts is not increased

by replacing less familiar items with more generally familiar items. Moreover, a policy promoting language-specific terms will not help medical learners gain a quicker understanding of the medical terms used in mainstream mostly English-language medical communication (see chapter 5).

Conclusion

7.0 Research Questions

In this chapter, the conclusions of this study are set out. It encompassed two main research questions, one in the area of scientific language vs. common language and the other covering the effect of L1 on L2 comprehension. These questions were:

1. whether English medical terms cause more comprehension problems than "simplified" common-English rewrites of these terms;
2. whether similarity (cognate status) of Dutch and English medical terms aids the comprehension of the latter by Dutch readers.

Answers to these questions were given in two dimensions:

- a. a theoretical psycholinguistic dimension;
- b. a practical, applicational dimension.

In the psycholinguistic dimension this study resulted in the formulation and experimental testing of a reading comprehension hypothesis (research question 1) and a language transfer hypothesis (research question 2).

In the application dimension, the results of this study have implications for English-language medical communication in The Netherlands as well as for medical education at Dutch universities and other centers of (para-)medical education. The conclusions applying to both of these dimensions are elaborated in 7.1 and 7.2 below.

7.1 Psycholinguistic Implications

In the psycholinguistic perspective of this study, the two research questions of 7.0 were dealt with through the formulation of hypotheses and their subsequent experimental testing. However, a necessary preliminary step was the definition of the English medical terms as well as the common-language items this study worked with (research question 1) and the differences/similarities between Dutch and English medical terms (research question 2). The opposition between medical terms and common-language lexical items is to a degree an opposition in language varieties. Hence, medical terms and common-language items were defined in terms of the language varieties in which they occur. The resulting definitions are given in 7.1.1. Section 7.1.1 also includes the conclusions about the relation between medical English and medical Dutch (background for research question 2).

7.1.1 Linguistic Background

A. The Definition of Medical Language

Medical language was defined as a type of register. In the medical register three dimensions of variation are distinguished:

1. medical specialism
2. manner of transmission of the medical message
3. relations between participants in the medical exchange

There are features of medical language (and scientific language in general) which distinguish it from other registers. These additional dimensions are **communicative purpose** and **national language**.

4. communicative purpose

Medical language requires **terminologies** with nonambiguous and preferably nonsynonymous language items to express relevant concepts, especially in the expert-to-expert tenor.

5. national language

Medical language deals with the same concepts internationally; hence it can also be differentiated according to the specific national languages which convey these concepts, such as medical Dutch, medical English, medical French, etc.

What new ideas does this definition of medical language contribute? For one thing, this definition accounts for the linguistic diversity (even within one language, and certainly across language boundaries) versus the conceptual similarity of medical texts. With respect to this study, the definition of medical language developed here forms the necessary frame of reference for the definition of the medical terms of which the effect on L2 reading comprehension is assessed in this study. The main implication of this definition of medical language for the definition of terms and other lexical items occurring in medical texts is that these are defined in terms of the situations in which they are used (cf. the five above dimensions of medical language) rather than in terms of their form or solely in terms of what they denote.

B. The Intralinguistic Definition of the Medical Lexicon

It was concluded in chapter 2 that medical language differs most from other language variants in the lexical items it can deploy, especially medical terms (discourse analysis and morphology were two other linguistic levels of analysis along which medical language was thought to differ from other language variants).

Content words in medical texts were defined according to two parameters: a lexical parameter (terms and non-terms) and a register parameter (unique to medical register or also occurring in other registers). This resulted in a definition of medical lexical items given in Table 7.1 (Table 2.1 repeated for the sake of convenience).

Table 7.1 Content Lexical Items in Medical Texts

Register	Lexical item type	
	Terms	Non-terms
medical only	specialist medical terms	-
medical/common language	common medical terms	submedical items
medical/other science or common-language registers	other specialist or common terms	submedical items

The implications of this definition of content lexical items in medical texts are that

1. two types of medical terms are distinguished: specialist and common medical terms. It is the effect on L2 reading comprehension of the specialist medical terms with which this study is concerned.
2. non-term content lexical items are not further differentiated; these are all termed submedical items.

The difference, then, between submedical items and common-language lexical items is not a difference in terms of sense, but in terms of type of reference (medical vs. non-medical) and type of text (medical vs. non-medical) in which they occur. Note that any attempt to further differentiate submedical items would involve the addition of a new parameter to the lexical and register parameters introduced above.

C. Cross-linguistic Differences and Similarities between Dutch- and English-Language Medical Terms

In chapter 5, the second-language dimension was introduced with an outline of the differences and similarities between Dutch and English medical terms. This outline was based on the types of cross-linguistic contrasts discussed in Ulijn (1978:50ff.). It was concluded that Dutch and English share the same medical concepts and also share many (mainly Latinate) forms for medical terms.

There were also differences between Dutch and English medical terms. Apart from differences in terms of language-specific derivation and inflection, contrasting lexical forms and misleading cognates, differences were also found in terms of **register mismatches** of cognate terms.

Register mismatches can occur when one language can deploy a doublet to cover a medical concept, while the other language only has one lexical item to cover the same concept, usually a cognate of the Latinate half of the doublet. For example, Dutch can deploy the doublet *blindedarmonsteking/appendicitis* where English only has *appendicitis*. There is a register mismatch between the Dutch and English forms inasmuch as the English word *appendicitis* is taken to be a common medical term, while the Dutch word *appendicitis* is used as a specialist medical term.

It is clear that the notion of register mismatch can only follow from the distinction made in chapter 2 between common and specialist medical terms. The importance of the concept of register mismatch is that it covers interlinguistic differences in general familiarity with cognate lexical items.

7.1.2 The Effect on Reading Comprehension of Specialist Medical Terms vs. Common-Language Items

The psycholinguistic discussion of the two research questions of this study involved the definition of the relevant linguistic material (discussed above in 7.1.1), the formulation of psycholinguistic hypotheses and their experimental testing. For the first research question, whether English medical terms cause more comprehension problems than "simplified" common-English rewrites of these terms, a hypothesis was set up in chapter 3.

This hypothesis, which at first sight bears little relation to the research question, is that, in reading comprehension, lexical analysis is invariably supported by two knowledge sources, the mental lexicon and the conceptual system (background knowledge). The relation of this hypothesis to the effect on reading comprehension of specialist medical terms vs. common-language items is as follows. Concerning the mental lexicon, medical experts are assumed to know specialist medical terms as well as common-language items. Concerning the conceptual system, medical experts are assumed to know the concepts denoted by specialist medical terms. On the other hand, medical nonexperts, are only assumed to know common-language lexical items, and tend not to be familiar with

specialist medical terms, nor are they assumed to be familiar with the concepts these terms denote.

Considering the question of comprehensibility of specialist medical terms vs. common-language paraphrases, it is clear that the lay reader of the paraphrases may know the words, but not the specialist concepts the words convey. If the lexical analysis hypothesis stated above is correct, then the comprehension of such a reader is poorer than that of a reader who knows both the words and concepts they convey. Such a reader would be a medical expert knowing either the words of the paraphrases or the terms as well as the concepts they convey.

This hypothesis was tested in chapter 4, where data were reported which supported it. The support for this hypothesis provides evidence for lexical analysis supported by the mental lexicon as well as by the conceptual system. This result is not to be construed as effect of conceptual analysis (context) along with lexical analysis.

What are the further implications of this result? These are mainly to be found in relation to recent research (e.g. Strother and Ulijn 1987) on the effect of syntactic analysis on reading comprehension (see chapter 3 for details). The conclusion of this research was, that syntactic analysis is not necessarily thorough in reading comprehension. This lack of thoroughness was observed in data where there was no distinction in comprehension of written texts involving typically scientific-language syntax vs. typically common-language syntax. Note that this result is also observable on the lexical level in chapter 4, where no difference in comprehension is obtained on differences in lexical form alone (e.g. terms vs. rewrites for medical experts). In conjunction with the research on syntactic analysis, then, the perhaps most significant psycholinguistic implication of this study is that form familiarity (syntactic or lexical) alone plays a very limited part in reading comprehension.

Another question dealt with in chapter 4 was whether the result of that chapter just included specialist medical terms and their common-language equivalents, i.e. lexical items denoting a specialized medical concept, or whether it also included specialist medical terms and submedical items which are not semantic equivalents of these terms and which hence do not denote specialized medical concepts. The data indicated that the latter possibility should be ruled out: the submedical items in question appeared to present fewer problems than medical terms for English-speaking Dutch medical nonexperts. Since submedi-

cal items tend to convey more generally familiar concepts than medical terms, this result did not contradict the main findings of chapter 4.

7.1.3 L1-L2 Transfer of Medical Terms

The second research question of this study was whether similarity of Dutch and English medical terms aids the comprehension of the latter by Dutch readers. A hypothesis on the transferability to English of Dutch medical terms was formulated in chapter 5; data reported in the same chapter provided support for the hypothesis.

In the course of the formulation of this hypothesis, the new concept of pseudo-transfer was introduced. Pseudo-transfer is like L2-L1 lexical borrowing. In the context of the topic of this study, L2-L1 lexical borrowing would occur when a hitherto unfamiliar medical term is first encountered in an L2 text and then subsequently adopted for use in an L1 context, with the necessary morphosyntactic adaptations of form. Such borrowing might occur under the mistaken assumption that the relevant L2 lexical item already has a psychological cognate in L1, with which the reader is however not familiar. In that case, we have an instance of pseudo-transfer.

The L1-L2 lexical transfer hypothesis for reading developed in chapter 5 stated that L1-L2 lexical transfer takes place if

- A. the L1 and L2 items are psychological cognates and
- B. the L1 lexical item is recoverable from the mental lexicon

For transfer of specialist medical terms, this hypothesis predicts that Dutch specialist medical terms with English cognate counterparts are susceptible to Dutch-English transfer for medically knowledgeable readers. Data discussed in chapter 5 bore out this hypothesis. The main conclusion was that the Dutch-English cognate status of written English medical terms aids their comprehension by Dutch readers who are medically knowledgeable.

It is clear that this result will be all the more relevant if the specialist medical terms employed by these Dutch medically knowledgeable readers happen to be Dutch-English cognates. However, according to data reported in chapter 6, where these Dutch medical experts have a choice between a cognate medical term and a non-cognate medical term, there is no clear preference for the cognate items.

7.2 Applicational Implications of this Research

As reported above, this study aimed at providing results in the practical, applicational dimension as well as in the theoretical psycholinguistic dimension.

In 1.2.3 a major problem at Dutch medical faculties was discussed, that students generally prefer Dutch texts to the required English texts. This was worrisome because many of the required English textbooks lack Dutch translations or other Dutch equivalents. How can answers to our two research question helps solve this particular problem or other similar problems?

The first research question was whether English medical terms (which tend to be restricted to medical texts) cause more comprehension problems than "simplified" common-English rewrites of these terms (employing generally familiar vocabulary). Recall that it was put forward in 1.2.4 that if this proves to be the case, a solution to at least part of the reading problem would be to review the effectiveness of teaching English medical terms, which would be clearly lacking in its present form.

However, the data of Experiment 1 showed no significant difference in the comprehensibility of English specialist medical terms for 4th year Dutch medical/Health Sciences students (mean score 68.4%) vs. both groups of lay subjects (mean scores 50% and 55.1%). On the other hand, the score for 4th year Health Sciences/medical students is lower than expected (although students were in the beginning of their 4th year at the time of the experiment; all subjects were interviewed in September-November 1987).

What practical implications do these results have? It was concluded in 4.6.1 that the comprehensibility of specialist medical terms is linked to medical background knowledge as well as to vocabulary knowledge. In practice, this means that the level of comprehension of English medical terms by Dutch students can be raised by working on knowledge in both dimensions. For the teaching of medical English, the implication is that it should be closely integrated with medical teaching as a whole.

On the other hand, the result of Experiment 1 as reported in chapter 5 may indicate that any difficulty medically knowledgeable Dutch readers have with English-language medical texts is probably not due to the medical terms in those texts, since most English medical terms formally resemble Dutch medical terms, and such resemblance, according to the experimental results in chapter 5, is

conducive to the comprehension of the English terms. Obviously, such resemblance of cognates is only helpful if it is in fact cognate terms which Dutch medical experts use. The findings of chapter 6, where no preference was found for the use of cognate vs. non-cognate terms (where both possibilities existed), indicate that use of cognate terms is, at least, certainly not automatic.

In Experiment 2 (chapter 4) data were reported which indicated that the overriding importance of medical background knowledge in the comprehension of English specialist medical terms may not extend in the same degree to submedical items (common-language lexical items in medical texts). In that case knowledge of English seemed more important. In the area of common-language lexical items which are not medical terms, any help in reading comprehension would thus seem to lie more in the sphere of medical English teaching than medical teaching proper. In fact, according to sources like Stephens (1986) it is difficulties with comprehending L2 submedical items which may cause many reading difficulties.

Appendix A: Text of Experiment 1

(target medical terms are given in boldface)

Imaging the Transplanted Kidney

A transplanted kidney is usually placed in the right or left iliac fossa where it lies in an extraperitoneal position, perfused from the iliac vessels and draining into the bladder. Although it can be felt fairly easily this is of limited value since enlargement and tenderness of the graft are unreliable indicators of rejection, especially in patients receiving **cyclosporin immunosuppression**. There remains a need for a test that would more accurately confirm the occurrence of rejection, and to this end many imaging procedures have been devised.

The least invasive procedure is real-time B-mode ultrasound imaging by means of a sector scanner, which is readily achieved at the patient's bedside with one of the small portable machines that are now available. Such scans will identify perirenal collections of fluid or blood clot and will also show dilatation of the collecting system. If the dilatation is thought to be due to obstruction then ultrasound-guided puncture of the kidney can be done and an **antegrade pyelogram** obtained.

Ultrasound may also detect rejection episodes, the diagnosis being based on changes in renal size and echogenicity. In a well-functioning transplant renal volume does not change appreciably, so a sudden increase of 30% or more strongly suggests rejection. Renal volume may be calculated from a series of transverse sections, but this is time consuming and it is more convenient to use the formula: length x height x width x 0.023. Various changes in echogenicity have been attributed to the rejection process. Accepted features are an increase in size and a decrease in echogenicity of the renal **pyramids**. Although an increase in sinus echoes has been described with rejection, it is generally accepted that sinus echoes are decreased. Other changes are an increase in cortical thickness, loss of definition of the corticomedullary junction, and focal loss of echogenicity. Unfortunately many of these features may be absent, and in cases of mild rejection ultrasound examination may be entirely normal. Acute tubular necrosis does not appear to affect the echogenicity of the renal substance,

and even in patients with frank cortical necrosis there may be no distinguishing features.

Ultrasound imaging of the kidney can be combined with pulsed doppler techniques to measure blood-flow in the renal artery (duplex scanning); the pattern of renal blood-flow may be further analysed by sound-spectrum analysis. Although flow patterns can change in the presence of renal artery stenosis and rejection, it is unclear whether such measurements are useful in the management of kidney transplant recipients.

Radionuclide imaging of kidney transplants can provide considerably more information than ultrasound, since the appearance and disappearance of the image after an intravenous injection of isotope gives an indication of kidney function. The isotopes most commonly used are I 'Hippuran' and Tc diethylene-triaminepenta-acetic acid (DPTA). By means of a gamma camera the transplanted kidney is demonstrated by both isotopes, even when there is no function as a result of acute tubular necrosis. However, renal uptake of isotope is delayed under these circumstances and there may be no excretion into the bladder. Unfortunately the same changes are seen with rejection, and so the two conditions are not easily distinguishable. A progressive deterioration in uptake and excretion would favour rejection but such assessment would require frequent examinations. Tc-methylene diphosphonate behaves slightly differently in that uptake is greater in kidneys that have sustained ischaemic damage.

Various blood components accumulate in kidneys undergoing rejection, and attempts have been made to demonstrate this after injection of the appropriately radiolabelled component. In-oxine autologous platelets have been used successfully. Whilst trapping of platelets in a transplanted kidney occurs during acute rejection it is less evident or absent in chronic rejection. Unfortunately infections and **haematomas** can give false-positive results, and the same is true when indium-labelled white cells are injected. Both techniques are rather complicated and have not been adopted for routine clinical use.

Intravenous **urography** is seldom carried out after renal transplantation since picture definition is easily lost when renal function becomes impaired. Computerised tomographic (CT) scanning of the kidney has also been unrewarding; kidneys have frequently appeared normal during rejection. Further information may be obtained if dynamic CT scans are done after a bolus injection of contrast material. Such a procedure resembles dynamic isotope scanning and is probably subject to the same errors of interpretation in the presence

of acute tubular necrosis. Magnetic resonance scanning has also been used; there appears to be a loss of definition of the corticomedullary junction in the presence of rejection but not when there is acute tubular necrosis.

Rejection may cause areas of narrowing in the smaller renal arteries which can be visualised by arteriography. In general these are late changes and therefore arteriography is of no value as a test for acute rejection. However it will confirm the presence of a stenosis in the main renal artery which can sometimes be treated by concurrent **percutaneous angioplasty**. The renal **vasculature** may also be demonstrated by digital vascular imaging; to obtain good results a bolus of contrast material must be delivered into a large vein or the **inferior vena cava**. Although the intrarenal branches are not well delineated, the test is useful for seeking stenoses in the main renal artery in transplant recipients with troublesome **hypertension**. Appearance of contrast in the renal **parenchyma** can be studied in much the same way as for dynamic isotope scanning, but again there are difficulties in distinguishing acute tubular necrosis from rejection.

Overall, imaging techniques have been disappointing, providing information little better than that obtained by careful observation of the patient. When it becomes necessary to confirm rejection, many transplant centres opt for a **needle biopsy** of the transplanted kidney, or carry out **fine-needle aspiration cytology**, or measurements of intrarenal pressure, again using a fine needle. These invasive manoeuvres will be needed until an imaging technique can be devised that identifies rejection more reliably.

Appendix B

Tests A and B (Experiment 1)

Leesbaarheidstest (A)

NAAM _____

STUDIERICHTING _____

GEBOORTEDATUM: _____

STUDIEFASE _____

MOEDERTAAL: _____

VOOROPLEIDING: _____

EERSTE JAAR VAN INSCHRIJVING: _____

Instructies

Lees de tekst zorgvuldig en beantwoord daarna de Juist/Onjuist vragen. Als u klaar bent met het lezen van de tekst, noteer dan de tijd op aangegeven plaats onderaan de tekst. Beantwoord de Juist/Onjuist vragen met behulp van de tekst. Als u klaar bent met het beantwoorden van de vragen, noteer dan de tijd op de aangegeven plaats na de vragen.

IMAGING THE TRANSPLANTED KIDNEY

A transplanted kidney is usually placed in the right or left iliac fossa where it lies in an extraperitoneal position, perfused from the iliac vessels and draining into the bladder. Although it can be felt fairly easily this is of limited value since enlargement and tenderness of the graft are unreliable indicators of rejection, especially in patients receiving treatment with cyclosporin to prevent or diminish rejection. There remains a need for a test that would more accurately confirm the occurrence of rejection, and to this end many imaging procedures have been devised.

The least invasive procedure is real-time B-mode ultrasound imaging by means of a sector scanner, which is readily achieved at the patient's bedside with one of the small portable machines that are now available. Such scans will identify perirenal collections of fluid or blood clot and will also show dilatation of the collecting system. If the dilatation is thought to be due to obstruction then ultrasound-guided puncture of the kidney can be done and an antegrade pyelogram obtained. Ultrasound may also detect rejection episodes, the diagnosis being based on changes in renal size and echogenicity. In a well-functioning transplant renal volume does not change appreciably, so a sudden increase of 30% or more strongly suggests rejection. Renal volume may be calculated from a series of transverse sections, but this is time consuming and it is more convenient to use the formula: length x height x width x 0.023. Various changes in echogenicity have been attributed to the rejection process. Accepted features are an increase in size and a decrease in echogenicity of the renal conical masses. Although an increase in sinus echoes has been described with rejection, it is generally accepted that sinus echoes are decreased. Other changes are an increase in cortical thickness, loss of definition of the corticomedullary junction, and focal loss of echogenicity. Unfortunately many of these features may be absent, and in cases of mild rejection ultrasound examination may be entirely normal. Acute tubular necrosis does not appear to affect the echogenicity of the renal substance, and even in patients with frank cortical necrosis there may be no distinguishing features.

Ultrasound imaging of the kidney can be combined with pulsed doppler

techniques to measure blood-flow in the renal artery (duplex scanning); the pattern of renal blood-flow may be further analysed by sound-spectrum analysis. Although flow patterns can change in the presence of renal artery stenosis and rejection, it is unclear whether such measurements are useful in the management of kidney transplant recipients. Radionuclide imaging of kidney transplants can provide considerably more information than ultrasound, since the appearance and disappearance of the image after an intravenous injection of isotope gives an indication of kidney function. The isotopes most commonly used are I 'Hippuran' and Tc diethylenetriaminepenta-acetic acid (DTPA). By means of a gamma camera the transplanted kidney is demonstrated by both isotopes, even when there is no function as a result of acute tubular necrosis. However, renal uptake of isotope is delayed under these circumstances and there may be no excretion into the bladder. Unfortunately the same changes are seen with rejection, and so the two conditions are not easily distinguishable. A progressive deterioration in uptake and excretion would favour rejection but such assessment would require frequent examinations. Tc-methylene diphosphonate behaves slightly differently in that uptake is greater in kidneys that have sustained ischaemic damage.

Various blood components accumulate in kidneys undergoing rejection, and attempts have been made to demonstrate this after injection of the appropriately radiolabelled component. In-oxine autologous platelets have been used successfully. Whilst trapping of platelets in a transplanted kidney occurs during acute rejection it is less evident or absent in chronic rejection. Unfortunately infections and haematomas can give false-positive results, and the same is true when indium-labelled white cells are injected. Both techniques are rather complicated and have not been adopted for routine clinical use.

Intravenous imaging of the urinary tract is seldom carried out after renal transplantation since picture definition is easily lost when renal function becomes impaired. Computerised tomographic (CT) scanning of the kidney has also been unrewarding; kidneys have frequently appeared normal during rejection. Further information may be obtained if dynamic CT scans are done after a bolus injection of contrast material. Such a procedure resembles dynamic isotope scanning and is probably subject to the same errors of interpretation in the presence of acute tubular

necrosis. Magnetic resonance scanning has also been used; there appears to be a loss of definition of the corticomedullary junction in the presence of rejection but not when there is acute tubular necrosis. Rejection may cause areas of narrowing in the smaller renal arteries which can be visualised by arteriography. In general these are late changes and therefore arteriography is of no value as a test for acute rejection. However it will confirm the presence of a stenosis in the main renal artery which can sometimes be treated by concurrent percutaneous angioplasty. The renal blood-vessel system may also be demonstrated by digital vascular imaging; to obtain good results a bolus of contrast material must be delivered into a large vein or the inferior vena cava. Although the intrarenal branches are not well delineated, the test is useful for seeking stenoses in the main renal artery in transplant recipients with troublesome continual elevated blood pressure. Appearance of contrast in the renal parenchyma can be studied in much the same way as for dynamic isotope scanning, but again there are difficulties in distinguishing acute tubular necrosis from rejection. Overall, imaging techniques have been disappointing, providing information little better than that obtained by careful observation of the patient. When it becomes necessary to confirm rejection, many transplant centres opt for a removal by needle of a tissue sample of the transplanted kidney, or carry out fine-needle aspiration cytology, or measurements of intrarenal pressure, again using a fine needle. These invasive manoeuvres will be needed until an imaging technique can be devised that identifies rejection more reliably.

A.u.b. hier de tijd noteren wanneer u klaar bent met het lezen van de tekst:

Instructies:

Gebruik de tekst die u nu heeft gelezen om de volgende vragen te beantwoorden. Geef aan welke van de volgende zinnen volgens de tekst juist zijn en welke volgens de tekst onjuist zijn. Als u om welke reden dan ook niet kan beslissen, sla de vraag dan over en ga verder met de volgende vraag.

VRAGEN

Juist Onjuist

0	0	1. (Lines 3-6)
Enlargement and tenderness of the graft do not reliably indicate rejection, especially for patients receiving treatment for the suppression of rejection with cyclosporin.
0	0	2. (Lines 14-16)
Guided by ultrasound, the kidney can then be punctured and a kidney X-ray obtained with contrast material.
0	0	3. (Lines 24-25)
Decreasing echogenicity of the tissue masses that make up the inner part of the kidney can be attributed to the rejection process.
0	0	4. (Lines 61-63)
Unfortunately infections and breaks in the walls of capillary arteries can result in false-positive indications of acute rejection.
0	0	5. (Lines 65-67)
The urinary tract is seldom visualised after renal transplantation.
0	0	6. (Lines 79-81)
A stenosis in the main renal artery can sometimes be treated by injections of isotope.

0	0	7. (Lines 81-84)
Digital vascular imaging may serve to visualise renal shape.
0	0	8. (Lines 81-84)
Good results can be obtained by delivery of a bolus of contrast material into a large vein or the venous trunk of the lower kidney.
0	0	9. (Lines 84-86)
Transplant patients with stenoses in the main renal artery may have persistently high blood pressure in the arteries.
0	0	10. (Lines 86-89)
It is possible to study contrast in the outer layer of the kidney in much the same way as for dynamic isotope scanning.
0	0	11. (Lines 92-95)
Sampling of kidney tissue by needle is opted for by many transplant centres when it becomes necessary to confirm rejection.
0	0	12. (Lines 92-95)
When it becomes necessary to confirm rejection of a transplanted kidney, a number of transplant centres carry out examinations of the kidney pelvis.

A.u.b. hier de tijd noteren wanneer u de test heeft voltooid

Leesbaarheidstest (B)

NAAM _____

STUDIERICHTING _____

GEBOORTEDATUM: _____

STUDIEFASE _____

MOEDERTAAL: _____

VOOROPLEIDING: _____

EERSTE JAAR VAN INSCHRIJVING: _____

Instructies

Lees de tekst zorgvuldig en beantwoord daarna de Juist/Onjuist vragen. Als u klaar bent met het lezen van de tekst, noteer dan de tijd op aangegeven plaats onderaan de tekst. Beantwoord de Juist/Onjuist vragen met behulp van de tekst. Als u klaar bent met het beantwoorden van de vragen, noteer dan de tijd op de aangegeven plaats na de vragen.

IMAGING THE TRANSPLANTED KIDNEY

A transplanted kidney is usually placed in the right or left iliac fossa where it lies in an extraperitoneal position, perfused from the iliac vessels and draining into the bladder. Although it can be felt fairly easily this is of limited value since enlargement and tenderness of the graft are unreliable indicators of rejection, especially in patients receiving cyclosporin immunosuppression. There remains a need for a test that would more accurately confirm the occurrence of rejection, and to this end many imaging procedures have been devised.

The least invasive procedure is real-time B-mode ultrasound imaging means of a sector scanner, which is readily achieved at the patient's bedside with one of the small portable machines that are now available. Such scans will identify perirenal collections of fluid or blood clot and will also show dilatation of the collecting system. If the dilatation is thought to be due to obstruction then ultrasound-guided puncture of the kidney can be done and an X-ray obtained of contrast material discharged into urine passageways.

Ultrasound may also detect rejection episodes, the diagnosis being based on changes in renal size and echogenicity. In a well-functioning transplant renal volume does not change appreciably, so a sudden increase of 30% or more strongly suggests rejection. Renal volume may be calculated from a series of transverse sections, but this is time consuming and it is more convenient to use the formula: length x height x width x 0.023. Various changes in echogenicity have been attributed to the rejection process. Accepted features are an increase in size and a decrease in echogenicity of the renal pyramids. Although an increase in sinus echoes has been described with rejection, it is generally accepted that sinus echoes are decreased. Other changes are an increase in cortical thickness, loss of definition of the corticomedullary junction, and focal loss of echogenicity. Unfortunately many of these features may be absent, and in cases of mild rejection ultrasound examination may be entirely normal. Acute tubular necrosis does not appear to affect the echogenicity of the renal substance, and even in patients with frank cortical necrosis there may be no distinguishing features.

Ultrasound imaging of the kidney can be combined with pulsed doppler techniques to measure blood-flow in the renal artery (duplex scanning);

the pattern of renal blood-flow may be further analysed by sound-spectrum analysis. Although flow patterns can change in the presence of renal artery stenosis and rejection, it is unclear whether such measurements are useful in the management of kidney transplant recipients.

Radionuclide imaging of kidney transplants can provide considerably more information than ultrasound, since the appearance and disappearance of the image after an intravenous injection of isotope gives an indication of kidney function. The isotopes most commonly used are I 'Hippuran' and Tc diethylenetriaminepenta-acetic acid (DPTA). By means of a gamma camera the transplanted kidney is demonstrated by both isotopes, even when there is no function as a result of acute tubular necrosis. However, renal uptake of isotope is delayed under these circumstances and there may be no excretion into the bladder. Unfortunately the same changes are seen with rejection, and so the two conditions are not easily distinguishable. A progressive deterioration in uptake and excretion would favour rejection but such assessment would require frequent examinations. Tc-methylene diphosphonate behaves slightly differently in that uptake is greater in kidneys that have sustained ischaemic damage.

Various blood components accumulate in kidneys undergoing rejection, and attempts have been made to demonstrate this after injection of the appropriately radiolabelled component. In-oxine autologous platelets have been used successfully. Whilst trapping of platelets in a transplanted kidney occurs during acute rejection it is less evident or absent in chronic rejection. Unfortunately infections and internal outpourings of blood can give false-positive results, and the same is true when indium-labelled white cells are injected. Both techniques are rather complicated and have not been adopted for routine clinical use. Intravenous urography is seldom carried out after renal transplantation since picture definition is easily lost when renal function becomes impaired. Computerised tomographic (CT) scanning of the kidney has also been unrewarding; kidneys have frequently appeared normal during rejection. Further information may be obtained if dynamic CT 70scans are done after a bolus injection of contrast material. Such a procedure resembles dynamic isotope scanning and is probably subject to the same errors of interpretation in the presence of acute tubular

necrosis. Magnetic resonance scanning has also been used; there appears to be a loss of definition of the corticomedullary junction in the presence of rejection but not when there is acute tubular necrosis. Rejection may cause areas of narrowing in the smaller renal arteries which can be visualised by arteriography. In general these are late changes and therefore arteriography is of no value as a test for acute rejection. However it will confirm the presence of a stenosis in the main renal artery which can sometimes be treated by concurrent blood-vessel repair by means of a balloon catheter. The renal vasculature may also be demonstrated by digital vascular imaging; to obtain good results a bolus of contrast material must be delivered into a large vein or the lower venous trunk. Although the intrarenal branches are not well delineated, the test is useful for seeking stenoses in the main renal artery in transplant recipients with troublesome hypertension. Appearance of contrast in the renal functional tissue can be studied in much the same way as for dynamic isotope scanning, but again there are difficulties in distinguishing acute tubular necrosis from rejection.

Overall, imaging techniques have been disappointing, providing information little better than that obtained by careful observation of the patient. When it becomes necessary to confirm rejection, many transplant centres opt for a needle biopsy of the transplanted kidney, or carry out studies of cells obtained through a fine needle, or measurements of intrarenal pressure, again using a fine needle. These invasive manoeuvres will be needed until an imaging technique can be devised that identifies rejection more reliably.

A.u.b. hier de tijd noteren wanneer u klaar bent met het lezen van de tekst:

Instructies:

Gebruik de tekst die u nu heeft gelezen om de volgende vragen te beantwoorden. Geef aan welke van de volgende zinnen volgens de tekst juist zijn en welke volgens de tekst onjuist zijn. Als u om welke reden dan ook niet kan beslissen, sla de vraag dan over en ga verder met de volgende vraag.

VRAGEN

Juist Onjuist

0	0	1. (Lines 3-6)
Enlargement and tenderness of the graft do not reliably indicate rejection, especially for patients receiving treatment for the suppression of rejection with cyclosporin.
0	0	2. (Lines 14-16)
Guided by ultrasound, the kidney can then be punctured and a kidney X-ray obtained with contrast material.
0	0	3. (Lines 24-25)
Decreasing echogenicity of the tissue masses that make up the inner part of the kidney can be attributed to the rejection process.
0	0	4. (Lines 61-63)
Unfortunately infections and breaks in the walls of capillary arteries can result in false-positive indications of acute rejection.
0	0	5. (Lines 65-67)
The urinary tract is seldom visualised after renal transplantation.
0	0	6. (Lines 79-81)
A stenosis in the main renal artery can sometimes be treated by injections of isotope.

0	0	7. (Lines 81-84)
Digital vascular imaging may serve to visualise renal shape.
0	0	8. (Lines 81-84)
Good results can be obtained by delivery of a bolus of contrast material into a large vein or the venous trunk of the lower kidney.
0	0	9. (Lines 84-86)
Transplant patients with stenoses in the main renal artery may have persistently high blood pressure in the arteries.
0	0	10. (Lines 86-89)
It is possible to study contrast in the outer layer of the kidney in much the same way as for dynamic isotope scanning.
0	0	11. (Lines 92-95)
Sampling of kidney tissue by needle is opted for by many transplant centres when it becomes necessary to confirm rejection.
0	0	12. (Lines 92-95)
When it becomes necessary to confirm rejection of a transplanted kidney, a number of transplant centres carry out examinations of the kidney pelvis.

A.u.b. hier de tijd noteren wanneer u de test heeft voltooid

Test Experiment 3

MEDISCH ENGELS VERTAAL EXPERIMENT

GEBOORTEJAAR: _____

MEDISCH SPECIALISME: _____

JAAR VAN AANVANG: _____

PLAATS VAN SPECIALISATIE: _____

Instructies

Hieronder volgt een aantal Nederlandse voorbeeldzinnen met daarin tussen haakjes 31 Engels (-Latijnse) medische termen.

Lees de zinnen zorgvuldig en vul vervolgens op de stippellijntjes die termen in, die u normaal beroepsmatig gebruikt.

Let wel! Het gaat hierbij om het professionele taalgebruik van medici onderling en dus *niet* om de dialoog met de patiënt.

Bovendien gaat het om de persoonlijke keuze van de proefpersoon en niet om wat als 'juist' wordt verondersteld.

Termen die als onbekend worden beschouwd moeten worden opengelaten i.v.m. een accurate verwerking van de gegevens.

1. _____ (irradiation) wordt dikwijls toegepast bij segmentaire _____ (mastectomy) of _____ (lumpectomy).
2. Het ontdekken van een knobbeltje in de borst, visueel, door _____ (palpation) of door _____ (mammography).
3. _____ (myelosuppression) kan leiden tot _____ (hemorrhage) en infecties.
4. In het geval van _____ (tubular necrosis) is de opname van isotoop door de nier vertraagd en is ook de _____ (excretion) vaak gestoord.
5. Om _____ (rejection) van een getransplanteerde nier vast te stellen is het nemen van een biopsie de meest betrouwbare methode.
6. _____ (echography) is sinds kort een betrouwbare methode om _____ (appendicitis) aan te tonen.
7. Bij oudere mensen is het moeilijk _____ (coprostatitis) te differentiëren van ernstiger afwijkingen zoals bijvoorbeeld _____ (subileus).
8. Wanneer een _____ (pneumonia) door aspiratie tot stand komt, b.v. na tandextractie of _____ (tonsillectomy), kunnen ook mondbacteriën worden gevonden.
9. Een _____ (benign) gezwel is vaak omgeven door een kapsel. De omgevende weefsels worden wel verdrongen, maar niet geïnfilteerd. _____ (malignant) groei daarentegen wordt gekenmerkt door infiltratie en _____ (metastasizing).
10. Acute _____ (cystitis) wordt veroorzaakt door bacteriën die door het zelfreinigingsmechanisme van de blaas niet konden worden verwijderd.
11. De onderzoeken hielden verband met de _____ (renal function), de leverfunctie, cholesterol en bloedformule.
12. Wanneer _____ (hemorrhoids) optreden tijdens de zwangerschap, verdwijnen deze meestal na de bevalling.

13. _____ (varices) komen vooral voor bij vrouwen (twee tot drie vrouwen op één man).
14. De gewone _____ (pelvis fractures) worden verdeeld in stabiele, die veruit het meest voorkomen, en de instabiele.
15. De meest voorkomende oorzaak van _____ (epistaxis) bij kinderen is peutenen in de neus; andere oorzaken zijn vallen en slaan.
16. Hoewel niet definitief is aangetoond dat all soorten _____ (verrucae) infectieus zijn of door virussen worden veroorzaakt, is de evidentie van _____ (auto-inoculation) en de overdracht van de ene op de andere persoon bij de verschillende soorten zeer overtuigend.
17. Onder _____ (endoscopy) verstaat men de rechtstreekse inspectie van lichaamsholte.
18. Het percentage kinderen en volwassenen dat immuun is voor _____ (rubella) stijgt met de leeftijd veel minder snel dan bij _____ (morbilli).
19. Bij 95% van de vrouwen die met _____ (hirsutism) op het spreekuur komen, wordt na uitgebreid endocrinologisch en gynaecologisch onderzoek geen oorzaak gevonden.

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Summary

Chapter 1: Introduction

The two research questions of this study are:

1. whether English medical terms cause more comprehension problems than "simplified" common-English rewrites of these terms;
2. whether similarity (cognate status) of Dutch and English medical terms aids the comprehension of the latter by Dutch readers;

This study aims at supplying answers to these questions which are relevant in two main dimensions: a practical, applicational dimension and the theoretical psycholinguistic dimension.

1. The psycholinguistic perspective

The greater part of this study consists of psycholinguistic research. In psycholinguistic terms, the possible implications of results with respect to the two questions posed above are as follows.

1. Let us for the moment assume an affirmative answer to the first question, whether English medical terms cause more comprehension problems than "simplified" common-English rewrites of these terms. If this question is answered affirmatively, then success in comprehending a text is apparently determined by lexical-level analysis or word recognition strategies. Such lexical analysis would receive input from bare lexical knowledge (i.e. lexical knowledge without conceptual background knowledge). Alternately, if the question whether medical terms cause more comprehension problems than common-language equivalents is not answered affirmatively, then other knowledge sources besides bare lexical knowledge may be involved.

2.. The question on the effect on reading comprehension of medical terms vs. their rewrites does not offer any special second-language perspective. The most obvious second-language perspective in the comprehensibility of medical terms is inherent to the second question of this research, i.e. whether similarity of Dutch and English medical terms aids the comprehension of the latter by Dutch

readers. Note that any affirmative answer to this question would have to take into account all those cases documented in recent research where similarity between first and second languages does not lead to better comprehension.

Also note that if international similarity of medical terms enhances their comprehension across language boundaries, then it would be helpful if first-language medical terms have internationally cognate forms.

2. The application dimension

The application dimension where the results of this study might prove useful can be characterized as follows.

English-language Dutch medical communication is concentrated at various centers of medical research, the biggest of which are the universities. There are eight medical faculties which provide university-level medical education. They have in common that most of their students are training to be physicians. The area in which the eight Dutch medical faculties differ most is in the fields of medical study they offer which do not lead to physician's qualifications. These are study programs such as Health Sciences, (Leiden, Nijmegen) General Health Care (Rotterdam) or Medical Biology (Amsterdam, Utrecht).

According to fairly recent research, English is the most frequently used foreign language at Dutch medical faculties.

Reading medical textbooks is quantitatively the single most important English-language skill required by Dutch medical students.

As for medical communication outside medical education, English is less often used at Dutch hospitals (with the exception of university hospitals), than at medical research centers, most hospital staff and of course most of the patients being Dutch. What are the problems in English-language Dutch medical communication and how can the present study play a part in solving them? Something which is seen as a major problem at Dutch medical faculties is that students generally prefer Dutch texts to the required English texts. This is worrisome because many of the required English textbooks lack Dutch translations or other Dutch equivalents.

Note that these reading problems exist despite all the attention that is paid to reading in English at Dutch secondary schools (English is a compulsory subject at almost all schools). This may indicate that the reading problems that students experience are caused by features of medical English texts which are not present in the types of common English texts which are read at school.

What part can this study play in solving these problems? Recall that the first research question posed above was whether English medical terms (which tend to be restricted to medical texts) cause more comprehension problems than "simplified" common-English rewrites of these terms (employing generally familiar vocabulary). If this proves to be the case, then a solution to at least part of the reading problem would be to review the effectiveness of teaching English medical terms, which would be possibly lacking at present. However, it may be that the similarity of Dutch and English medical terms (see the second research question above) helps Dutch students understand English medical terms, which would minimize the effort required for learning them.

Chapter 2: Medical Language and Lexicon

In this chapter a linguistic definition is provided of the medical terms of which the effect on comprehensibility is to be determined by way of experiments reported in chapters 4-6.

1. A linguistic definition of medical language.

A linguistic definition of medical language provides a frame of reference within which an understanding can be gained of what the medical lexicon is (the main linguistic object of study in this research) and how it differs from other lexicons.

What are the major approaches to studying medical language?

- A. The **terminological approach** is an approach from within the medical profession investigating the nature of concepts and terms with the purpose of creating consistent intra- and interlinguistic terminologies.
- B. The **stylistic approach**, also from within the medical profession itself, is concerned the effectiveness of a mode of expression.
- C. The present study of medical language is undertaken from a linguistic point of view rather than from a medical professional point of view on medical communication. For this reason, the terminological and stylistic approaches seem to provide less appropriate frames of reference for the definition of medical language than what are termed the **educational and linguistic approaches**.

Recent linguistic work in the area of medical language (and other professional or academic usage) can be subdivided into two major linguistic approaches:

1. the **quantitative** approach which defines language varieties in terms of frequency counts of linguistic items in texts and
2. the **(socio-)linguistic** approach which defines language varieties in terms of communicative situations.

2. Quantitative analysis

A weakness of the quantitative approach is that frequency counts are often limited to single words. As frequency counts thus seldom count extended terms, figures on the occurrence of terms tend to be of limited value. At least one instance of quantitative analysis is concerned with the frequencies of complex nominal phrases. However, that study does not (apparently) distinguish between lexicalized nominal compounds and nominal compounds with no existence outside the text. Quantitative analysis is unable to distinguish between such expressions without having recourse to non-quantitative criteria such as familiarity of language users with the items in question. This difficulty makes a linguistic approach based on quantitative analysis unsuitable for this study, where a procedure is required for identifying medical terms in a text which, obviously, should be able to pick out one-word medical terms as well as the more complex ones.

3. The sociolinguistic approach

Here a linguistic definition of medical language is given mainly in terms of speakers and communication situations. In terms of speakers and communicative situations, medical language is seen as a type of register. The term register is widely used to refer to varieties of language appropriate to different occasions and situations of use which are used by a single speaker.

This analysis distinguishes three dimensions of variation:

A. Medical specialism

It is quite likely that the type of linguistic differences that exists between medical language and other language variations is also encountered when the language of one medical professional group or specialism is contrasted to those of other medical professional groups or specialisms.

B. Oral vs. written transmission of the medical message

It is well known that, in general language usage, written language can differ from spoken language, the former often being associated with a more formal use of language. In medical communication this can also be the case; the use of medical slang, for example, will not extend to medical research papers in journals.

C. Relations between participants in the medical exchange

This dimension covers language characteristics which mark different relations between participants in a linguistic exchange. We can distinguish the following major variants of medical language:

1. the language of medical education (e.g. textbooks, lectures),
2. the language of medical occupation (e.g. medical journal articles, oral papers, case conferences),
3. the language of medical journalism (popular medicine, medical encyclopedias) and
4. doctor-patient language (including written items such as the language of medical instructions or commercial brochures).
5. medical technical language (e.g. manuals)

From the above it is clear that medical language can be easily defined as a type of register. There are, however, some features of medical language (and scientific language in general) which distinguish it from other registers and which do not fit in any of the three aforementioned categories of professional group, mode or tenor. These additional parameters are:

D. Communicative Purpose

An important distinction between a register, in a general sense, and a language for special purposes-type register such as medical language is the function of a language for special purposes type of register to communicate information of a specialist nature at any level of complexity in the most economic, precise and unambiguous terms possible, i.e. as efficiently as possible, especially in the expert-to-expert tenor.

E. National Language

It is clear that, besides in terms of specialism, type of transmission and type of text, medical language is also differentiated according to specific national languages. In this dimension, medical language is differentiated in medical Dutch, medical English, medical French etc. (see chapter 6 for a cross-linguistic view of medical language).

4. Linguistic levels of analysis

What is the role played by the lexicon and the other linguistic levels of analysis in the differentiation between medical language, specifically medical English, and other English language variations? In the analysis given below medical English is not only contrasted with common everyday English, but also with other, related science and technology English language variations.

A. Discourse Analysis

In the context of medical English research, conversation analysis and discourse analysis have often been applied to interactional processes which occur in communication in medical contexts, especially doctor-patient interaction. Analyses of written medical English tend to concentrate on discourse-level items which medical English shares with science and technology English such as the textualization of the author's point of view. Aspects of other typically medical discourse, such as case conferences, tend to be described in accounts of medical English syllabus design.

B. Syntax

There are no syntactic structures which are particular to medical English and which (generally) do not occur in other English language variants.

C. Semantics

At the truth-conditional semantic level there is no way to distinguish medical language from common language or special-purpose languages.

D. Morphology

Certain morphological items tend to occur only in medical English texts and to a lesser degree in general English texts or in English-language texts in other fields of science or technology. These are various Graeco-Latinate suffixes such as *-asis* (*elephantiasis*), *-itis* (*bronchitis*), *-oma* (*carcinoma*), *-osis* (*neurosis*) and *-ectomy* (*appendectomy*).

E. Lexicon

Intuitively, it is clear that medical English is best characterized in terms of lexical items. Lexical items such as *percutaneous angioplasty* or *antegrade pyelogram* and many others tend to occur only in medical English texts. The rest of this chapter deals with an investigation of the lexical items which characterize medical English in this way.

5. Types of lexical items in medical text

What are the types of lexical items that appear in English-language medical texts? As in all texts, words in medical texts can be defined as either function words or content words. The rest of this account is solely concerned with content words.

Content words in medical texts are defined according to two parameters: a lexical parameter and a register parameter. In the lexical parameter, a distinction is made between **medical terms** (referring to specifically medical concepts) and **lexical items in general**. In the register parameter content words form either medical-register lexical items, or not.

The lexical and register parameters define the following types of lexical items in medical texts: **specialist medical terms** (terms unique to medical register), **common medical terms** (more generally familiar medical terms), **other specialist or common terms**, **submedical items** (non-term content items in medical texts, i.e. common-language content words which are not terms and which appear in medical texts).

6. Identification of specialist medical terms

What is the procedure for the identification of medical terms in a text to be used in chapter 4, which is consistent with the adopted definition of medical terms in this chapter? The register approach to medical language implies expert judgments as the criterion for medical term identification. Many such judgments are of course available in the form of terminology lists.

Chapter 3: A Reading Comprehension Model

This chapter deals with the psycholinguistic theory in which this study is embedded. The aim of this chapter is the formulation of a psycholinguistic hypothesis on the effect of medical terms on reading comprehension. This hypothesis is subsequently tested in an experiment described in chapter 4.

1. A model of reading comprehension

The psycholinguistic model of reading in terms of which this hypothesis is stated consists of the following minimal set of items needed for successful reading.

The **monitor** is the coordinating and controlling mechanism in the reading comprehension process. The earliest stage in reading comprehension consists of the sensory perception of certain marks and blank spaces by the **visual system**. Marks can be identified by the **script recognizer** as a certain script.

The link between the visual system to the script recognizer is not always direct; the step from the visual system to the script recognizer may (also) be taken by way of a mechanism called the **phonological feedback circuit**. Phonological segments (phonemes) and suprasegmental features (stress patterns, intonation) which are associated with script are identified by the phonological feedback circuit.

The **text and sentence parser** constitutes the stage which follows script recognition in the reading comprehension model. The task of the text and sentence parser is to detect the conceptualization underlying each sentence of an input text, including of course sentences with medical terms. Operations in the text and sentence parser include **formal processing** (supported by syntactic analysis and lexical analysis) and **conceptual processing** (supported by lexical analysis and conceptual analysis).

It is in line with current experimental evidence to suppose a simultaneous and interdependent interaction between the different analyses of the text and sentence parser. In particular, it is held that the lexical and conceptual analyses involved in reading operate interdependently and in parallel.

The parser makes a superficial syntactic analysis, focuses on conceptual analysis supported mainly by lexical analysis and only reverts to a thorough syntactic analysis if comprehension is still incomplete.

This organization of levels of analysis in the text and sentence parser applies to reading for full comprehension of a text. In case of other tasks, as for example conscious syntactic parsing during translation, complete syntactic analysis is required from the outset. On the other hand, the degree of thoroughness of lexical and conceptual analysis can be affected by reading tasks as well: in skim-reading, for example, lexical analysis of a text will not be as thorough as in reading for full comprehension.

As its name implies, formal processing is concerned with the identification of forms, with both the formal features of lexical items (graphemic form and syntactic category) as well as with sentence structures. Formal processing encompasses syntactic and lexical analysis. It is assumed here that syntactic analysis consists of the isolation and identification of syntactic structures, with the goal of assigning a meaning to those structures. The importance of lexical analysis for syntactic analysis is obvious: the textual information used for inferring syntactic structures is mainly lexical, such as word order (which presupposes word recognition), the nature of various function words and content words and morphological features.

The goal of conceptual analysis is the construction of the meaning of a text. The conceptual analysis sub-mechanism in the text and sentence parser is thus involved in measuring the effect of medical terms on the comprehensibility of the text in which they occur. The goal of conceptual analysis is achieved by relating the information contained in the text to the reader's prior knowledge. The knowledge stored in the reader's memory is organized in schemata (or related concepts such as scripts or frames). There is a two-way relation between these schemata and the text. On the one hand, there is a top-down movement which is knowledge-based and in which the schemata explain the text. On the other hand, there is a bottom-up movement which is text-based and through which the text modifies the schemata.

Together with lexical analysis, conceptual analysis makes up the conceptual processing component of the text and sentence parser. Note that lexical analysis also plays a role in formal processing. Conceptual analysis is important for lexical analysis in that it allows the reader to infer the meaning of a given word from the context in which the word occurs.

The other sub-mechanism in conceptual processing besides conceptual analysis is lexical analysis. This mechanism is discussed at some length below. The process of lexical analysis consists of the following three stages:

1. input from the text recognizer and syntactic analysis,
2. scanning of this input for information on which to base the decision to mentally represent one lexical item rather than another,
3. the mental representation of a lexical item in working memory.

2. A lexical analysis hypothesis

It is held here that lexical analysis in reading is supported by two interacting knowledge sources: the **mental lexicon** and the **conceptual system**. The nature of this knowledge support of lexical analysis has major implications for our hypothesis on the effect of medical terms on reading comprehension. Support of lexical analysis by both the conceptual system and the mental lexicon means that, roughly, not just bare vocabulary knowledge is involved in lexical analysis, but that background knowledge is involved as well. This position is fairly traditional.

An argument in favor of the division of lexical knowledge across two sources is that an extended semantic component of lexical items (which would be the logical alternative) could put a great, and often unnecessary and time-consuming burden on lexical analysis, since the entire world knowledge that goes with a word need not be recovered every time that word is encountered. A second argument is that through this configuration it is possible to make a clear division between the two types of lexical knowledge; as it is shown below such a division proves to be necessary in the discussion on the scope of lexical analysis.

One implication of this approach towards lexical analysis is that reading comprehension at the lexical level is affected by the vocabulary knowledge of the mental lexicon as well as by the field familiarity, i.e. lexical conceptual

knowledge, of the conceptual system. This is of particular importance to the study of the effect of medical terms on reading comprehension.

Evidence for what has been held to be correct so far, for the support of lexical analysis by two interacting sources, the mental lexicon and the conceptual system, would follow if it can be shown that neither of these two knowledge sources under consideration can affect the level of reading comprehension independently.

Another part of the lexical analysis hypothesis is that, in reading for full comprehension (i.e. not scanning or skimming the text), lexical analysis is essential towards representing the meaning of a text. In view of the knowledge support of lexical analysis discussed above, the importance of lexical analysis can only be demonstrated by lexical and conceptual familiarity versus lack of both lexical and conceptual familiarity. In terms of our topic here, then, the importance of lexical analysis can only be demonstrated by medical lexical and conceptual familiarity versus the lack of both. In other words, our hypothesis on the effect of medical terms on reading comprehension derives from a more general hypothesis on lexical analysis.

Chapter 4: The Effect on Comprehensibility of Medical Terms and their Common-Language Counterparts

1. Hypotheses

In chapter 3, the main hypothesis for the first part of this study was formulated. For the experiment presented in this chapter (from here on referred to as Experiment 1), this translates into Hypothesis A:

A. Medical students (from here on meant to include students in related academic fields) will achieve higher scores on a reading comprehension test involving either specialist medical terms or their common-language rewrites than other students with no medical expertise on the same reading comprehension test involving just specialist medical terms.

In Hypothesis A it is assumed that Dutch medical students know specialist medical terms occurring in a text and that they also know the common-language equivalents of such terms. The other students with no medical expertise differ from the medical students in their (lack of) knowledge of specialist medical

terms, and not in their lack of knowledge of common-language items. Therefore, it is only on reading comprehension tests involving specialist medical terms that the non-medical group achieves lower scores.

Evidence for the hypothesis of chapter 3 also follows from support for Hypotheses B and C.

- B. Subjects with similar levels of medical knowledge will not achieve significantly different scores on a reading comprehension test involving specialist medical terms as compared to an identical reading comprehension test involving common-language equivalents of those terms,
- C. Subjects with similar levels of lexical knowledge will not achieve significantly different scores on a reading comprehension test involving specialist medical terms as compared to an identical reading comprehension test involving common-language equivalents of those terms.

2. Subjects, material, procedure

Experiment 1 involved four groups of subjects: 28 4th year Health Sciences and medical students, 28 2nd year Health Sciences students, 26 3rd/4th year students of English and 24 other students (Dutch, French etc.).

The material for the reading test was an editorial taken from a nonspecialist *The Lancet* 1986, Vol.1, pp. 781-783, titled "Imaging the Transplanted Kidney". This is a nonspecialist journal; the medical terms used in it were assumed to be comprehensible to a wide range of medical experts. Twelve specialist medical terms in the text were rewritten into semantically equivalent common-language phrases. Otherwise the word-order has been left unchanged. The selected terms all occurred just once in the text, to avoid any "learning effect" distortion; selected terms were all NPs (nominal phrases) - this avoided (possible) different effects of the various lexical categories; selected terms all had grammatical heads which were also specialist medical terms.

Each term had two rewrites: one in the text and one in tasks used to test comprehension. To enhance the validity of the tests, both types of rewrites were checked by medical experts.

Reading comprehension was operationally defined as comprehension which enables the reader to distinguish between correct and incorrect paraphrases and inferences of passages of the text. The simplest question format

consistent with this definition is true/false statements. There were 12 such true/false statements, i.e. one for each selected phrase.

Two versions of the text were prepared. In Text A, every other test passage contained a rewritten term. Text B contained the other half of the rewritten terms. Distribution of rewritten terms over two texts limited the odd impression these rewritten terms might have made on medically knowledgeable subjects. Half of each group of subjects was randomly assigned a reading comprehension test on Text A, while the other half was assigned a test on Text B.

In addition, subjects were asked to fill in reading times at three places: at the beginning of the test, at their completion of reading the text and finally at completion of the twelve true/false statements. It was thought that any significant correlation between test scores and reading times might give an indication of the difficulty of the task.

A oneway analysis of variance was used with the following independent variables and conditions: English language knowledge (3rd/4th year English students, other 3rd/4th year students), medical knowledge (4th year Health Sciences and medical students, 2nd year Health Sciences students, other 3rd/4th year students).

The dependent variables were: scores on true/false statements pertaining to authentic items and scores on true/false statements pertaining to equivalent common-language items as well as reading times for the text and reading times for completion of the test (exclusive of reading time of the text).

For each subject in the four groups, the total test score was split in two, resulting in one score for authentic items and another score for rewritten items. This resulted in eight groups of scores. The significance of the differences between the mean scores of these groups was computed by way of a multiple range test (Student-Keuls-Newman procedure).

3. Results

A. The effect of medical knowledge

The effect of medical knowledge on the comprehension, by Dutch readers, of English medical terms vs. the English common-language equivalents of these terms was measured by comparing the mean scores for such medical terms and their common-language equivalents of the two groups of medical students and

the students not studying a medicine-related field nor English. Significant differences were obtained between on the one hand scores on authentic medical terms by the non-medical non-English students and on the other hand scores on both authentic and rewritten items by 4th year medical/Health Sciences students and scores on rewritten items by 2nd year Health Sciences students.

These results are evidence for Hypothesis A, as both rewritten and authentic scores for 4th year Health Sciences students exceeded scores on authentic items by the non-English non-medical students.

Hypothesis B in fact says that for any group of subjects there is no significant difference between mean scores for authentic medical terms and mean scores for the common-language counterparts of those terms. Note that no such significant differences were found, which supports Hypothesis B.

According to Hypothesis C, mean scores on rewritten items should not differ significantly, assuming that all groups involved here have no greatly different knowledge of the common-language rewritten items. The results also supported Hypothesis C.

B. The effect of general English knowledge

The effect of general English knowledge on the comprehension, by Dutch readers, of English medical terms vs. the English common-language equivalents of these terms was measured as follows. A comparison was made of the mean scores for medical terms and their common-language equivalents of the group of students of English and the group not studying a medicine-related field nor English. There was no significant difference between the mean scores of the groups involved. This again supports Hypothesis B, according to which subjects with the same level of medical knowledge (or in this case the lack of it) will not achieve significantly different scores on a reading comprehension test involving medical terms as compared to an identical reading comprehension test involving common-language equivalents of those terms.

C. Reading times

Two task completion times were recorded: one for reading the text and the other for completing the true/false statements (exclusive of text reading time). For all groups, there was a significant negative correlation (about $-.15$) of individual scores and text reading times. Roughly, the longer it took to read the text,

the lower the score. No significant correlation was found between scores and test completion times.

4. Discussion

A. Psycholinguistic implications

The support for Hypotheses A, B and C provides evidence for lexical analysis supported by the mental lexicon as well as by the conceptual system. While for Hypotheses B and C the level of comprehension generally did not differ significantly, it became apparent during Experiment 1 that reading times of the text to be tested did differ significantly, in the sense that the group of subjects with the least medical (and general English) knowledge took the longest to read the text. In view of the negative correlation between reading times and scores, these reading times may be interpreted as a rough measure of difficulty. In that light, then, lay subjects, although scoring on the same level as medically knowledgeable subjects, found the task significantly more difficult.

B. Practical application

In the area of application, the question is for what group of readers medical terms, or else common-language equivalents should be used in written texts. The data of Experiment 1 indicate that, per group, it does not matter whether medical terms are used or common-language equivalents.

5. Specialist medical terms vs. other lexical items

Does the scope of the above results just include specialist medical terms and their common-language equivalents, i.e. lexical items denoting a specialized medical concept, or does it also include specialist medical terms and submedical items which are not semantic equivalents of these terms and which hence do not denote specialized medical concepts? Data which may provide an answer to this question are discussed below.

A. Hypotheses

In general, according to the model of lexical analysis developed in chapter 3, English submedical items, common medical terms and the like may be easier to comprehend for medical laity than specialist medical terms.

What about the effect of knowledge of common-language English on submedical items, common medical terms and other terms? Since no uniquely medical concepts are involved here, one would expect that the higher the knowledge of English, the better the submedical items, the common medical terms and perhaps also the other terms are comprehended.

B. Subjects, material and method

The experiment reported below (henceforth referred to as Experiment 2) involved four groups of subjects: 9 2nd year medical students, 9 4th year medical students, 11 2nd year students of English and 10 4th year students of English.

The text was the same one as was used for Experiment 1. The task assigned to all subjects was to underline in the text the lexical items which were semantically unfamiliar.

C. Results

Specialist medical terms. Significant differences were obtained on mean scores per group for specialist medical terms; the more medical knowledge, the fewer underlinings.

Common medical terms. There was no clear decrease in difficulty with common medical terms as the knowledge of English increased. In fact, difficulty with these lexical items decreased significantly with the increase of medical knowledge.

Other terms. There was again no decrease in difficulty with the increase of English-language knowledge. Again, significant decrease in difficulty was observable with the increase of medical knowledge.

Submedical items. Students of English had significantly less difficulty with these items than medical students; the 4th year medical students had significantly fewer difficulties than the 2nd year medical students.

D. Discussion

What are the implications of these results? First, they confirm that lexical knowledge is not only a matter of "bare" vocabulary knowledge, but essentially also a matter of conceptual background knowledge. According to the results of Experiment 2, lack of medical knowledge gives rise to difficulty with specialist

medical terms, while the lack of English language knowledge can cause difficulty with submedical items (see chapter 2).

More practical implications of these results seem to extend most to the role of L2 medical English in medical education. As medical knowledge seems to be a significant factor for comprehending even non uniquely medical English lexical items, it seems advisable to teach medical students the L2 common-language English they need for reading (submedical items) in a way which is integrated as much as possible with the rest of the medical curriculum.

Chapter 5: The Comprehension of Cognate Medical Terms

The next two chapters of this study are concerned with the effect of interference (i.e. transfer of linguistic items) from Dutch on the comprehensibility of English medical terms for medically knowledgeable speakers of Dutch. The present chapter deals with the following topics.

1. Cross-linguistic differences and similarities between Dutch- and English-language medical terms

A. Similarities between Dutch and English medical terms

Medical Dutch and medical English tend not to differ from each other in the medical concepts which are denoted by the medical terms in either language. Many of the lexical forms which have been chosen to communicate medical concepts are similar in Dutch and English. Many medical Dutch and medical English terms are cognates, and many are borrowings from Latin.

B. Differences between Dutch and English medical terms

The types of differences found within the category of lexical differences are formal contrasts, misleading cognates, and register mismatches of cognate terms.

2. L1-L2 transfer of medical terms

A. The Contrastive Analysis Hypothesis

Roughly, the Contrastive Analysis Hypothesis stated that problems of L2 learners were predictable from the differences between L1 and L2. Conversely, L2 learners would have least difficulty in the areas in which L1 and L2 were simi-

lar. For reading, criticism of the Contrastive Analysis Hypothesis covers the following items.

1. Learners simply do not always semantically associate unfamiliar L2 forms with formally similar L1 lexical forms (transfer avoidance).
2. Learners can confuse unfamiliar L2 forms with other, formally similar, L2 forms they already know.
3. Many errors L2 users make do not appear to have their origin in any kind of transfer at all; many correct "guesses" of L2 word meanings appear to stem from an analysis of the context in which the word occurs.

The Contrastive Analysis Hypothesis needed to be replaced by a hypothesis which predicts L2 learner difficulties more accurately and which describes under what conditions L1 knowledge interferes in L2 language use. The alternative approach to L1-L2 transfer discussed below is not so much based on comparisons of L1 and L2 forms but on the way in which readers process these forms.

B. The organization of lexical knowledge in L2 reading

L1-L2 lexical transfer implies mutual accessibility of L1 and L2 lexical knowledge. This raises the question of how such mutual access is organized. Two possibilities for the organization of L2 lexical access come to mind:

1. all lexical knowledge is stored in a single mental lexicon, or 2. L1 and L2 lexical knowledge are somehow stored separately.

The argument for separate L1 and L2 mental lexicons is that such separation is needed in order to enable distinction between L1 and L2 lexical items in language production and comprehension. Joint storage of L1 and L2 lexical items would result in a mix-up between them in language use.

C. L1 and L2 lexical knowledge vs. the conceptual system

It remains to be seen in what ways the L1 and L2 mental lexicons can interact to produce L1-L2 lexical transfer. This question can be approached in terms of various types of relations of pairs of cognate lexical items with the conceptual system. The various relations of this kind discussed below are inspired by models of **bilingualism**. Here, bilingualism is defined in terms of the following re-

lations between L1 and L2 mental lexicons and the language user's conceptual system.

1. In the first type of relation between a pair of cognate lexical items and the conceptual system there is a stronger direct relation between each of the cognate lexical items and the conceptual system than the lexical items have with each other. Such lexical relations will hold for many fluent L2 users who are not conscious of formal similarity of a pair of L1 and L2 words or phrases.
2. Another relation is a translation-type situation which might be found with beginning learners. In this type of relation the L2 lexical item is related to the conceptual system by way of the L1 lexical item. This situation is consistent with what we might expect in L1-L2 lexical transfer, in the sense that an unfamiliar L2 lexical item being analyzed as a cognate of an L1 lexical item would have no independent conceptual information associated with it.

Thus, given that lexical transfer is possible for all L2 users, models of lexical bilingualism imply that a link-up is possible (but not always necessarily present) between the L2 and L1 mental lexicons.

D. The L1-L2 lexical transfer hypothesis

We now turn to the lexical analysis process during which L1-L2 lexical transfer occurs. L1-L2 lexical transfer is often described in terms of a number of stages (see e.g. Nas 1983). These first stages could be described as follows:

1. L2 input to L2 mental lexicon
2. failure to find a matching entry in the L2 mental lexicon

The next logical stage in the L1-L2 lexical transfer hypothesis for reading would be that the L2 input would search the L1 mental lexicon for a matching entry. The question at this stage is what factors determine the matchability of the L2 input with the L1 lexical item. It is clear that perceived similarity of form in L2 input to an L1 lexical item is an important criterion for matching L2 input with an L1 lexical entry. Such pairs of formally similar L1 and L2 word forms are termed psychological cognates. Psychological cognates which are semantically similar would be true cognates. Psychological cognates that are not true cognates are misleading cognates.

However, perceived similarity of form alone is not a sufficient condition for matchability of L2 input with an L1 lexical entry. The main reason is that readers may decide not to transfer in spite of perceived similarity of form between an unknown L2 lexical item and an L1 lexical item (transfer avoidance). A more satisfactory characterization of psychological cognates would have to include the notion that psychological cognates are in fact judged by readers to be susceptible to L1-L2 lexical transfer. This is incorporated as the next L1-L2 lexical transfer stage.

1. L2 input to L2 mental lexicon
2. failure to find a matching entry in the L2 mental lexicon perceived to be sufficiently similar
3. L2 input to L1 mental lexicon
4. match of L2 input with L1 psychological cognate

Specifically in the case of medical terms, a language user may be able to tell by the Latinate form of a medical term that it is transferable to a specific L2 (such as English), based on the knowledge that Latinate forms are in general transferable to that L2. A better definition of L1-L2 psychological cognates is therefore that these are pairs of lexical items in L1 and L2 which are judged to be transferable from L1 to L2 on the basis of the reader's linguistic knowledge.

It has been assumed implicitly that for L1-L2 lexical transfer to be able to occur, some familiarity with the L1 lexical item is necessary. The absence of such an L1 lexical item could result in L2-L1 lexical borrowing rather than transfer. Such borrowing might actually occur under the assumption that the relevant L2 lexical item already has a psychological cognate in L1, with which the reader is however not familiar. Such pseudo-transfer typically occurs for example in nonexpert medical translations.

The conclusion that can be drawn from the above discussion is that L1-L2 lexical transfer involves the following process:

1. L2 input to L2 mental lexicon
2. failure to find a matching entry in the L2 mental lexicon
3. L2 input to L1 mental lexicon
4. match of L2 input with L1 psychological cognate (an entry in the L1 mental lexicon)

The hypothesis on L1-L2 lexical transfer adopted here says that L1-L2 lexical transfer only takes place if the L1 and L2 lexical items are psychological cognates and the L1 lexical item constitutes an entry in the L1 mental lexicon. Note that the scope of this hypothesis is intended to be confined to reading.

3. L1-L2 lexical transfer and the comprehension of L2 medical terms

A. Prediction

Here we will assume that formally similar or identical Dutch and English medical terms of Greek-Latin derivation are recognizable as psychological cognates. A second assumption is that cognate status of Dutch and English medical terms implies synonymy of those terms. For the transferability of Dutch Greek-Latin derived medical terms, the L1-L2 lexical transfer hypothesis for reading thus predicts that medically knowledgeable groups of Dutch subjects score significantly higher on a reading comprehension test involving English Greek-Latin derived medical terms than medically less knowledgeable groups of Dutch subjects.

B. Experimental verification of the L1-L2 lexical transfer hypothesis for reading

The data of experiment 1 (see chapter 4) were used to test the L1-L2 lexical transfer hypothesis for reading. The selected English medical terms tended to have Dutch cognate counterparts. These terms therefore seemed suitable to verify the L1-L2 lexical transfer hypothesis for reading.

It was found that the 4th year Health Sciences students scored significantly higher on authentic terms than the 3rd/4th year Arts faculty students (not English). Scores for 2nd year Health Sciences students took up a middle position, not differing significantly from either other score. This result is evidence for the L1-L2 lexical transfer hypothesis, which predicts that L1-L2 transfer of specialist medical terms only takes place for medically knowledgeable language users.

By way of contrast, the scores for the generally non-cognate text rewrites did not improve with increasing medical knowledge. This is what was predicted by the L1-L2 lexical transfer hypothesis, i.e. that it is of medical terms that L1-L2 transfer takes place, and not for rewrites of those terms.

The main conclusion is that the Dutch-English cognate status of written English medical terms aids their comprehension by Dutch readers who are medically knowledgeable. A practical implication would be that any difficulty

that medically knowledgeable Dutch readers have with English-language medical texts is probably not due to the medical terms in those texts - most English medical terms formally resemble Dutch medical terms.

Chapter 6: The Dutch Preference for Cognate/Language-Specific Medical Terms

A question left unanswered in chapter 5 was to what degree cognate medical terms are accepted by Dutch medical experts. At least theoretically, there is a choice in Dutch medical term formation between cognate and non-cognate forms for the expression of medical concepts. A preference for cognate terms would help enhance comprehension of English medical terms. A preference for non-cognate forms would not enhance such comprehension. In this chapter, then, it is investigated to what degree Dutch medical experts prefer cognate terms.

1. Cross-linguistic alternatives for medical termformation

A. Standard international medical terms

Dutch and English cognate medical terms are usually the standard international forms. The advantages of having as many standard international medical terms as possible can be expressed in terms of their intelligibility and their appropriateness. Standard international medical terms undoubtedly maximize international mutual understanding in the area of the dissemination of scientific and technical innovation. It is assumed that the appropriateness of standard international medical terms lies in the widespread use that is being made of them.

There are also possible drawbacks to using standard international medical terms. One conceivable drawback is that the Latinate and other forms used for medical internationalisms are often unknown to the lay or novice medical language user. If so, the enhanced international mutual understanding referred to above only works for medical experts. However, on the basis of the data of chapter 4 it was concluded that lexical choice alone does not significantly affect comprehension; comprehension is enhanced by lexical choice in combination with the required background knowledge.

B. Borrowing from medical English

The second possibility for term formation, and the second possibility for having cognate medical terms, is simply to use medical terms current in English as the international standard. The most compelling argument for this option is that English is already widely used in professional medical communication, so that medical English terms tend to be internationally familiar. One reason for the increasing use of English in this area seems to be that most of the contributions in medicine are published in English in international American, British or European reviews.

The international standardization of medical English terms is a process that is taking place and which coincides with the increasing international standardization of Latinate terms. There already is little or no difference between many existing English-language medical terms and the medical terms in other languages such as Dutch.

C. Language-specific medical terms

The institution of language-specific medical terms rather than a Latin or English international standard is motivated by

1. a desire to make medical communication as intelligible as possible for a wide public or
2. by a concern for the survival of a national-language dimension of medical register.

Note, however, that the findings in chapter 4 indicate that language-specific terms will not contribute more to the general comprehensibility of a medical text than the corresponding cognate forms. The sole valid reason for a preference for language-specific terms is therefore a concern for their survival. Let us now move to the question as to the preference of Dutch medical experts for internationally cognate vs. language-specific medical terms. In this respect, knowledge of Dutch medical terms can be described according to the following criteria.

1. Necessarily cognate terms. We must assume that at least part of the medical terms in the mental lexicon of Dutch medical experts has to consist of cog-

nate "international" terms which are the only ones available to express a medical concept. There are clearly many of these, mainly Greek-Latin derivations.

2. Necessarily language-specific terms. These would cover the concepts for which there is only a language-specific term available.
3. Doublets of cognate and non-cognate terms. In this case, a choice is possible between a cognate and a non-cognate term, depending on what is considered to be most suitable.

Clearly, the preference of Dutch medical experts for Dutch-English cognate medical terms can only be tested with respect to doublets of cognate and non-cognate terms.

In the experiment reported below (Experiment 3) it was investigated to what degree English medical terms which are translatable as doublets in Dutch prompt either cognate or non-cognate Dutch translations. It was assumed that such translation brings out the preference for using either the cognate or the non-cognate of Dutch medical terms.

2. Subjects, materials and procedure

The subjects for Experiment 3 were 27 Dutch physicians. The test material consisted of 19 sentences involving 31 common and specialist English medical terms. The sentences are authentic items taken from various pharmaceutical brochures and medical research reports. A differentiation was made between general and specialist medical terms to see if this affected lexical choice one way or another. Most of these terms had both Dutch cognate or language-specific translations. Some terms marked with an asterisk were control items which were assumed to have only a cognate translation (this was checked with medical experts). The 31 terms thus included 6 control items, 13 specialist terms translatable as doublets and 12 general terms translatable as doublets. The test consisted of sentences in Dutch containing clozes with English prompts for translation.

3. Results

A. Preferred form of medical terms

Preferred translations were given for three types of items: control items with cognate translations, common medical terms and specialist medical terms.

The control items with one exception were given cognate translations.

There were great differences in the conventions regarding cognate/non cognate translations per common term with two translation possibilities. On the whole, for most of the common medical terms cognate translations seemed to be preferred (just more than half.).

Similarly to common medical terms, there seemed to be great differences in the conventions regarding translations of English specialist terms as cognate/non-cognate items. For most of the specialized medical terms cognate translations were preferred (mean number of cognate translations was 16 out of 27).

A *t*-test did not indicate any significant difference between the means of cognate specialist and common medical term translations.

B. Individual preferences for cognate vs. non-cognate translations

The mean percentage per subject of common medical terms given a cognate translation was slightly lower than for specialist medical terms (both around 50%).

4. Discussion

The main conclusion is that when there is a choice between a language-specific term and an international cognate term, the chance that Dutch medical experts select either possibility is about even, depending on both the medical terms involved and personal inclination.

From a linguistic point of view it cannot be predicted which type of term gains wider acceptance in its language-specific form vs. a cognate form. As to the non-linguistic considerations guiding the choices made, it is not clear whether the choice for a non-cognate item was consciously motivated by any desire to preserve it in the face of the growing number of international cognate terms.

Chapter 7: Conclusion

The two research questions of this study were:

1. whether English specialist medical terms cause more comprehension problems than "simplified" common-English rewrites of these terms;

2. whether similarity (cognate status) of Dutch and English medical terms aids the comprehension of the latter by Dutch readers.

This study aimed at supplying answers to these questions which were relevant in two main dimensions: the theoretical psycholinguistic dimension and a practical, applicational dimension.

1. The psycholinguistic perspective

The result for the first research question, that there is no difference in comprehension for a group of Dutch readers of English specialist medical terms vs. their rewrites, has the following psycholinguistic implication. What this result indicates is that success in comprehending a text is NOT determined by lexical analysis with input from bare (i.e. nonconceptual) lexical knowledge. The result of chapter 4 indicates that conceptual knowledge sources are also involved.

The second-language perspective in the comprehensibility of medical terms is inherent to the second question of this research, i.e. whether similarity of Dutch and English medical terms aids the comprehension of the latter by Dutch readers. In chapter 6, the affirmative answer to this question has taken into account cases where similarity between first and second languages does not lead to better comprehension. This was done by affirming that formal similarity alone is not the sole prompt for language transfer; rather, it is the perceived transferability, in this case knowledge that terms with Latinate forms are generally transferable, which prompts transfer.

2. The application perspective

In chapter 1 a major problem at Dutch medical faculties was discussed, i.e. that students generally prefer Dutch texts to the required English texts. This was worrisome because many of the required English textbooks lack Dutch translations or other Dutch equivalents.

How can the results of this study play in solving these problems? The first research question posed above was whether English specialist medical terms (which tend to be restricted to medical texts) cause more comprehension problems than "simplified" common-English rewrites of these terms. In chapter 4 we have seen that this is not the case: there is no difference in reading comprehension between specialist medical terms and their rewrites.

Let us assume that English-language reading difficulties for Dutch medical students (or students of related studies such as Health Sciences) are caused by difficulties with reading comprehension. The results of chapter 4 indicate that such difficulties with reading comprehension are not solved by simplifying the specialist medical terms in students' texts.

Knowledge of medical terms as well as medical concepts enhances comprehension of terms, as shown in chapter 4. Therefore, if reading problems are related to comprehension of medical terms, these problems may be alleviated by increased knowledge of medical terms and the concepts they convey.

On the other hand, it was also shown in chapter 4 that common-language content words in English medical texts (submedical items) tend to pose more problems than the specialist medical terms do. This indicates that Dutch medical students' reading difficulties may lessen with increased attention on the teaching of common-language English vocabulary - typically a task for medical English teaching.

As for the second research question, the results in chapter 5 indicated that similarity in form of Dutch and English medical terms aids the comprehension of English medical terms (if their Dutch counterparts are sufficiently familiar). Any preference for language-specific Dutch medical terms over their Dutch-English cognate counterparts can thus cause extra difficulty in the acquisition of English medical terms. Finally (third research question), the findings of chapter 6 indicate that language-specific medical terms apparently play an important role in Dutch medical communication. This being the case, it can be assumed that for users of medical Dutch the comprehension of English medical terms is not always simply a matter of invoking the formally similar Dutch term.

Samenvatting

Hoofdstuk 1: Inleiding

De twee vragen van dit onderzoek zijn:

1. Veroorzaken Engelse medische termen meer leesproblemen dan "vereenvoudigde" algemeen-Engelse herschrijvingen van deze termen?
2. Bevorderen vormovereenkomsten tussen Nederlandse en Engelse medische termen het begrip van deze Engelse termen door Nederlandse lezers?

Deze vragen zijn op twee dimensies relevant: praktische toepassing en psycholinguïstische theorievorming.

1. De psycholinguïstische dimensie

Het grootste deel van dit onderzoek bestaat uit psycholinguïstisch onderzoek. In psycholinguïstische termen hebben de resultaten van dit onderzoek de volgende mogelijke implicaties.

1. Een bevestigend antwoord op de eerste hierboven genoemde onderzoeksvraag impliceert dat lexicale analyse (woordherkenning) input ontvangt van "kale" lexicale kennis, d.w.z. lexicale kennis zonder conceptuele achtergrondkennis. Het zijn in dat geval immers vormverschillen (en het niveau van kennis van vormen) die leesproblemen veroorzaken, en niet achtergrondkennis. Aan de andere kant, als blijkt dat medische termen evenveel begripsproblemen veroorzaken als equivalenten in de gewone omgangstaal, zouden andere bronnen van kennis dan kale lexicale kennis bij het leesproces betrokken kunnen zijn.
2. De vraag naar het effect op leesbegrip van medische termen vs. hun herschrijvingen biedt geen speciaal tweede-taal perspectief. Een dergelijk tweede-taal perspectief komt wel aan de orde bij de tweede onderzoeksvraag, d.w.z. of vormovereenkomsten tussen Nederlandse en Engelse medische termen het begrip van de laatste door Nederlandse lezers bevordert. Een bevestigend antwoord op deze vraag zou rekening moeten houden

met al die gevallen, gedocumenteerd in recent onderzoek, waar overeenkomsten tussen twee talen niet tot beter begrip leidt.

Merk ook op dat als vormovereenkomst van medische termen in verschillende talen hun begrip internationaal bevordert, het in dat opzicht nuttig zou zijn wanneer de medische termen in de moedertaal qua vorm internationale cognaten zijn.

2. De toepassingsdimensie

De toepassingsdimensie waarin de resultaten van dit onderzoek bruikbaar kunnen blijken te zijn kan als volgt worden omschreven.

Nederlandse medische communicatie in de Engelse taal vindt hoofdzakelijk plaats in verscheidene centra van medisch onderzoek. De grootste hiervan zijn de universiteiten. Er zijn acht medische faculteiten. Alle acht faculteiten verzorgen studierichtingen waarin studenten tot arts worden opgeleid. Een aantal medische faculteiten verzorgen ook studierichtingen die niet tot arts opleiden. Deze studierichtingen zijn bijvoorbeeld gezondheidswetenschappen, (Leiden, Nijmegen) of medische biologie (Amsterdam, Utrecht).

Volgens betrekkelijk recent onderzoek is Engels de meest gebruikte vreemde taal op Nederlandse medische faculteiten. Het lezen van medische handboeken is kwantitatief de belangrijkste Engelse taalvaardigheid die voor Nederlandse medische studenten wordt vereist.

Wat betreft medische communicatie buiten de medische faculteiten, wordt het Engels minder vaak in Nederlandse ziekenhuizen gebruikt (met uitzondering van academische ziekenhuizen), dan op medische onderzoekcentra. Het ziekenhuispersoneel en de patiënten zijn doorgaans Nederlanders. Wel is Engels de voertaal bij onderzoeksafdelingen van de farmaceutische industrie in Nederland.

Wat zijn de problemen in Engelstalige Nederlandse medische communicatie en hoe kan dit onderzoek een rol spelen bij hun oplossing? Op Nederlandse medische faculteiten wordt geconstateerd dat studenten in het algemeen de voorkeur geven aan Nederlandstalige teksten boven de vereiste Engelse teksten, ook als er voor de vereiste Engelse boeken geen Nederlandse vertaling of andere Nederlandse equivalenten zijn.

Merk op dat de leesproblemen die hier waarschijnlijk de oorzaak van zijn nog bestaan ondanks de aandacht die wordt besteed aan het lezen van Engels

in het VWO. Dit zou kunnen betekenen dat de leesproblemen van studenten worden veroorzaakt door eigenschappen van medische Engelse teksten die niet aanwezig waren in de Engelse teksten die op school werden gelezen.

Welke rol kan dit onderzoek spelen bij de oplossing van deze problemen? De eerste onderzoeksvraag die hierboven werd gesteld was of Engelse medische termen meer leesproblemen tot gevolg hebben dan "vereenvoudigde" algemeen-Engelse herschrijvingen van deze termen. Als dit inderdaad het geval blijkt te zijn, dan zou tenminste een deel van het leesprobleem worden veroorzaakt door medische termen. In dat geval zou het onderwijs in deze termen meer aandacht moeten krijgen. Echter, het zou kunnen zijn dat de vormovereenkomsten tussen Nederlandse en Engelse medische termen (de tweede onderzoeksvraag) Nederlandse studenten helpt bij het begrip van Engelse medische termen; in dat geval zou het begrijpen van de Engelse termen niet veel extra inspanning vergen.

Hoofdstuk 2: Medische taal en lexicon

In dit hoofdstuk wordt een taalkundige definitie gegeven van de medische termen waarvan het effect op de leesbegrip wordt gemeten d.m.v. de experimenten in hoofdstukken 4-6.

1. Een taalkundige definitie van medische taal

Een taalkundige definitie van medische taal verschaft een referentiekader in termen waarvan het medische lexicon (dus ook medische termen) kan worden gedefinieerd. Wat zijn de belangrijkste benaderingen op dit gebied?

- A. De **terminologische benadering** is er een die binnen het medische beroep wordt gehanteerd en die de aard onderzoekt van concepten en termen om consistente intra- en intertalige terminologieën te creëren.
- B. De **stylistische benadering**, ook beperkt tot de medische wereld, houdt zich bezig met de effectiviteit van een wijze van uitdrukken.
- C. Vanwege het taalkundige gezichtspunt van dit onderzoek zijn de **taalkundige benaderingen** meer geschikte referentiekaders voor de definitie van medische taal dan terminologische en stylistische benaderingen.

Recent taalkundig werk op het gebied van medische taal (en ander beroeps- of academisch taalgebruik) kan in twee benaderingen worden onderverdeeld:

1. de **kwantitatieve** benadering die taalvarianten definieert in termen van tellingen van taalkundige items en
2. de **(socio-)linguistische** benadering die taalvarianten definieert in termen van communicatieve situaties.

2. De kwantitatieve analyse

Een zwakte van de kwantitatieve benadering is dat tellingen vaak worden beperkt tot enkelvoudige woorden. Om deze reden zijn tellingen van termen weinig betrouwbaar, omdat termen uit meerdere woorden kunnen bestaan. Tellingen van complexe NP's (zelfstandige naamwoorden van meer dan één woord) zullen evenmin een betrouwbaar resultaat opleveren, omdat niet alle complexe NP's termen zijn. Termen kunnen dus niet worden gedefinieerd d.m.v. kwantitatieve analyse. Deze moeilijkheid maakt kwantitatieve analyse ongeschikt voor dit onderzoek, aangezien er hier een naar een procedure wordt gezocht voor de identificatie van zowel complexe als niet-complexe medische termen in een tekst.

3. De sociolinguistische benadering

In de sociolinguistische benadering wordt een taalkundige definitie van medische taal voornamelijk gegeven in termen van sprekers en communicatieve situaties. Medische taal wordt hier gezien als een soort **register**. De term register verwijst meestal naar taalvarianten die geschikt zijn voor bepaalde situaties en die door één enkele spreker worden gebruikt.

Deze analyse onderscheidt drie variabelen:

A. Medisch specialisme

Het soort verschillen tussen medische taal en andere taalvarianten wordt waarschijnlijk ook gevonden in het taalgebruik van de diverse medische specialisten.

B. Mondelinge vs. geschreven medische taalgebruik

In het algemeen kan geschreven taal verschillen van gesproken taal; de laatste wordt vaak geassocieerd met meer informeel taalgebruik. In medische communicatie kan dit ook het geval zijn; het gebruik van medische "slang" bijvoorbeeld komt typisch niet voor in wetenschappelijke publicaties.

C. Relatie tussen de deelnemers in de medische communicatie

Deze dimensie bestaat uit taalvariatie die bepaalt welke relaties er zijn tussen deelnemers in medische communicatie. In dit opzicht kunnen we de volgende hoofdvarianten van medische taal onderscheiden:

1. de taal van medisch onderwijs (bijvoorbeeld boeken, colleges),
2. medische beroepstaal (bijvoorbeeld medische onderzoeksartikelen, mondelinge voordrachten)
3. de taal van de medische journalistiek (medische encyclopedieën)
4. arts-patiëntentaal (met inbegrip van geschreven items zoals de taal van bijsluiters of commerciële brochures).
5. medisch technische taal (bijvoorbeeld handleidingen van ziekenhuisapparatuur)

Het is dus duidelijk dat medische taal gemakkelijk als een type register kan worden gedefinieerd. Er zijn echter eigenschappen van medisch (en algemeen-wetenschappelijk) taalgebruik waardoor er verschillen met andere registers optreden en die niet in een van de drie bovengenoemde categorieën passen. Deze eigenschappen zijn:

D. Terminologie

Het verschil tussen een register in algemene zin en wetenschappelijke vaktaal zoals medische taal is dat de laatste de functie heeft complexe specialistische informatie precies, ondubbelzinnig en efficiënt over te brengen. Zulke specialistische informatie is georganiseerd in terminologieën, ofwel systemen van termen.

E. Nationale taal

Medische taal wordt behalve door specialisme, wijze van overdracht en relatie tussen de taalgebruikers ook gedifferentieerd volgens specifieke nationale talen die aan dezelfde medische concepten een verschillende uitdrukking kunnen geven. In deze zin wordt medische taal onderscheiden naar medisch Nederlands, medisch Engels, medisch Frans enz.

4. Taalkundige analyseniveaus

Wat is de rol van het lexicon en de andere taalkundige analyseniveaus bij het verschil tussen medisch Engels en andere Engelse taalvarianten? In de analyse hieronder wordt medisch Engels niet alleen gecontrasteerd met algemeen Engels, maar ook met andere Engelse wetenschappelijk taalvarianten.

A. Discourse analyse

In onderzoek van het medisch Engels zijn conversatie-analyse en discourse analyse vaak toegepast op interactie in medische contexten, vooral de interactie tussen arts en patiënt. Analyse van geschreven medisch Engels legt zich vooral toe op discourse-niveau items die medisch Engels deelt met wetenschappelijk en technisch Engels. Andere aspecten van medisch Engels taalgebruik op discourse niveau worden besproken in medisch Engels cursusmateriaal.

B. Syntaxis

Er zijn geen syntactische structuren die beperkt zijn tot medisch Engels en die niet voorkomen in andere Engelse taalvarianten.

C. Semantiek

Op het semantische niveau kan medische taal niet onderscheiden worden van andere taalvarianten.

D. Morfologie

Een aantal morfologische items komen veelal alleen voor in medisch Engelse teksten. Dit zijn verscheidene Grieks-Latijnse achtervoegsels zoals *-asis* (*elephantiasis*), *-itis* (*bronchitis*), *-oma* (*carcinoma*), *-osis* (*neurosis*) en *-ectomy* (*appendectomy*).

E. *Lexicon*

Het is duidelijk dat medisch Engels het best gekarakteriseerd wordt in termen van lexicale items. Lexicale items zoals *percutaneous angioplasty* of *antegrade pyelogram* en veel andere komen meestal alleen voor in medisch Engelse teksten. De rest van dit hoofdstuk behelst een onderzoek naar de lexicale items die typerend zijn voor medisch Engels.

5. Soorten lexicale items in medische teksten

Welke soorten lexicale items komen voor in Engelstalige medische teksten? Zoals in alle teksten, zijn woorden in medische teksten hetzij functiewoorden of inhoudswoorden. Hieronder zijn alleen inhoudswoorden verder van belang. Inhoudswoorden, of beter gezegd inhouds-lexicale items, worden hier gedefinieerd volgens twee parameters: een lexicale parameter en een register parameter. In de lexicale parameter wordt onderscheid gemaakt tussen **medische termen** (verwijzend naar specifiek medische concepten) en **algemene lexicale items**. In de register parameter zijn inhoudswoorden wel of geen medische-register lexicale items. De lexicale en register parameters definiëren de volgende soorten lexicale items in medische teksten: **specialistische medische termen** (termen die alleen in het medische register voorkomen), **algemene medische termen** (die meer algemeen bekend zijn), **andere specialistische of algemene termen**, **submedische items** (inhoudsitems in medische teksten die geen termen zijn, d.w.z. algemene inhouds-lexicale items in medische teksten).

6. De identificatie van specialistische medische termen

Welke procedure voor de identificatie van medische termen is consistent met de zojuist geformuleerde definitie van medische termen? De registerbenadering maakt beoordeling door deskundigen noodzakelijk als het criterium voor de identificatie van medische termen. Vaak zijn zulke oordelen beschikbaar in de vorm van terminologielijsten.

Hoofdstuk 3: Een leesbegripsmodel

Dit hoofdstuk behandelt de psycholinguistische theorie waarin dit onderzoek is ingebed. Het doel van dit hoofdstuk is de formulering van een psycholinguistische hypothese over het effect van medische termen op leesbegrip. Deze hy-

pothese wordt getoetst in een experiment dat in hoofdstuk 4 wordt beschreven.

1. Grondslagen van een leesbegripsmodel

Het psycholinguistische leesmodel in termen waarvan deze hypothese wordt geformuleerd bestaat uit de volgende minimale set items die nodig zijn voor leesbegrip.

De **monitor** is het coördinerende en controlerende mechanisme in het leesbegripsproces. Het eerste stadium in dit proces is de zintuigelijke waarneming van tekens door het **optische systeem**. Tekens kunnen door de **schriftherkenner** als een bepaald soort schrift worden geïdentificeerd.

De stap van optisch systeem naar schriftherkenner is niet altijd direct; die kan ook worden genomen d.m.v. het **fonologisch feedback circuit**. Fonologische segmenten (fonemen) en suprasegmentele kenmerken (bijv. intonatie) die met geschreven taal worden geassocieerd worden door het fonologische terugkoppel-circuit geïdentificeerd.

Het stadium dat op schriftherkenning volgt bestaat uit de **tekst- en zinsontleder** (text and sentence parser). De taak van de tekst- en zinsontleder is de zinsbetekenissen te vinden in een tekst. De belangrijkste processen binnen de tekst- en zinsontleder zijn **vormverwerking** (formal processing), gesteund door syntactische analyse en lexicale analyse en **betekenisverwerking** (conceptual processing) gesteund door lexicale analyse en conceptuele analyse.

Uit recent onderzoek blijkt dat er een gelijktijdige en onderling afhankelijke interactie bestaat tussen de verschillende soorten analyse van de tekst- en zinsontleder. In het bijzonder gaat men er van uit dat de analyses op lexicaal en conceptueel niveau parallel en onderling afhankelijk werken. De ontleder maakt een oppervlakkige syntactische analyse, gaat vervolgens over tot conceptuele analyse en lexicale analyse en schakelt alleen bij onvolledig begrip over op grondige syntactische analyse.

Deze organisatie van analyseniveaus in de tekst- en zinsontleder geldt voor lezen met als doel grondig tekstbegrip. Bij andere soorten lezen, zoals bijvoorbeeld bij bewuste syntactische ontleding tijdens een vertaling, wordt er wel volledige syntactische analyse vereist. Aan de andere kant kan de graad van grondigheid van lexicale en conceptuele analyse eveneens beïnvloed worden door het leesdoel: bij oppervlakkig lezen, bijvoorbeeld, zal de lexicale analyse van een tekst niet zo grondig zijn als bij lezen voor volledig tekstbegrip.

Vormverwerking houdt zich bezig met de identificatie van taalvormen, d.w.z. zowel de vormkenmerken van lexicale items (grafemische vorm en syntactische categorie) als met zinsstructuren. Vormverwerking omvat syntactische en lexicale analyse. Aangenomen wordt dat syntactische analyse bestaat uit de isolering en identificatie van syntactische structuren, met als doel de toekenning van betekenis aan deze structuren. Het belang van lexicale analyse voor syntactische analyse ligt voor de hand: de tekstuele informatie die wordt gebruikt voor het maken van inferenties omtrent syntactische structuren is met name lexicaal, zoals woordvolgorde, de aard van diverse functiewoorden en inhoudswoorden en morfologische kenmerken.

Het doel van conceptuele analyse is de constructie van de betekenis van een tekst. Conceptuele analyse is dus betrokken bij de meting van het effect van medische termen op tekstbegrip. Het doel van conceptuele analyse wordt bereikt door de informatie in de tekst te relateren aan de voorkennis van de lezer. Deze kennis is georganiseerd in schemata (of soortgelijke concepten zoals scripts of frames).

Hoe interacteren dergelijke schemata met de informatie uit een tekst? Dat gebeurt op twee manieren. Aan de ene kant is er de top-down richting van verwerking, gebaseerd op kennis en waarin de schemata de tekst uitleggen. Aan de andere kant is er de bottom-up richting die is gebaseerd op tekst en waar deze tekst de schemata verandert.

Samen met lexicale analyse maakt conceptuele analyse deel uit van de betekenisverwerkingscomponent van de tekst- en zinsontleder. Lexicale analyse speelt ook een rol in de vormverwerking. Conceptuele analyse is belangrijk voor lexicale analyse omdat de lezer daardoor woordbetekenissen uit de context kan opmaken.

Lexicale analyse bestaat uit de volgende drie stadia:

1. input uit de schriftherkenner en syntactische analyse,
2. scanning van deze input voor informatie waarop de beslissing kan worden gebaseerd een bepaald lexicaal item mentaal te representeren,
3. opslag van deze representatie in het werkgeheugen.

2. Een lexicale analyse hypothese

We gaan er hier van uit dat lexicale analyse wordt ondersteund door twee interacterende bronnen van kennis: het **mentale lexicon** en het **conceptuele systeem**. De aard van deze kennisondersteuning van lexicale analyse heeft belangrijke implicaties voor onze hypothese over het effect van medische termen op leesbegrip. De ondersteuning van lexicale analyse door zowel het conceptuele systeem als het mentale lexicon betekent dat, ruwweg, niet alleen kale woordkennis betrokken is bij lexicale analyse, maar ook dat achtergrondkennis een rol speelt. Dit standpunt wordt vrij algemeen aanvaard. De vraag is nu of de kennis van het conceptuele systeem en de informatie van het mentale lexicon als één geheel moet worden gezien, of niet. Een argument ten gunste van de verdeling van lexicale kennis over twee bronnen is dat een uitgebreide semantische component van lexicale items een grote, tijdrovende en vaak onnodige belasting zou vormen voor lexicale analyse, aangezien de gehele kennis van de wereld die met een woord wordt geassocieerd niet bij elke lezing van dat woord aangesproken behoeft te worden.

Eén implicatie van deze benadering van lexicale analyse is dat leesbegrip op lexicaal niveau zowel bepaald wordt door de inhoud van het mentale lexicon als door achtergrondkennis, d.w.z. lexicale conceptuele kennis van het conceptuele systeem. Dit is van groot belang voor het onderzoek naar het effect van medische termen op leesbegrip.

De juistheid van de stelling dat lexicale analyse door twee bronnen wordt gesteund, het mentale lexicon en het conceptuele systeem, zou worden aangetoond als beide kennisbronnen op gezamenlijk het niveau van leesbegrip kunnen beïnvloeden.

Een ander deel van een dergelijke lexicale analyse hypothese is dat bij het lezen voor volledig tekstbegrip lexicale analyse essentieel is voor de representatie van de betekenis van de tekst. Dit belang van lexicale analyse kan echter alleen worden aangetoond in termen van zowel lexicale als conceptuele bekendheid versus het ontbreken van beide. Toegepast op onze onderzoeksvraag kan het belang van lexicale analyse alleen worden aangetoond in termen van medische lexicale items (termen zowel als herschrijvingen daarvan) en conceptuele bekendheid (medische kennis) versus het ontbreken daarvan. Met andere woorden, onze hypothese over het effect van medische termen op

leesbegrip wordt afgeleid van een meer algemene hypothese over lexicale analyse.

Hoofdstuk 4: Het effect op de begrijpelijkheid van medische termen en hun algemene taal tegenhangers.

1. Hypothesen

In hoofdstuk 3 werd de belangrijkste hypothese voor het eerste deel van dit onderzoek geformuleerd. Voor het experiment dat in dit hoofdstuk wordt gepresenteerd (experiment 1) kan dit worden vertaald in Hypothese A:

A. Medische studenten (m.i.v. studenten in geassocieerde onderzoeksgebieden) scoren hoger op een leesbegripstoets waarin hetzij specialistische medische termen voorkomen, hetzij herschrijvingen van deze termen in algemene taal, dan andere studenten zonder medische expertise op dezelfde leesbegripstoets waarin alleen specialistische medische termen voorkomen.

In Hypothese A wordt aangenomen dat Nederlandse medische studenten de specialistische medische termen kennen die in een tekst voorkomen, alsmede de algemene-taal equivalenten van dergelijke termen. De andere studenten zonder medische expertise verschillen van de medische studenten wat betreft hun (gebrek aan) kennis van specialistische medische termen, en niet wat betreft hun kennis van algemene-taal items. Daarom scoort de niet-medische groep alleen lager op leesbegripstoetsen waarin specialistische medische termen voorkomen.

De hypothese van hoofdstuk 3 wordt ook gesteund als hypothesen B en C aannvaard kunnen worden.

B. Personen met een vergelijkbaar niveau van medische kennis behalen geen significant verschillende scores op een leesbegripstoets waarin specialistische medische termen voorkomen in vergelijking met eenzelfde leesbegripstoets waarin algemene-taal equivalenten van die termen voorkomen,

C. Personen met een vergelijkbaar niveau van woordenkennis behalen geen significant verschillende scores op een leesbegripstoets waarin specialistische medische termen voorkomen in vergelijking met eenzelfde leesbegripstoets waarin algemene-taal equivalenten van die termen voorkomen,

2. Proefpersonen, materiaal, procedure

In experiment 1 waren vier groepen proefpersonen betrokken: 28 4de-jaars studenten Gezondheidswetenschappen en Medicijnen, 28 2de-jaars studenten Gezondheidswetenschappen, 26 3de-/4de-jaars studenten Engels en 24 andere Letterenstudenten (Nederlands, Frans enz.).

Het materiaal dat werd gebruikt voor de leesbegripstoets was een artikel uit de *The Lancet* 1986 Vol.1 pp. 781-783 getiteld "Imaging the Transplanted Kidney". Dit is een niet-specialistisch tijdschrift; aangenomen werd dat de medische termen die hierin worden gebruikt begrijpelijk waren voor medische experts op verschillende gebieden. Twaalf specialistische medische termen in de gekozen tekst werden herschreven in algemene-taal equivalenten. Voor het overige bleven woordkeus, woordvolgorde en tekststructuur ongewijzigd. De geselecteerde termen kwamen allemaal slechts éénmaal in de tekst voor om vertekening door een "leereffect" te voorkomen; ook waren alle gekozen termen NP's - dit ter voorkoming van (mogelijk) verschillende effecten van de verschillende lexicale categorieën. De grammaticale hoofden van de geselecteerde termen waren eveneens specialistische medische termen.

Elke term had twee herschrijvingen: één in de tekst en één in de taken die gebruikt werden voor het toetsen van begrip. Ter vergroting van de geldigheid van de toetsen werden beide typen herschrijvingen gecontroleerd door medische experts.

Leesbegrip werd operationeel gedefinieerd als het vermogen juiste en onjuiste parafrasen en inferenties van passages in de tekst te onderscheiden. De meest eenvoudige vraagvorm die met deze definitie overeenkomt is de juist/onjuist bewering. De toets bevatte 12 van dergelijke juist/onjuist beweringen, d.w.z. één voor elke gekozen term.

Er werden twee versies van de tekst vervaardigd. In tekst A werd de ene helft van de termen herschreven, in tekst B de andere helft. Authentieke en herschreven termen werden steeds om en om gepresenteerd. Met deze distributie van de herschreven termen over twee teksten werd een mogelijke vervreemdende indruk voor medische experts zo goed mogelijk voorkomen. De verdeling van teksten A en B over de proefpersonen was willekeurig.

Ook werden de proefpersonen gevraagd op drie punten tijden in te vullen: aan het begin van de toets, de tijd waarop zij klaar waren met het lezen van de tekst

en tenslotte de tijd waarop de twaalf juist/onjuist vragen beantwoord waren. De achterliggende gedachte was dat mogelijke significante correlaties tussen test scores en leestijden een moeilijkheidsgraad konden aanwijzen.

Een eenrichtingvariantie-analyse werd gebruikt met de volgende onafhankelijke variabelen en condities: kennis van de Engelse taal (3de/4dejaars studenten Engels, andere 3de/4dejaars studenten), medische kennis (4dejaars studenten Gezondheidswetenschappen en medicijnen, 2dejaars studenten Gezondheidswetenschappen, andere 3de/4dejaars studenten).

De afhankelijke variabelen waren: scores voor juist/onjuist vragen die betrekking hadden op authentieke items, scores voor juist/onjuist statements die betrekking hadden op equivalente algemene-taal items en leestijd nodig voor het lezen van de tekst zowel als de tijd benodigd voor het voltooien van de toets (de leestijd van de tekst niet meegerekend). Voor elke persoon in de vier groepen werd de totale testscore in tweeën gesplitst, wat resulteerde in één score voor authentieke items en één score voor herschreven items. Het gevolg hiervan was acht groepen scores. De significantie van de verschillen tussen de gemiddelde scores van deze groepen werd berekend d.m.v. een "multiple range" toets (Student-Keuls-Newman procedure).

3. Resultaten

A. Het effect van medische kennis

Het effect van medische kennis op het begrip van Nederlandse lezers van Engelse medische termen vs. de Engelse algemene-taal equivalenten van deze termen werd als volgt gemeten. De gemiddelde scores per groep voor de medische termen en de gemiddelde scores per groep voor de algemene-taal equivalenten werden vergeleken. De groepen waarvan de resultaten werden vergeleken waren aan de ene kant studenten Gezondheidswetenschappen/geneeskunde en aan de andere kant de Letterenstudenten (niet Engels). Significante verschillen werden verkregen tussen aan de ene kant scores voor authentieke medische termen door de Letterenstudenten en aan de andere kant scores voor zowel authentieke termen als herschreven termen door 4de-jaars studenten medicijnen/Gezondheidswetenschappen en scores voor herschreven items door 2dejaars studenten Gezondheidswetenschappen.

Deze resultaten ondersteunen hypothese A, aangezien de scores voor zowel herschreven als authentieke termen van 4dejaars studenten Gezondheidswetenschappen

tenschappen de scores overtroffen voor authentieke items behaald door de Letterenstudenten.

Hypothese B stelt in feite dat er voor elke willekeurige groep proefpersonen geen significant verschil is tussen gemiddelde scores voor authentieke medische termen en gemiddelde scores voor de algemene-taal tegenhangers van die termen. Merk op dat het ontbreken van dergelijke significante verschillen hypothese B ondersteunt.

Volgens Hypothese C, zullen gemiddelde scores voor herschreven termen niet significant verschillen, aangenomen dat alle betrokken groepen niet veel verschillen wat betreft hun kennis van de items herschreven in algemene taal. De resultaten ondersteunden ook Hypothese C.

B. Het effect van de kennis van algemeen Engels

Het effect van de kennis van algemeen Engels op de leesbegrip door Nederlandse lezers van Engelse medische termen vs. de Engelse algemene-taal equivalenten van deze termen werd als volgt gemeten. De gemiddelde scores voor de medische termen en hun algemene-taal equivalenten van de studenten Engels werd vergeleken met de groep Letterenstudenten (niet Engels). Er werd geen significant verschil gevonden tussen de gemiddelde scores van betrokken groepen. Dit ondersteunt wederom Hypothese B, volgens welke proefpersonen op hetzelfde niveau van medische kennis (of in dit geval het gebrek hieraan) geen significante verschillende scores zullen behalen op een leesbegripstoets die medische termen bevat in vergelijking met eenzelfde leesbegripstoets waarin zich algemene-taal equivalenten van die termen bevinden. Een betere kennis van algemeen Engels brengt geen verandering in dit beeld.

C. Leestijden

Er werden twee tijden vastgelegd: één bij voltooiing van het lezen van de tekst en één bij voltooiing van de waar/niet-waar vragen (exclusief leestijd van de tekst). Voor alle groepen was er een kleine (maar significante) negatieve correlatie (ongeveer -0,15) tussen individuele scores en tijd benodigd voor het lezen van de tekst. Ruwweg kan worden gesteld dat hoe langer de leestijd, hoe lager de score. Er werd geen significante correlatie gevonden tussen score en tijd van voltooiing van de toets.

4. Discussie

A. Psycholinguistische implicaties

De ondersteuning voor Hypothese A, B en C kan worden gezien als een aanwijzing dat lexicale analyse plaats vindt met behulp van zowel het mentale lexicon als het conceptuele systeem. Er werd wel een significant verschil geconstateerd bij leestijden van de tekst, in de zin dat de groep proefpersonen met de minste medische (en algemene Engelse) kennis de meeste tijd nodig hadden voor het lezen van de tekst. Gezien de negatieve correlatie tussen leestijden en scores, kunnen deze leestijden geïnterpreteerd worden als een grove moeilijkheidsgraad. In dit licht bezien was de opgave moeilijker voor ondeskundige proefpersonen, hoewel zij hetzelfde scoreniveau behaalden als proefpersonen met medische kennis.

B. Praktische toepassing

Wat betreft de toepassing van deze kennis, geven de data van experiment 1 aan dat het voor leesbegrip per groep niet uitmaakt of er medische termen worden gebruikt of algemene-taal equivalenten.

5. Specialistische medische termen vs. andere lexicale items

De vraag is nu of de hierboven gegeven conclusies alleen gelden voor specialistische medische termen en hun algemene-taal equivalenten, d.w.z. lexicale items die naar een gespecialiseerd medisch concept verwijzen, of dat ze ook gelden voor specialistische medische termen en submedische items die semantisch niet equivalent zijn en waar de submedische items dus niet naar speciale medische concepten verwijzen. Data die hier een antwoord op kunnen geven worden hieronder besproken.

A. Hypothesen

In het algemeen, volgens het model van lexicale analyse van hoofdstuk 3, kunnen Engelse submedische items, algemene medische termen en dergelijke gemakkelijker te begrijpen zijn voor medische leken dan specialistische medische termen. Aangezien er hier geen sprake is van speciale medische concepten, zou algemene kennis van het Engels een grotere rol kunnen spelen bij het leesbegrip dan hierboven bij experiment 1 het geval was.

B. Proefpersonen, materiaal en methode

Het volgende experiment (experiment 2) betrof vier groepen proefpersonen: 9 2dejaars medische studenten, 9 4dejaars medische studenten, 11 2dejaars studenten Engels en 10 4dejaars studenten Engels.

De tekst was dezelfde als in experiment 1. De taak voor proefpersonen was in de tekst de lexicale items te onderstrepen waarvan de betekenis onbekend was.

C. Resultaten

Specialistische medische termen. Significante verschillen werden verkregen op gemiddelde aantallen onderstrepingen per groep voor specialistische medische termen; hoe meer medische kennis, hoe minder onderstrepingen.

Algemene medische termen. Er was geen duidelijke afname van moeilijkheidsgraad (d.w.z. minder onderstrepingen) voor algemene medische termen met de toename van de kennis van het Engels. Het was zelfs zo dat de moeilijkheid van deze lexicale items significant afnam met de toename van medische kennis.

Andere termen. Er was hier weer geen afname van moeilijkheid bij toename van van kennis van de Engelse taal. Significante afname van moeilijkheid was te zien bij toename van medische kennis.

Submedische items. Studenten Engels hadden significant minder moeilijkheden met deze items dan medische studenten; de 4dejaars medische studenten hadden significant minder moeilijkheden dan de 2dejaars medische studenten.

D. Discussie

Wat zijn de implicaties van deze resultaten? Ten eerste wordt bevestigd dat lexicale kennis is niet alleen een zaak is van "kale" woordkennis, maar ook een zaak van conceptuele achtergrondkennis. Volgens de resultaten van experiment 2, leidt een gebrek aan medische kennis tot moeilijkheden niet alleen met specialistische medische termen, maar ook met andere soorten inhouds-lexicale items.

De meer praktische implicaties van deze resultaten strekken zich het meest uit naar de rol van T2 medisch Engels in medisch onderwijs. Aangezien medische kennis een significante factor lijkt voor het begrip van zelfs die lexicale items

die niet vrijwel uitsluitend medisch Engelse teksten voorkomen, lijkt het raadzaam het onderwijs voor medische studenten in algemene-taal Engels (submedische items) zo goed mogelijk te integreren in de medische opleiding in zijn geheel.

Hoofdstuk 5: Het begrip van cognate medische termen

De twee volgende hoofdstukken van dit onderzoek behandelen het effect van interferentie (d.w.z. transfer van kennis van taalkundig items) uit het Nederlands op het begrip van Engelse medische termen voor medisch deskundige sprekers van het Nederlands. Dit hoofdstuk behandelt de volgende onderwerpen.

1. Verschillen en overeenkomsten tussen Nederlandse en Engelse medische termen

A. Verschillen tussen Nederlandse en Engelse medische termen

Medisch Nederlands en medisch Engels verschillen nauwelijks in de medische concepten waar medische termen in beide talen naar verwijzen. Veel lexicale vormen die benut worden voor de uitdrukking van medische concepten lijken op elkaar. Veel medisch Nederlandse en medisch Engelse termen zijn cognaten, en veel van deze termen zijn leenwoorden uit het Latijn.

B. Verschillen tussen Nederlandse en Engelse medische termen

De soorten lexicale verschillen zijn formele contrasten, misleidende cognaten, en "register-mismatches" van cognate termen.

2. T1-T2 transfer van medische termen

A. De Contrastieve Analyse Hypothese

De Contrastive Analyse Hypothese stelt ruwweg dat problemen van T2 leiders kunnen worden voorspeld d.m.v. de verschillen tussen T1 en T2. Aan de andere kant, zo stelt de hypothese, hebben T2 leiders de minste moeilijkheden op de gebieden waarin T1 en T2 op elkaar lijken. Op het gebied van specifiek lezen kan de volgende kritiek op de Contrastieve Analyse Hypothese worden geleverd.

1. Leerders associëren onbekende T2 lexicale vormen niet altijd met bekende T1 lexicale vormen die daarop lijken. ("transfer avoidance", d.w.z. afzien van transfer).
2. Leerders kunnen onbekende T2 vormen verwarren met daarop lijkende andere, bekende T2 vormen.
3. T2 gebruikers kunnen ook andere bronnen dan T1 gebruiken voor de toekenning van betekenis aan een onbekend T2 lexicaal item; betekenissen van T2 woorden kunnen uit de context worden afgeleid.

Daarom is de Contrastieve Analyse Hypothese vervangen door een hypothese die moeilijkheden van T2-leerders nauwkeuriger voorspelt en die de omstandigheden beschrijft waaronder T1 kennis in T2 taalgebruik interfereert. De alternatieve benadering van T1-T2 transfer die hieronder wordt besproken is niet zozeer gebaseerd op vergelijkingen van T1 en T2 vormen maar op de manier waarop lezers deze vormen verwerken.

B. De organisatie van lexicale kennis bij het T2 lezen

T1-T2 lexicale transfer impliceert onderlinge toegankelijkheid van T1 en T2 lexicale kennis. Hier rijst de vraag hoe zulke onderlinge toegankelijkheid is georganiseerd. Twee mogelijkheden doen zich voor voor de organisatie van T2 lexicale toegankelijkheid:

1. alle lexicale kennis wordt opgeslagen in één enkel mentaal lexicon, of
2. T1 en T2 lexicale kennis worden apart opgeslagen.

Het argument voor aparte T1 en T2 mentale lexicons is dat zo'n scheiding nodig is om verschil te kunnen maken tussen T1 en T2 lexicale items.

C. T1 en T2 lexicale kennis vs. het conceptuele systeem

Hoe interacteren de T1 en T2 mentale lexicons bij de totstandkoming van T1-T2 lexicale transfer? Deze vraag kan worden benaderd in termen van verschillende soorten relaties van tweetallen cognate lexicale items met het conceptuele systeem. De verschillende relaties die hieronder worden besproken zijn geïnspireerd door modellen van **bilingualisme**. Hier wordt bilingualisme gedefi-

nieerd in termen van de volgende relaties tussen de T1 en T2 mentale lexicons en het conceptuele systeem.

1. In het eerste soort relatie tussen een tweetal cognate lexicale items en het conceptuele systeem is er een sterkere directe relatie tussen elk van de cognate lexicale items met het conceptuele systeem dan dat de lexicale items onderling hebben. Zulke lexicale relaties zullen opgaan voor veel competente T2 gebruikers die niet bewust zijn van vormovereenkomst in een tweetal T1 en T2 woorden of zinnen.
2. Een andere relatie tussen twee cognate lexicale items is een die van een vertaling. Dit type relatie wordt het meest aangetroffen bij beginnende leerders. In dit type relatie is het T2 lexicale item gerelateerd aan het conceptuele systeem d.m.v. het T1 lexicaal item. Deze situatie is consistent met wat we kunnen verwachten in T1-T2 lexicale transfer, in de zin dat een onbekend T2 lexicaal item dat wordt geanalyseerd als een cognaat van een T1 lexicaal item zelf geen link zou hebben met conceptuele informatie.

De conclusie is dat verbintenissen mogelijk (maar niet altijd noodzakelijk) zijn tussen de T2 en T1 mentale lexicons.

D. De T1-T2 lexicale transfer hypothese

Op dit punt komt het lexicale analyse proces aan de orde gedurende welke T1-T2 lexicale transfer plaats vindt. T1-T2 lexicale transfer wordt vaak beschreven in termen van een aantal stadia. De eerste stadia zouden als volgt kunnen worden beschreven:

1. T2 input naar T2 mentale lexicon
2. er wordt geen passend item in het T2 mentale lexicon gevonden

De volgende stap in de T1-T2 lexicale transfer hypothese voor lezen zou zijn dat het T1 mentale lexicon zou worden afgezocht naar een item passend bij de T2 input. De vraag is nu welke factoren de mogelijke koppeling bepalen van de T2 input met het T1 lexicale item. Het is duidelijk dat waargenomen gelijkvormigheid met een T1 lexicaal item in T2 input een belangrijk criterium is bij het koppelen van T2 input aan een T1 lexicaal item. Zulke tweetallen vormovereenkomstige T1 en T2 woordvormen worden psychologische cognaten genoemd. Psychologische cognaten die semantisch op elkaar lijken zijn echte

cognaten. Psychologische cognaten die niet echte cognaten zijn, zijn misleidende cognaten.

Echter, waargenomen vormovereenkomst alleen is niet voldoende om T2 input aan een T1 lexicaal item te koppelen. Lezers kunnen besluiten niet te transfereren ondanks vormovereenkomsten tussen een onbekend T2 lexicaal item en een T1 lexicaal item (transfer avoidance). Een betere omschrijving van psychologische cognaten zou zijn dat ze in feite door een lezer als transfereerbaar worden beoordeeld. Dit wordt weergegeven in het volgende stadium van T1-T2 lexicale transfer.

1. T2 input naar T2 mentale lexicon
2. er wordt geen passend item in het T2 mentale lexicon gevonden
3. T2 input naar T1 mentale lexicon
4. koppeling van T2 input aan T1 psychologisch cognaat.

Specifiek in het geval van medische termen, kan een taalgebruiker de transfereerbaarheid van een medische term bepalen aan de hand van diens Latijnse vorm, gebaseerd op de wetenschap dat Latijnse vormen in het algemeen transfereerbaar zijn. Een betere omschrijving van een T1-T2 psychologisch cognaat is dus dat het hier gaat om een tweetal lexicale items in T1 en T2 die als transfereerbaar van T1 naar T2 worden beoordeeld op basis van taalkundige kennis van de lezer.

T1-T2 lexicale transfer vindt alleen plaats in het geval van bekendheid met het T1 lexicale item. Het ontbreken van een dergelijk T1 lexicaal item kan resulteren in T2-T1 lexicaal lenen i.p.v. transfer. Zulk lenen zou kunnen plaats vinden onder de aanname dat het relevante T2 lexicale item een psychologisch cognaat in T1 heeft, waarmee de lezer echter niet bekend is. Zulke pseudo-transfer vindt bijvoorbeeld plaats in medische vertalingen door niet-deskundigen.

De conclusie van deze discussie is dat T1-T2 lexicale transfer het volgende proces inhoudt (het verschil met de vorige versie zit in het laatste item):

1. T2 input naar T2 mentale lexicon
2. er wordt geen passend item in het T2 mentale lexicon gevonden
3. T2 input naar T1 mentale lexicon
4. koppeling van T2 input aan T1 psychologisch cognaat (item in het T1 mentale lexicon).

De hypothese over T1-T2 lexicale transfer die hier wordt aangehouden stelt dat T1-T2 lexicale transfer alleen dan plaats vindt als de T1 en T2 lexicale items psychologische cognaten zijn en als het T1 lexicale item aanwezig is in het T1 mentale lexicon van de lezer. Deze hypothese geldt alleen voor het lezen.

3. T1-T2 lexicale transfer en het begrip van T2 medische termen

A. Voorspelling

We nemen hier aan dat Nederlandse en Engelse medische termen van Grieks-Latijnse derivatie die qua vorm (bijna) identiek zijn ook herkenbaar zijn als psychologische cognaten. Een tweede assumptie is dat de cognate status van Nederlandse en Engelse medische termen de synonymiteit impliceert van die termen. M.b.t. de transfereerbaarheid van Nederlandse medische termen van Grieks-Latijnse afkomst, voorspelt de T1-T2 lexicale transfer hypothese voor lezen dat medische deskundige groepen Nederlandse proefpersonen significant hoger scoren op een leestoets met Engelse medische termen van Grieks-Latijnse afkomst dan medisch niet-deskundige Nederlandse proefpersonen.

B. Experimentele toetsing van de T1-T2 lexicale transfer hypothese voor lezen

De data van experiment 1 (zie hoofdstuk 4) werden opnieuw gebruikt om de T1-T2 lexicale transfer hypothese voor lezen te toetsen. De Engelse medische termen van experiment 1 hadden Nederlandse cognate tegenhangers. Deze termen leken dus geschikt om de T1-T2 lexicale transfer hypothese voor lezen te verifiëren.

Het resultaat van experiment 1 was dat de 4dejaars studenten Gezondheidswetenschappen significant hoger scoorden op authentieke termen dan de Letterenstudenten (geen studenten Engels). De scores voor de 2dejaars studenten Gezondheidswetenschappen kregen een plaats daartussen in, niet significant verschillend van de andere twee. Dit resultaat steunt de T1-T2 lexicale trans-

fer hypothese, die voorspelt dat T1-T2 transfer van specialistische medische termen alleen plaats vindt voor medisch deskundige lezers.

Bij wijze van contrast bleven de scores gelijk voor de in het algemeen niet-cognate tekst-herschrijvingen bij toename van medische kennis. Dit is wat werd voorspeld door de T1-T2 lexicale transfer hypothese, d.w.z. dat T1-T2 transfer plaats vindt m.b.t. medische termen, en niet m.b.t. herschrijvingen van die termen.

De hoofdconclusie is dat de Nederlandse-Engelse cognate status van geschreven Engelse medische termen begripsbevorderend werkt voor medisch onderlegde Nederlandse lezers. Een praktische implicatie hiervan is dat moeilijkheden van medisch onderlegde Nederlandse lezers met Engelse medische teksten waarschijnlijk niet te wijten zijn aan de medische termen in die teksten, aangezien de meeste Engelse medische termen een cognate Nederlandse tegenhanger hebben.

Hoofdstuk 6: De Nederlandse voorkeur voor cognate medische termen

Een vraag die in hoofdstuk 5 onbeantwoord bleef was in hoeverre cognate medische termen daadwerkelijk door Nederlandse medische experts worden gebruikt. Theoretisch is er een keuze tussen cognate en niet-cognate vormen voor de uitdrukking van medische concepten. Voorkeur voor cognate termen zou het begrip helpen vergroten van Engelse medische termen. Voorkeur voor niet-cognate vormen zou zulk begrip niet helpen vergroten.

1. Alternatieven voor de vorming van medische termen

A. Standaard internationale medische termen

De meeste Nederlandse en Engelse cognate medische termen zijn ook de standaard internationale vormen. Het voordeel van zo veel mogelijk standaard internationale medische termen kan worden uitgedrukt in termen van hun verstaanbaarheid en hun toepasselijkheid. Standaard internationale medische termen vergroten zonder twijfel internationaal wederzijds begrip op het gebied van wetenschap en technologie. Aangenomen wordt dat de toepasselijkheid van standaard internationale medische termen voortkomt uit het wijd verbreide gebruik dat ervan wordt gemaakt.

Er zijn ook nadelen aan het gebruik van standaard internationale medische termen. Eén denkbaar nadeel is dat de Latijnse en andere vormen die voor medische internationalismen worden gebruikt vaak onbekend zijn aan de medische leek. Als dat zo is, geldt de hierboven genoemde verstaanbaarheid alleen voor medische experts. Echter, op basis van de data van hoofdstuk 4 kon worden geconcludeerd dat lexicale keuze alleen geen significant effect heeft op begrip; begrip wordt geholpen door lexicale keuze in samenhang met de vereiste achtergrondkennis.

B. Lenen van medisch Engels

De tweede mogelijkheid voor de vorming van termen, en de tweede mogelijkheid voor de formatie van cognate medische termen, is eenvoudigweg overgaan tot het gebruik van Engelse medische termen. Het sterkste argument hiervoor is dat Engels toch al zo vaak wordt gebruikt in professionele medische communicatie, zodat medisch Engelse termen meestal internationaal bekend zijn. Eén reden voor het toenemende gebruik van Engelse op dit gebied lijkt te zijn dat de beste wetenschappelijke bijdragen in de geneeskunde in internationale Engelstalige vakbladen worden gepubliceerd.

Merk op dat de internationale standaardisatie van medisch Engelse termen samenvalt met de toenemende internationale standaardisatie van Latijnse termen. Er is al weinig of geen verschil tussen veel bestaande Engelse medische termen en de medische termen in andere talen zoals het Nederlands.

C. Taalspecifieke medische termen

De invoering van taalspecifieke medische termen i.p.v. Latijnse of Engelse internationale standaard termen wordt gemotiveerd door

1. de wens medische communicatie zo begrijpelijk mogelijk te maken voor een breed publiek of
2. zorgen m.b.t. de overleving van de het medische register in de moedertaal.

Merk echter op dat de bevindingen in hoofdstuk 4 aangeven dat taalspecifieke termen niet meer bijdragen tot de algemene begrijpelijkheid van een medische tekst dan de overeenkomstige cognate vormen. De enige goede reden voor een voorkeur voor taalspecifieke termen is dus de zorg voor hun overleving.

Laten wij ons nu buigen over de vraag of Nederlandse medische experts voorkeur hebben voor internationaal cognate dan wel niet-cognate medische termen. In dit opzicht kan kennis van Nederlandse medische termen worden beschreven volgens de volgende criteria.

1. Noodzakelijk cognate termen. We moeten aannemen dat tenminste een deel van de medische termen in het mentale lexicon van Nederlandse medische experts uit cognate "internationale" termen moet bestaan die de enige beschikbare zijn om een medisch concept uit te drukken. Er zijn duidelijk veel van deze voornamelijk Grieks-Latijnse derivaties.
2. Noodzakelijk taalspecifieke termen. Deze zouden de concepten dekken waarvoor er alleen een taalspecifieke term beschikbaar is.
3. Doubletten van cognate en niet-cognate termen. In dit geval is een keuze mogelijke tussen een cognate en een niet-cognate term.

De voorkeur van Nederlandse medische experts voor Nederlandse-Engelse cognate medische termen kan alleen worden getoetst m.b.t. doubletten van cognate en non-cognate termen.

In experiment 3 werd onderzocht in hoeverre Engelse medische termen die als doubletten vertaalbaar zijn in het Nederlands cognate of niet-cognate Nederlandse vertalingen krijgen. Aangenomen werd dat zulke vertalingen de voorkeur aan zouden geven voor het gebruik van hetzij cognate, hetzij niet-cognate Nederlandse medische termen.

2. Proefpersonen, materiaal en procedure

De proefpersonen voor experiment 3 waren 27 Nederlandstalige artsen. Het toetsmateriaal bestond uit 19 zinnen met 31 algemene en specialistische Engelse medische termen. De zinnen werden gehaald uit diverse farmaceutische brochures en artikelen in medische vakbladen. Onderscheid werd gemaakt tussen algemene en specialistische medische termen om na te gaan of dit enig effect had op lexicale keuze. De meeste gebruikte termen hadden zowel een Nederlandse cognate of een niet-cognate vertaling. De toets bestond uit Nederlandse zinnen waarin een aantal medische termen ontbraken - de lege plekken waren voorzien van de te vertalen Engelse medische termen.

3. Resultaten

A. Voorkeur voor soort medische termen

Vertalingen werden gegeven voor drie soorten items: controle-items met alleen cognate vertalingen, algemene medische termen en specialistische medische termen.

De controle items kregen cognate vertalingen (met één uitzondering).

Er waren grote verschillen in de conventies m.b.t. cognate/niet cognate vertalingen van algemene termen. Voor iets meer dan de helft van de algemene medische termen vertalingen werd de voorkeur gegeven aan cognate vertalingen (geen significante meerderheid).

Een vergelijkbaar resultaat werd behaald bij de specialistische medische termen. De meeste specialistische medische termen kregen cognate vertalingen (ook hier geen significant verschil).

Er werd evenmin een significant verschil gevonden tussen het gemiddelde aantal cognate vertalingen van specialistische en algemene medische termen.

B. Individuele voorkeur voor cognate vs. niet-cognate vertalingen

Het gemiddelde percentage per proefpersoon voor algemene medische termen met een cognate vertaling was iets lager dan voor specialistische medische termen (beide rond de 50%).

4. Discussie

De belangrijkste conclusie is dat wanneer de keuze bestaat tussen een niet-cognate term en cognate term, de kans dat Nederlandse medische experts één van de geboden mogelijkheden selecteren ongeveer gelijk is; de keus is afhankelijk van zowel de medische termen als persoonlijke voorkeur.

Vanuit taalkundig oogpunt kan niet worden voorspeld of een cognate of een niet-cognate wijze van uitdrukken de voorkeur krijgt (d.w.z. wanneer beide mogelijkheden daadwerkelijk aanwezig zijn). Er is dus geen significante voorkeur voor Engels-Nederlandse cognaten.

Hoofdstuk 7: Conclusie

De twee onderzoeksvragen waren:

1. of Engelse specialistische medische termen meer begripproblemen veroorzaken dan "vereenvoudigde" algemeen-Engelse herschrijvingen van deze termen;
2. of de cognate status van Nederlandse en Engelse medische termen het begrip bevordert van de Engelse termen door Nederlandse lezers;

Antwoorden op deze vragen werden gegeven in termen van theoretische psycholinguïstiek en praktische toepassing.

1. Het psycholinguïstische uitgangspunt

Het resultaat voor de eerste onderzoeksvraag, dat er geen verschil is in begrip voor een groep Nederlandse lezers van Engelse specialistische medische termen vs. herschrijvingen van die termen, heeft de volgende psycholinguïstische implicatie. Wat dit resultaat aangeeft is dat succesvol leesbegrip op lexicaal niveau niet wordt bepaald door lexicale analyse met input van kale (d.w.z. niet-conceptuele) lexicale kennis. Het resultaat van hoofdstuk 4 geeft aan dat bronnen van conceptuele kennis ook worden betrokken bij lexicale analyse.

Het tweede-taal perspectief voor de begrijpelijkheid van medische termen is inherent aan de tweede vraag van dit onderzoek, d.w.z. of vormgelijkenis van Nederlandse en Engelse medische termen begripsbevorderend werkt voor Nederlandse lezers. In de discussie in hoofdstuk 6 is er mee rekening gehouden dat overeenkomsten tussen eerste en tweede talen niet altijd tot beter begrip leiden. Gesteld werd dat vormgelijkenis alleen geen transfer veroorzaakt, maar dat het de waargenomen transfereerbaarheid is, in dit geval de kennis dat termen met Latijnse vormen in het algemeen transfereerbaar zijn, dat aanleiding geeft tot transfer.

2. Het toepassingsperspectief

In hoofdstuk 1 werd een probleem voor Nederlandse medische faculteiten besproken, nl. dat studenten in het algemeen de voorkeur geven aan Nederlandse teksten boven de vereiste Engelse teksten. Dit was zorgwekkend omdat er voor veel van de vereiste Engelse leerboeken geen Nederlandse vertalingen of andere Nederlandse equivalenten bestaan.

Hoe kunnen de resultaten van dit onderzoek een rol spelen bij de oplossing van deze problemen? De eerste onderzoeksvraag die hierboven werd gesteld was of Engelse specialistische medische termen meer begripproblemen veroorzaken dan "vereenvoudigde" algemene-Engelse herschrijvingen van deze termen. In hoofdstuk 4 hebben we gezien dat dit is niet het geval is: er is geen verschil in leesbegrip tussen specialistische medische termen en hun herschrijvingen. De resultaten van hoofdstuk 4 geven aan dat leesproblemen voor de betrokken studenten niet worden opgelost door vereenvoudiging van de specialistische medische termen.

Wat in hoofdstuk 4 wordt aangetoond is dat kennis van medische termen zowel als medische concepten het begrip van termen vergroot. Als leesproblemen gerelateerd worden zijn aan moeilijkheden met medische termen, kunnen deze problemen worden opgelost door meer kennis van medische termen en medische concepten.

Aan de andere kant werd in hoofdstuk 4 ook aangetoond dat algemene-taal inhoudswoorden in Engelse medische teksten (submedische items) meer problemen veroorzaken bij het lezen door Nederlandse medische studenten dan specialistische medische termen. Dit geeft aan dat leesmoeilijkheden van Nederlandse medische studenten kunnen afnemen als meer aandacht wordt geschonken aan het onderwijs in algemeen-Engels vocabulaire - typisch een taak voor medisch Engels onderwijs.

Wat betreft de tweede onderzoeksvraag, de resultaten van hoofdstuk 5 geven aan dat gelijkvormigheid van Nederlandse en Engelse medische termen begripsbevorderend werkt. Voorkeuren voor taalspecifieke Nederlandse of andere niet-cognate Nederlandse medische termen boven hun Nederlandse-Engelse cognate tegenhangers kan dus extra moeilijkheden veroorzaken bij het verwerven van Engelse medische termen. Tenslotte gaven de bevindingen van hoofdstuk 6 aan dat niet-cognate medische termen een belangrijke rol spelen in Nederlandse medische communicatie. Er mag dus worden aangenomen dat

voor gebruikers van medisch Nederlands het begrip van Engelse medische termen niet altijd eenvoudig een zaak is van het invullen van een Nederlandse termen die er qua vorm op lijken.

Stellingen

1. Een cursus in een vreemde taal in het kader van een technische of wetenschappelijke opleiding dient aan te sluiten op de inhoud van de overige vakken.
2. Van de temporele coördinaten S , R en E die in Reichenbach (1947) worden gebruikt voor de semantische representatie van Engelse werkwoordstijden, is R redundant (H. Reichenbach, *Elements of Symbolic Logic*, New York: Macmillan, 1947).
3. Een docent van een vreemde taal dient bij voorkeur een *terzake deskundige native speaker* van het Nederlands te zijn.
4. In zekere zin is taalverandering inderdaad taalachteruitgang.
5. Het vertalen van een pagina tekst duurt gemiddeld een uur en dient overeenkomstig te worden gehonoreerd.
6. Volgens de structuralisten wordt de syntactische beschrijving van de ontelbaar vele zinnen van een taal inductief afgeleid uit een betrekkelijk beperkt corpus van voorbeelden. Deze opvatting vormt geen zwak punt in de filosofische basis van het structuralisme.
7. Het kunnen lezen staat tot deskundigheid op het gebied van leesbaarheid als het kunnen typen staat tot deskundigheid op het gebied van de informatica.