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PRIOR KNOWLEDGE, L2 WORKING MEMORY CAPACITY, AND L2 READING COMPREHENSION: HOW DO THEY RELATE?

por

ANA CECÍLIA DA GAMA TORRES

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Dra. Barbara Oughton Baptista
Coordenadora

BANCA EXAMINADORA:

Dra. Lêda Maria Braga Tomitch
Orientadora e Presidente

Dr. José Luís Meurer
Examinador

Dra. Reinildes Dias
Examinador

Florianópolis, 11 de dezembro de 1998

para Luís
Ney e
Maria do Carmo

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ABSTRACT

PRIOR KNOWLEDGE, L2 WORKING MEMORY CAPACITY, L2 READING COMPREHESION: HOW DO THEY RELATE?

ANA CECÍLIA DA GAMA TORRES

UNIVERSIDADE FEDERAL DE SANTA CATARINA
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Supervising Professor: Dra. Lêda Maria Braga Tomitch

The objective of this study is to investigate how prior knowledge, L2 working memory capacity, and L2 reading comprehension relate. The claim is the following: a high degree of domain knowledge enhances readers' processing efficiency so as to yield a larger reading span, and also higher levels of comprehension and recall. An Experiment was conducted to compare the performance of two groups of native speakers of Portuguese when reading in English. Subjects differed in area of expertise, five of them were high knowledge in electrical engineering, and the other five high knowledge in linguistics. Their performance was compared in the reading span test (Daneman and Carpenter, 1980), and in reading comprehension tests, namely, free written recall, and comprehension questions. Subjects with high knowledge in engineering turned out to be less proficient in English than the ones with high knowledge in linguistics. Therefore, the results of the present study can be attributed not only to the fact that readers differ in area of expertise, but also to the fact that they differ in language proficiency. The processing of information in L2 imposed a heavier burden on the working memory of the less proficient readers, so their reading spans were smaller. On the other hand, a high degree of domain knowledge yielded higher scores on the span tests, and on the reading comprehension tests. In short, it seems that knowledge activation can to some extent compensate for the processing difficulties in L2. However, it is not argued here that that domain knowledge will enable L2 readers to entirely overcome inefficiencies at a linguistic level. The results obtained in the present investigation suggest that

readers' processing efficiency affects their working memory capacity and also the quality of comprehension and recall they achieve.

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RESUMO

PRIOR KNOWLEDGE, L2 WORKING MEMORY CAPACITY, L2 READING COMPREHESION: HOW DO THEY RELATE?

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Orientadora: Dra. Lêda Maria Braga Tomitch

Este trabalho tem como objetivo investigar como o conhecimento prévio sobre um determinado assunto, a memória operacional em L2, e a leitura em L2 se relacionam. O argumento principal é que o conhecimento prévio permite aos leitores processar a informação de maneira mais eficiente, e portanto obter uma melhor compreensão do texto. Um experimento foi conduzido para comparar o desempenho de dois grupos de falantes nativos de português que leram textos em inglês. Os informantes foram divididos em dois grupos de acordo com a sua área de conhecimento, um grupo de lingüística, e outro de engenharia elétrica. A memória operacional foi medida através do Teste de Capacidade de Leitura (Daneman and Carpenter, 1980), e a compreensão em leitura, medida através de duas tarefas - evocação do conteúdo lido, e respostas a perguntas de compreensão sobre o texto. O grupo de informantes com conhecimento prévio em engenharia era menos proficiente em L2 do que o outro grupo, portanto os resultados encontrados são atribuídos a dois fatos: os informantes diferem em níveis de proficiência em L2, e em área de conhecimento. Os resultados indicam que a capacidade de memória operacional em L2 é sensível à proficiência que o leitor tem em um segundo idioma. O processamento de informação em L2 impôs uma sobrecarga maior na memória operacional dos leitores que eram menos proficientes. Mas, por outro lado, o conhecimento prévio possibilitou aos leitores ter um desempenho melhor no teste de memória operacional, e nos testes de compreensão de textos. Até um certo ponto, o conhecimento prévio compensou as dificuldades que os leitores menos proficientes encontraram ao processar informação em L2. No entanto, o conhecimento

prévio não faz com que os leitores superem totalmente as suas deficiências lingüísticas em L2. Os resultados indicam que a eficiência no processamento de informação tem uma grande influência na capacidade de memória operacional e na compreensão em leitura.

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CHAPTER I

INTRODUCTION

PRELIMINARIES

Prior knowledge, L2[1] working memory capacity, and L2 reading comprehension: how do these three variables relate? The three main points underlying this discussion are: first, individuals have a limited capacity to process information (Daneman and Carpenter, 1980, 1983; Tomitch, 1995, 1996, 1998, among others); second, processing can be even more demanding in L2 (Berquist, 1997); third, readers process information in the light of what they already know (Afflerbach, 1990; Fincher-Kiefer, Post, Greene, and Voss, 1988, among others).

The term working memory can be explained as a "brain system" which has an essential role in language comprehension (Baddeley 1992: 255). It is the system used for the simultaneous storage and processing of information as language comprehension takes place. In other words, not only should readers process the flow of incoming input, but in order to integrate the text, they should also maintain at least the gist of the previously read information in working memory (Just and Carpenter,1992). Working memory is a system with limited capacity, so a trade-off between the storage and the processing functions comes into play (Daneman and Carpenter 1980, 1983, Just and Carpenter1992, Tomitch, 1995, 1996, 1998, among others). The trade between the

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1. When it comes to the distinction between second language and foreign language, some authors, for instance, Aebersold and Field (1997) use both L2/FL together. Other authors such as Berquist (1997), although he tested native speakers of French in France, he prefers to use L2. As for Harrington and Sawyer (1992), they tested Japanese subjects in Japan, but they also have chosen to use L2. In the present study, the author has also decided to use L2.

processing and storage functions of working memory takes place under a scheme of allocation of resources (Just and Carpenter, 1992).

Since the capacity of working memory is limited, readers can use some resource-saving mechanisms so as to avoid exceeding the available resources. For instance, in order to reduce the demands on the storage of information readers do not recall every individual proposition from a text, but they tend to condense the information so as to construct the gist of a text (Kintsch and van DijK, 1978). Moreover, it is also possible to lessen the demands on the processing of information. Indeed, schemata activation may guide the scheme of allocation of resources (Rumelhart, 1981). As a result, the processing of information will be facilitated, and the overall demands on working memory will be minimised (Just and Carpenter, 1992).

Even though the capacity of working memory is finite, the scheme of allocation of resources is "dynamic" (Just and Carpenter, 1992: 144). Once readers are able to put to use these resource-saving mechanism, they will have a larger pool of cognitive resources to draw upon, that is, a larger reading span. This is particularly important for L2 readers because working memory capacity seems to be even more limited in L2 (Berquist, 1997). In other words, on the one hand, the processing of information in L2 may impose a heavier burden on readers' working memory; on the other hand, schemata activation may enable readers to spend fewer resources on the processing of information (Afflerbach, 1990; Fincher-Kiefer et al., 1988). In short, knowledge activation seems to some extent to make up for a limited memory capacity. The present study sets out to investigate how knowledge activation affects the memory span of L2 readers and the levels of comprehension they achieve.

THE STUDY

In order to carry out the present investigation, ten L2 readers, graduate students, were divided into two groups. Five subjects were high knowledge in linguistics, and five high knowledge in electrical engineering. An Experiment was conducted to compare the performance of the ten subjects when reading in English. Their performance was compared in reading span tests, and in reading comprehension tests, namely, free written recall, and comprehension questions. Moreover, a questionnaire was applied before the reading comprehension tests so as to assess whether subjects were suitable for the purposes of the study.

RESEARCH QUESTIONS

(1) Does domain knowledge yield a larger working memory span?

(2) Are high knowledge readers likely to make more accurate inferences than low knowledge readers?

(3) Are high knowledge readers better able to integrate different parts of the text so as to extract the theme of the passage?

(4) Are high knowledge readers able to present higher levels of recall?

(5) Does domain knowledge result in shorter reading time for the domain related and the control texts ?

SIGNIFICANCE OF THE STUDY

This study has two main justifications. First, in academic settings students read to obtain information and become more knowledgeable, and the ones who cannot read and write well are less likely to succeed. Moreover, not only are the ones who reach graduate courses expected to perform well in reading tasks, but they are also required to read well in a foreign language, specially in English. Since our ability to process

information is limited, and it can be even more restricted in a second language (Berquist, 1997), it is important for L2 readers to seek greater processing efficiency, in other words, they should try to make the most of their limited resources. Indeed, it seems that knowledge activation may provide some compensation for our limited capacity. Therefore, one of the goals of this research is to shed some light on how prior knowledge affects L2 readers' processing efficiency.

Second, most of the studies on individual differences in working memory capacity were carried out in the readers' first language (Daneman and Carpeter, 1980, 1983; Fincher- Kiefer et al. 1988, Tomitch, 1995, 1996,1998 among others). To the writer's knowledge, there are very few studies on working memory in L2.

ORGANISATION OF THE THESIS

In chapter two, the literature is reviewed. This chapter is organised in three parts, the first reviews working memory capacity, the second part is concerned with schema theory, the third part establishes a connection between the two former parts. A great deal has been written about working memory capacity, and schema theory. As it is not possible to review all these studies, the researcher attempted to select the materials she considers most relevant to the present investigation. Some of the research reported here has already been addressed in the work developed by Mota (1995), and Tomitch (1995, 1996, 1998).

In chapter three, the methodology used in the present study is described.

In chapter four, the research questions raised in chapter three are retaken. The results of each question are presented, and also analysed in the light of other studies. Moreover, the scoring procedure for the reading span test, and the reading comprehension tests is also explained.

In chapter five, the findings of the study are commented on. This chapter also reports the limitations of the study, and presents suggestions for further research. Finally, it also includes the pedagogical implications of the results obtained in the present investigation.

CHAPTER II

REVIEW OF LITERATURE

ON WORKING MEMORY CAPACITY

This review on working memory is organised in two parts. First, it provides an account of the psychometric approach, a conception of working memory developed by Daneman and Carpenter (1980, 1983), Just and Carpenter (1992) in North America, and also by Tomitch (1995, 1996, 1998), and Mota (1995) in Brazil. This approach relies heavily on experimental results, and it focuses on the functional aspects of working memory. Second, a different account of working memory will be reported, the work developed by Baddeley (1990, 1992) in England. His work relies on neuro-psychological evidence found in patients who have some kind of brain deficit, and it highlights the structural aspects of the system. Although Baddeley's approach differs from the one adopted in the present study, given its importance, it is worth comparing his approach to the perspective addressed here.

The Psychometric Approach

Initially, this review compares the concept of working memory to the traditional concept of short term memory. Moreover, it reports five pieces of research: first, the work of Daneman and Carpenter (1980), second, Daneman and Carpenter (1983). This review starts with Daneman and Carpenter because they devised the reading span test which is also used in the Experiment carried out here. Daneman and Carpenter (1980, 1983) interpret individual differences in working memory as efficiency of processing. The third study reported here is Just and Carpenter (1992). They do not interpret

individual differences in working memory only in terms of processing skills. According to them, individual differences may also be related to long-term memory activation. These three studies report a correlation between L1 working memory capacity and L1 reading comprehension. The last two studies reviewed in this section, namely, Harrington and Sawyer (1992), and Berquist (1997) turn out to be very important for the present investigation because they found a correlation between L2 working memory capacity and reading comprehension in L2.

Although the results from the research on working memory capacity and reading comprehension are correlational in nature, they indicate that this capacity is an important source of individual differences in reading comprehension (Daneman and Carpenter, 1980: 463). By contrast, research indicates that the traditional view of short term memory cannot fully account for individual differences in reading comprehension. According to the traditional conception of short term memory, differences in memory capacity can be attributed to a passive storage capacity. Former research on short term memory used to place emphasis on the storage of items for later retrieval after quick intervals (Just and Carpenter, 1992: 122), and the limitation of short memory was explained in terms of the number of items it could hold at one time (Tomitch, 1995: 2). Moreover, short term memory was also viewed as the path to long-term memory, that is, before reaching long-term memory information would have to go through short-term memory, where it was memorised by means of rehearsal or elaboration. Tomitch (1995) explains that the modern view on working memory was derived from the traditional concept of short term memory, and it still maintains the notion of a transient and limited system (p.2). However, it is the current conception of working memory as a dynamic system, having storage and processing functions, that can actually depict the information-processing operation involved in language comprehension (Daneman and

Carpenter 1980, 1983; Just and Carpenter 1992; Tomitch, 1995, 1996, 1998). The limitation in this system is interpreted in terms of the resources available to process and store information (Tomitch, 1995: 2).

Studies on Working Memory in L1

A processing efficiency explanation. Daneman and Carpenter (1980) developed an experimental task, namely, the reading span test, which puts together the storage and processing functions of working memory. Such test is reported to correlate with reading comprehension measures. Indeed, the results obtained by Daneman and Carpenter indicate that the reading span test correlated with three measures of reading comprehension: the Verbal Scholastic Aptitude Test (SAT), and two other tests involving fact retrieval, and computation of pronominal reference. The results found by Tomitch (1995, 1996, 1998) also point to a similar correlation: she found a correlation between readers' span measure and their ability to perceive textual structure. By contrast, Daneman and Carpenter say that the traditional digit and word span tests did not significantly correlate with any reading comprehension measures. These results suggest that, on the one hand, the reading span test can be considered an index of working memory capacity because it taxes both storage and processing. On the other hand, it seems that the traditional span measures tend to reflect a passive storage capacity.

The second study to be mentioned is Daneman and Carpenter (1983). They set out to investigate the role of working memory in the process that integrates just read information with the preceding text. The integration process was examined by observing how readers detect and recover from inconsistencies. According to Daneman and Carpenter, to detect an inconsistency, the reader has to incorporate the new chunk

of information in working memory and join it to information previously read (p.562). Detecting inconsistencies is expected to be difficult, if the representation of previous relevant information, at least the gist of it, is no longer available in working memory (p.562). As for the process of recovering, it is even more difficult, readers need a precise phonological or visual representation of the previous ambiguous information in working memory. Indeed, the representation of only the gist of the previous information is not sufficient for recovery to take place (p.563). Daneman and Carpenter (1983) go on to explain that small span readers, that is, the ones with a small working memory capacity, spend so much of their working memory resources on processing incoming information that they are less likely to hold earlier information in working memory, or they may be unable to retrieve it from long-term memory (p.562). For such reasons, small span readers are not likely to recover from an inconsistency (p.568).

Daneman and Carpenter (1980, 1983) raise some important points: first, individual differences in working memory are manifest because readers differ in their overall processing efficiency. Since it taxes both the storage and processing of information, the reading span measure is said to be an indicator of processing efficiency. According to these researchers, poor readers allocate a great deal of their working memory resources to process information, or to perform the component processes of reading, namely, decoding, lexical accessing, parsing, inferencing, and integrating (Daneman and Carpenter, 1980: 451). Therefore, poor readers have less resources available to store and maintain information in working memory; hence, they will probably face greater difficulties integrating and comprehending texts. Second, the studies of Daneman and Carpenter (1980,1983), and of Daneman and Green (1986) suggest that processing efficiency is "task specific" (Daneman and Green 1986: 15). Put another way, memory capacity varies as a function of how skilled an individual is at the

processes required by a particular task (p.17). Third, as the results obtained in the experiments above are correlational in nature, most researchers acknowledge that a cause/effect relationship cannot be established between processing efficiency and reading performance.

A capacity theory of comprehension. Just and Carpenter (1992) proposed a capacity theory of comprehension, which attempts to explain how our ability to comprehend language is constrained by working memory capacity. Their theory differs from the processing efficiency explanation, which interprets individual differences in terms of efficiency to perform the component reading processes (Daneman and Carpenter, 1980, 1983). According to the capacity theory of comprehension, reading ability depends on the component processes: decoding, lexical accessing, parsing, inferencing, and integrating (Daneman and Carpenter, 1980: 451), which are efficient or not, due to an overall, fixed, capacity, namely, an activation limit.

According to this framework, the contents of working memory consist of information retrieved from long term memory. Nevertheless, to become part of working memory, this information has to be activated above some critical threshold level. Capacity is defined here as the "maximum amount of activation available in working memory" to sustain the demands of storage and processing (Just and Carpenter, 1992: 123). Individuals differ in the total amount of activation they have at their disposal in working memory for satisfying the demands of storage and processing (p. 124).

Daneman and Carpenter (1992) describe capacity as "an energy source some people have more than other people have" (p.124). In other words, they suggest that an individual with a larger capacity can take advantage of a larger "supply" of cognitive resources (p.124). Indeed, high span readers are likely to perform better than low span readers. However, the differences in their performances become evident when the task

is so difficult as to strain the available resources, if the task is easy, differences may not be manifest. Capacity limitations tend to affect performance only when task demands strain the available store of resources, that is, "when the activation limit is about to be exceeded" (p.123). In short, when the total amount of activation available to the reader is less than the amount necessary to carry out a task, the constraint on capacity manifests itself. On the other hand, differences in processing efficiency may show up regardless of the demands of the task.

Just and Carpenter (1992) point out that the capacity theory is compatible with the processing efficiency account. Choosing between these two accounts of individual differences in working memory is just a matter of selecting the most suitable explanation for a particular evidence (p.145). In the present study, if the hypothesis under investigation turns out to be confirmed, it will favour a processing efficiency explanation. First, L2 working memory seems to be bound up with a processing efficiency explanation (Berquist 1997). Second, it is expected here that schemata activation will enhance readers' processing efficiency so as to yield a larger reading span. As a result, readers will present higher levels of comprehension and recall. Indeed, knowledge tends to make the component reading processes more efficient, such process if slow, would use up the resources of working memory (Afflerbach, 1990: 35). For instance, when readers activate schemata, they might gain access to domain specific vocabulary, so word recognition, and derivation of word meaning will be easier, and faster (p.35). As a result, readers will spend fewer cognitive resources on it (p.35). On the other hand, if readers lack content knowledge, they are likely to make greater effort to process information. Consequently, they are expected to have a smaller reading span, which may lead to deficits in comprehension and poorer levels of recall.

Studies on Working Memory in L2

Harrington and Sawyer (1992) tested a group of Japanese, advanced learners of English as a second language. They found a strong correlation between the L2 reading span test measured by the Daneman and Carpenter task, and the L2 reading comprehension tests, namely, the reading and grammar sections of the Test of English as a Foreign Language (TOEFL). On the other hand, the L2 simple span measures, the traditional digit and word span tests did not correlate significantly with the L2 reading comprehension measures or the L2 reading span measure. These results lend support to the interpretation of the Daneman and Carpenter reading span task as an index of working memory capacity even if the experimental task is carried out in the foreign or second language. As for the correlation between the memory span measures across L1 and L2, it was in "moderate-to-strong range" (p.32). Harrington and Sawyer explain that this correlation only hinted a relationship between L1 and L2 working memory capacity.

Berquist (1997) carried out an experiment with a group of native speakers of French, advanced and intermediate learners of English as a second language. They were given two types of memory tests, namely, a word span and a reading span test in both L1 (French) and L2 (English). The reading span tests, L1 and L2, correlated strongly with the reading section of Test of English for International Communication (TOEIC). Moreover, reading spans in L1 turned out to be larger than in L2. In other words, subjects presented a reduced working memory span in L2. This result was considered an indication that L2 working memory capacity is bound up with efficiency of processing. Put another way, Berquist argues that an individual is not able to process information so easily in L2 as in L1 even at very advanced levels (p.472). He also suggests that L2 working memory seems to be a good indicator of L2 proficiency (p.471). Finally, his results are slightly different from the ones of Harrington and Sawyer (1992), Berquist

reports that L1 working memory was more significantly correlated with L2 working memory. According to him, memory capacity in L1 and L2 might be related because the same task, namely, the Daneman and Carpenter (1980) reading span test, is the index of working memory capacity in both L1 and L2. However, L2 working memory is not exactly proportional to L1 capacity. As Berquist puts it,

> *We might expect L1 and L2 to correlate weakly if L2 WM is not an indicator of fixed capacity but of L2 proficiency. Nonetheless, it is evident that the same test (rdg span) is measuring a fixed capacity and should produce at least moderate correlations. (p.471)*

Although working memory in L2 seems to best explained in terms of a processing efficiency explanation (Berquist, 1997), and L1 working memory may be related to a fixed capacity (Just and Carpenter, 1992), it seems worth investigating to what extent L1 working memory can influence processing efficiency in L2. If a reader has a small working memory span in L1, will this disadvantage necessarily hinder L2 processing efficiency? Or can individual differences in L2 be interpreted only as function of readers' proficiency in L2? Harrington and Sawyer (1992) pointed to the importance of investigating these issues. Berquist (1997) to some extent answered the second question. As for the first question, it still remains to be answered. Nevertheless, this discussion is beyond the scope of the present study.

A Multi-Component Model of Working Memory

Baddeley (1990) highlights the structural aspects of working memory (Cantor, Engle and Hamilton, 1991: 241), that is, for Baddeley working memory is divided into component parts, which are interconnected. In one of his experiments, Baddeley (1990) used a dual task technique in which subjects were required to store sequences of digits in short-term memory while simultaneously carrying out other tasks such as syntactic

reasoning tests, and comprehension of prose passages (p.p.69-70). Were working memory a single unitary store, its limited capacity would have been completely consumed by the digit span task to the detriment of reasoning, and comprehension tasks (p.69). In fact, results indicated that subjects had some difficulties in the reasoning, and comprehension tasks. However, unexpectedly, the extent of the "disruption" caused by the digit test was not so great as to prevent subjects from performing these reasoning and comprehension tests (p.95). Baddeley argued that a unitary working memory system could not really account for the results of his experiment. In other words, the digit span test was handled by one of the subsystems of working memory, while leaving the other component parts available for performing the other tasks (p.71).

Grounded on these results, Baddeley (1990, 1992) puts forward a multi-component model of working memory, that is, a tripartite model. According to his model, a "controlling attentional system" or the central executive regulates the other systems (Baddeley, 1990:71), namely, the articulatory or phonological loop, and the visuo-spatial scratchpad or sketchpad (p.71). As for the phonological loop, it is assumed to manage "speech based information" (Baddeley, 1990: 72); moreover, it comprises two components: (1) a phonological store whose main function is to keep "speech based information" (p.72), (2) and an articulatory control process that provides the phonological store with information. Indeed, the articulatory control process has two main functions. First, by means of a process of rehearsal, it revives memory traces so as to prevent them from fading. Then, such memory traces can be sent back to the phonological store. Second, the articulatory control process also translates written materials into a phonological code so that they can be retained into the phonological store (p.72).

As for the visuo-spatial scratchpad, it is assumed to be divided into a spatial and a visual component, and they may be selected according to the task being performed (Baddeley, 1992: 558). As for the visual component, it attends to images, which may gain access to the system in two different ways: either indirectly, when you remember a particular object, or directly, when you actually see the object (Searleman and Herrmann, 1994: 70). As for the spatial component, it aids people in designing spatial tasks, and in finding direction in a particular setting (p.70).

According to Just and Carpenter (1992), roughly, their conception of working memory can be compared to the part of the central executive in Baddeley's framework (p.123). However, neither Daneman and Carpenter (1980, 1983) nor Just and Carpenter (1992) nor Tomitch (1995, 1996, 1998) are particularly concerned with the division of working memory into component parts such as the buffers, for instance, the phonological loop (p.123).

ON SCHEMA THEORY

A widely accepted view on reading comprehension research is that texts do not "carry meaning" by themselves (Carrell and Eisterhold, 1988: 76). Actually, texts provide readers with some guidelines on how to "construct meaning" grounded on their already acquired knowledge (p.76). Therefore, in order to accomplish efficient comprehension, a connection should be established between the input information readers receive from texts and their previously existing knowledge. Put another way, much of the meaning extracted from texts comes from the reader, and her/his own knowledge. It is the reader's pre-existing knowledge that enables her/him to predict the content, the structure and the language s/he will find in texts so that the reader may be able to go beyond the written text. Dias (1985) also subscribes to a similar position, as

she puts it, "comprehension is not an effortless task" (p.26), the reader is expected to participate actively in it (p.26).

Approaches to reading comprehension which recognise the importance of the interaction between the reader and the text are known as interactive (Grabe 1991). The term interactive can also be used to indicate another type of interaction which takes place during the course of reading, that is, the interplay between the lower level reading processes, which are concerned with the identification and processing of input information, and the higher level processes, which are interpretative (Grabe 1991: 383). Both perspectives are complementary.

Besides knowledge of the language, researchers have identified at least two types of knowledge readers should have in order to provide a satisfactory interpretation for a text. First, knowledge about the rhetorical organisation of texts, or formal schemata (Carrell, 1983, cited in Meurer, 1985). Second, knowledge about the content area of a text, or content schemata (Carrell, 1983, cited in Meurer, 1985). Both content and formal schemata are culturally bound. The present study focuses on the interaction between working memory capacity and readers' knowledge about the content area of the text.

Research into the effects of previous knowledge on reading comprehension has led to the development of schema (plural schemata) theory. From this theoretical point of view, readers process information in the light of what they already know. More accurately, readers have at their advantage schematic knowledge structures stored in long term memory, then they match incoming information from the text to such structures (Afflerbach, 1990; Carrell and Eisterhold, 1988; Fincher-Kiefer et al., 1988, among others). In other words, to interpret language, readers "map" input from texts onto their existing schema (Carrell and Eisterhold, 1988: 76). This mapping operates on

the basis of two mechanisms of information processing, namely, bottom-up and top-down processing.

A schema is a mental structure similar to a network, which comprises sub-schemata, that is, component parts. If one of these component parts is activated, this procedure results in the activation of a schema as a whole (bottom-up processing) (Anderson and Pearson, 1988: 43). In turn, once the activation of a schema has been triggered, it will bring to our mind other component parts of this schema (top-down processing) (p.43).

If incoming information, which is interpreted by bottom-up processing, is consistent with predictions made by top-down processing, readers will be able to interpret the text satisfactorily (Carrell and Eisterhold, 1988:79). Whenever there is a "mismatch" (p.79), that is, top-down predictions and bottom-up processing are not in accordance, readers have to evaluate and even change their interpretation so that incoming information and predictions will be "compatible" (p.79). On the one hand, the making of predictions (top-down processing) is of great importance, for it enables the reader to infer information which is implicit in the text (Carrell, 1988: 101). Previous knowledge is the key element for this inference-making operation to take place. On the other hand, the building of textual meaning from the smaller parts to the whole schema (bottom-up processing) is also crucial, for it enables the reader to change their prior knowledge and check their predictions according to the information they receive from the text (p.101).

Carrell (1988) mentions how important the possession of an appropriate schema is for the reader: first, lack of content or formal schemata makes text processing more difficult (p.105), for readers who lack these two types of knowledge tend to resort to an excess of text based processing (p.105). If readers rely only on textual input to interpret

information, they will be faced with difficulties because "no text contains all the information necessary for its comprehension" (p.105). Therefore, these readers will miss a great deal of implicit information. Second, Carrell also points to the problem of schema interference. That is, if readers lack the appropriate schema, they may put to use the closest schema they have to the detriment of comprehension (p.105).

Anderson (1994) summarises the six main functions of schemata. (1) Schemata are the foundation on which readers construct their interpretation. In Anderson's own words, "a schema provides a niche, or slot for certain text information" (p.p. 473-474). Consequently, readers who possess an appropriate schema will be able to assimilate information with less mental effort (p.474). (2) As it has already been mentioned above (Carrell 1988), the possession of an appropriate schema enables readers to make inferences in order to bridge the gap between the information that is explicitly stated and what remains implicit in a text (p.474). (3) A schema also enables readers to select the most important information and focus their attention on it (p.474). (4) If a schema provides the reader with the basis for making a distinction between trivial and relevant information, it will be much easier for them to summarise a text (p.474). In other words, domain knowledge influences readers at both times: input and output. At the time of input, because it guides how they allocate their resources so as to select the most important elements in the text. At the time of output, because it enables them to formulate a summary of the text. (5) Schemata guides readers through memory searches so that they will be able to gain access to the information previously read in a text (p.474). (6) If gaps in memory need to be filled, readers' schemata plus the textual information that can be recalled may enable readers to construct inferences; consequently, they may be able to supply the missing information (p.474).

Despite the importance of prior knowledge, readers should not rely only on it to construct their interpretation. Readers who depend too much on their ability to predict tend to overlook textual information. As a result, they may fail to grasp the message of the text (Meurer, 1985: 174). Moreover, although this review is concerned with content schemata, the importance of bottom-up processing cannot be denied. Davies (1995) mentions the importance of efficient bottom-up processing. Since readers' ability to process information is limited, those who are deficient in lower level processes such as decoding tend to overload working memory. Such load is detrimental to comprehension. This can be particularly true for L2 reading comprehension, if readers' syntactic and vocabulary knowledge of L2 is too poor, they will be inefficient in lower level reading processes (Grabe 1991). Consequently, their processing efficiency will be impaired. Indeed, Berquist (1997) suggests that the reading span measure is sensitive to language proficiency. Finally, Grabe (1991) reports the recent research on eye movements. According to the studies mentioned by him (Adams, 1990; Carpenter and Just, 1986; Rayner and Pollatsek, 1989), fluent readers perform the lower level identification processes automatically, that is, they allocate fewer resources to carry out such processes.

ON THE INTERACTION BETWEEN WORKING MEMORY AND PRIOR KNOWLEDGE.

Establishing a connection between working memory and prior knowledge is of great relevance to this discussion. In the present study, it is expected that prior knowledge will enhance processing efficiency, so the overall demands on working memory will be reduced. This assumption is based on the studies of Afflerbach (1990), and Fincher-Kiefer et al. (1988), their studies will be reported next.

According to Afflerbach (1990), prior knowledge enables readers to get rid of "processing bottlenecks in working memory" because the processing of familiar texts makes fewer demands on readers' cognitive resources (p.35). Afflerbach explains that prior knowledge tends to make the component reading processes easier. One of the arguments underling Afflerbach's work is that if prior knowledge eases the component reading processes, readers will have resources at their disposal for higher operations, for instance, the construction of a main idea statement (p.35). Afflerbach concludes that prior knowledge of content domain should help readers construct the main idea statement of a text automatically (p.40).

On the other hand, if readers lack the appropriate schemata, they might have to draw on their already existing schemata so as to accommodate the unfamiliar information, or even build a new one (Afflerbach 1990: 42). To accomplish either of these tasks, a great deal of a reader's working memory resources will be allocated (p.42); hence, low knowledge readers are not likely to have cognitive resources available for the automatic construction of a main idea statement. Moreover, readers who lack the appropriate schemata are more likely to come up with inaccurate inferences.

Another piece of research worth mentioning is Fincher-Kiefer et al.'s (1988). They describe the effects of domain knowledge on readers' processing efficiency. Their results indicate that domain knowledge enables readers to develop more efficient processing. Consequently, high knowledge readers present a larger reading span. As for low knowledge individuals, they are not able to process domain related text so efficiently. However, Fincher-Kiefer et al. argue that processing differences between high and low knowledge readers become evident when a particular task calls for the construction of "retrieval structures" (p. 425). Fincher-Kiefer et al. carried out two

different span tests, the difference between them being concerned with task demands. In both Experiments, subjects recalled the last word of sets of sentences. In the second Experiment, individuals also recalled the sentence contents. They argue that only in the second task processing differences between high and low knowledge readers were evident. This result is attributed to the fact that, in the second task, readers had to construct retrieval structures in order to remember the sentence contents. Grounded on these results, they also argue that the reading span measure is sensitive to task demands.

Fincher-Kiefer et al. (1988) also assume that high knowledge individuals assimilate information fast and readily. As a result, they can organise input into chunks (p.417), which reduces the demands on working memory. In agreement with Fincher-Kiefer et al. (1988), Chiesi et al. (1979) also mention that "information is processed more as a 'whole' by high knowledge individuals" (p.263). To perceive the "whole", high knowledge readers need less "part" information than low knowledge readers (p.263). On the other hand, as it is not so easy for low knowledge readers to interpret input: low knowledge readers tend to store greater amounts of information in working memory, that is, they need to receive more input until they can come up with an appropriate interpretation for a text (Fincher-Kiefer et al. 1988: 417). This operation demands a great deal of working memory resources of low knowledge individuals, which results in processing difficulties (p.417). Consequently, a smaller reading span can be expected and also recall deficiencies. Where recall is concerned, the longer the text is, the more evident is the difference between high and low knowledge individuals (p.417).

CHAPTER III

METHODOLOGY

OBJECTIVES AND HYPOTHESIS

The hypothesis this study puts forward is grounded on widely accepted views, that is, prior knowledge about the content area of a text enhances readers' processing efficiency; consequently, it affects the level of comprehension and recall they attain (Afflerbach, 1990; Chiesi et al., 1979; Fincher-Kiefer et al., 1988; Spilich, Vesonder, Chiesi and Voss, 1979). Although the present hypothesis draws on these previous studies, it attempts to expand their conclusions. While they investigate L1 reading ability, the present work sets out to examine the relationship between L2 working memory capacity, L2 reading comprehension and prior knowledge. The hypothesis is discussed here only in general terms. In order to narrow the focus of the investigation, the hypothesis is unfolded into five research questions.

The following discussion is based on the studies of Daneman and Carpenter (1980), Afflerbach (1990), and Fincher-Kiefer et al. (1988). High knowledge readers present more efficient processing, so they might have more functional working memory resources at their disposal for accomplishing memory consuming tasks such as integrating the text, extracting its theme, and also for achieving higher levels of recall, that is, higher levels in terms of both quantity and quality of recall. Put another way, as the high knowledge do not allocate so much of their cognitive resources for processing information, they might be able to have more ideas and relations from previous parts of the text accessible in working memory. Indeed, readers with high knowledge are likely

to perceive the relations among the parts of the text, and also their importance so as to integrate the text, extract its theme, and remember a great deal of relevant information. In sum, this study puts forward the following hypothesis: domain knowledge is expected to render readers a larger working memory span; consequently, higher levels of comprehension and recall. By contrast, the processing of low knowledge readers is not so efficient, so they might spend a great deal of resources on it. In other words, their reading spans are likely to be smaller. Therefore, they may not have enough functional working memory capacity for the demands of integrating the text, and extracting its theme. If the hypothesis turns out to be confirmed, it will indicate that, in the present study, memory capacity is best interpreted in terms of processing efficiency (Daneman and Carpenter, 1980).

RESEARCH QUESTIONS

In order to test the hypothesis, this study intends to compare the performance of high and low knowledge subjects in reading span tests, and in reading comprehension tests. The following research questions are raised:

(1) Does domain knowledge yield a larger working memory span?

(2) Are high knowledge readers likely to make more accurate inferences than low knowledge readers?

(3) Are high knowledge readers better able to integrate different parts of the text so as to extract the theme of the passage?

(4) Are high knowledge readers able to present higher levels of recall?

(5) Does domain knowledge result in shorter reading time for the domain related (linguistics or engineering) and the control texts?

SUBJECTS

Although this study is to some extent grounded on the work of Afflerbach (1990), and Fincher-Kiefer et al. (1988), it differs from them: they have tested subjects who are native speakers of English, whereas the subjects in this study are all L2 readers. Nine of these subjects are Brazilian, native speakers of Portuguese, one subject is Chilean, native speaker of Spanish. The ten subjects were divided into two groups of five readers. Subjects in each group knew either linguistics or electrical engineering. One of the subjects was discarded because she claimed to be high knowledge in computer science rather than in electrical engineering. She was replaced by another subject with high knowledge in engineering so as to complete a group of five subjects. It is noteworthy that none of these subjects were paid. In fact, the researcher counted on subjects' goodwill to carry out the research.

Furthermore, all subjects were graduate students. The reasons for choosing graduate students are the following: first, a reasonable proficiency in L2 reading is a prerequisite for joining the graduate courses at UFSC. In other words, graduate students should be able to read in English at least for academic purposes. These students are even required to sit for an English test before enrolling in their courses. Second, graduate students have to do a great deal of reading in their field of research; therefore, they are expected to be highly motivated to read for academic purposes (Grabe, 1991). Indeed, a large amount of their academic reading is carried out in English. Although this study is not particularly concerned with motivation, one cannot deny that motivation plays a role in reading comprehension (Fincher-Kiefer et al., 1988). Third, the importance of choosing graduate students is that they are expected to have a high degree of knowledge about a particular topic.

The researcher was faced with a practical problem: both linguistics and electrical engineering are very broad fields of study. Therefore, it would be difficult to find five subjects who shared the same type of knowledge within the field of linguistics, and electrical engineering. In other words, it would be almost impossible for the researcher to ensure uniformity of knowledge among the subjects in each group. For instance, one subject may limit all of his/her study to a particular topic such as transformational-generative syntax; another subject may be an expert in systemic linguistics, but may know nothing about other areas of study in the field of linguistics. Therefore, how could the researcher guarantee that the subjects would possess the appropriate schema to read the texts? In order to tackle this problem, the technical texts were not particularly concerned with detailed studies in a specific area of linguistics or electrical engineering. However, some general, basic knowledge of linguistics or electrical engineering was essential to read them.

The researcher also acknowledges the fact that levels of knowledge tend to be proportional, so it would be more accurate to label the subjects as *higher* and *lower* knowledge, rather than just *high* and *low knowledge*. However, there is no denying that subjects may actually be high or low knowledge in a particular domain. For the sake of simplicity, and also in order to follow Chiesi et al. (1979) and Fincher-Kiefer et al. (1988), the researcher chose the labels *high* and *low*.

DESIGN

The experiment was divided into two parts. The first consisted of a survey, and the reading comprehension measures. The second part consisted of the reading span measures.

In the first part, a questionnaire (appendix A) was applied in order to make sure that subjects were suitable for the purposes of the experiment. Next, subjects read three texts, namely, control, a text on linguistics, and a text on engineering. In order to access the comprehension of these texts, two types of tests were conducted, respectively, free written recall, and comprehension questions. Data from the free recall task enabled the researcher to answer research questions three and four. Data from the comprehension questions were used to answer the second research question. Moreover, subjects were timed to see how long it took them to read each text, these data were used to answer research question five.

In the second part, three reading span tests, namely, control, linguistics and engineering were conducted so as to enable the researcher to answer research question one. The results of the two parts were compared, and it was also possible to establish a connection among all five research questions. Not only is the idea unit analysis (research question four) a new source of data, but it also verifies the results of research questions two and three. Furthermore, since the answers given to the questionnaire provided a profile of the readers, the information was also used as a complementary source of data.

TEXTS USED IN THE READING COMPREHENSION TESTS

The control text (appendix C), "The Irresponsibility that Spreads AIDS", by Mayer, A. J. deals with a topic of general interest. The title indicates the main idea of the text, that is, individuals should take responsibility for the AIDS epidemic. The text was taken from a monthly magazine, *"Reader's Digest"*, (April, 1998).

The title of the text on linguistics is "Structural and Functional Views on Language". The text presents a comparison between these two different approaches

(appendix C). It was taken from an introductory book on applied linguistics, namely, *Communicative Language Teaching- An introduction,* by Littlewood (1981). The text is a whole section of chapter one.

As for the text on electricity, "Forward-Mode Switching Regulators", it was taken from the book *Practical Switching Supply Design,* by Brown, M. (1990). To be more accurate, the text is on power electronics. In this text, a process is described, namely, how a power switch operates (appendix C). The text is a whole section of chapter two.

Criteria for Selection

Content. The criteria used for choosing the control text was based on Tomitch (1995): this particular text was selected because (1) it deals with a topic of general interest, that is, individuals should take responsibility for the AIDS epidemic. (2) This issue is also a current one. Due to these reasons, knowledge differences were not expected to be found between the two groups. In other words, where the content of the control text is concerned, both groups are expected to be high knowledge.

The main reason for selecting the texts on linguistics and engineering were: neither was the text on linguistics concerned with detailed studies in applied linguistics, nor was the one on engineering concerned with the particularities of power electronics. Nevertheless, readers were still required to have some basic knowledge of linguistics, or electrical engineering to read them. The text on linguistics was taken from an introductory book. Moreover, the whole text is the first section of chapter one, which is, again, an introductory part. Therefore, the content of this text was presented in very general terms. The same criteria of selection was used for the text on power electronics, the whole text is also the introductory part of a chapter.

Furthermore, the three texts were authentic, so they were expected to be somehow similar to the ones graduate students usually come across in their graduate courses.

Size. The size of the texts have also contributed to their selection, first, the researcher wanted texts that contained approximately the same number of words: control, 494 words, linguistics, 430 words, and electronics, 402 words. Moreover, if the texts had been longer, they would have made the reading of the texts plus the recall collection too tiresome.

Textual Structure. The three texts also had a clear textual structure. The control text presented a clear pattern of organisation, namely, situation- problem- solution-evaluation (Hoey, 1994). The one on linguistics presented a comparison and contrast (Spencer and Beverly, 1996). As for engineering, the structure of the text clearly signalled that the operation described could be divided into two distinct periods, namely, first period, the power switch is on, second period, it is off. The reasons for choosing texts with a clear pattern of organisation were the following: first, textual structure was used so as to guide the researcher into formulating comprehension questions that would extract the core of the texts. Second, texts with a clear pattern of organisation would also enable the researcher to judge whether subjects could extract the theme of the text or not (research question three). Moreover, the organisation of these texts was used to design the scale for scoring research question three, and also to classify the main idea units, research question four.

An electrical engineer was consulted so as to decide whether the text on electronics would serve the purposes of this experiment.

Main Changes Made

The three texts, control, linguistics, and electrical engineering were typed on a blank page, so the original layout was removed. Visual aids such as titles, and bold

types were taken away; therefore, readers were not provided with any hints that would help them interpret the texts, and activate their schemata. The text on electronics presented the picture of a circuit which was removed.

READING ABILITY MEASURES

Questionnaire

The researcher acknowledges that some threshold knowledge of the English language is important for interpreting the texts, and activating the appropriate schemata (Aebersold and Field, 1997; Tomitch, 1991). As it has already been mentioned, this is one of the reasons why graduate students were chosen: they should be able to read in English in order to join the graduate program at UFSC. On the one hand, it was important for the researcher to become acquainted with the subjects' level, that is, if their English was good enough for reading for academic purposes. On the other hand, the tests carried out here did not aim at testing whether the subjects could write and speak English. Indeed, the aim of these tests was to assess L2 reading comprehension and L2 working memory capacity. Consequently, the subjects were expected to "read" in English, that is, the texts used in this study were written in English, but subjects were allowed to answer the initial questionnaire, their recall protocols, and also the comprehension questions in Portuguese.

According to Richards, Platt and Platt (1992) assessment is defined as "the measurement of ability of a person" (p.23), and it may be carried out by means of tests, interviews, questionnaire and observation (p.23). In the present study a questionnaire was regarded as suitable to assess subjects' level of English. Subjects completed a list of questions so as to provide information about their level of English, and their reading

habits in English (appendix A). These questions were formulated in Portuguese, and subjects were also allowed to answer them in Portuguese.

Free Written Recall

Subjects' free written recalls were collected to assess reading comprehension, and the protocols provided the researcher with data to answer research question four. Both the quantity and the quality of recall were assessed (Carrell, 1992; Meurer, 1987). In other words, the number of idea units in each protocol was counted, and each unit recalled was classified as main idea, supporting idea or detail. The scoring procedure was described in chapter four. Each recall protocol was collected subsequent to the reading of each of the three texts. As a result, there were three recall protocols per subject, that is, in total, thirty protocols.

The written recalls also informed the researcher about readers' ability to integrate, and extract the theme of the texts (research question three). In short, the quality of the information recalled was also evaluated in the third research question. However, the perspectives of research question three and four differ. Question three provides an overall picture of the data whereas question four is concerned with a more detailed assessment of the protocols. Moreover, the results obtained in question three were used to support the idea unit analyses carried out in research question four. The scoring procedure of question three is described in chapter four.

Comprehension Questions

In order to answer the second research question, that is, to test the accuracy of readers' inferences, subjects were required to answer a single comprehension question about each of the three texts. This question was asked after each of the free recalls. Scoring procedure for the second comprehension question is described in chapter four.

Textual structure was used so as to guide the researcher into formulating a question that would really extract the core of the text. In order to answer the control question, subjects were required to infer the solution the author proposed to the problem of the AIDS epidemic (appendix D). As for linguistics, subjects were requested to draw a distinction between the functional and structural views on language (appendix D). As for the question on electronics, the text described a process and this question investigated whether subjects could identify and explicate the two parts of this process (appendix D).

As for the present task, namely, question-answering, the questions prompted the answers. When it comes to the free recall task, no hints were provided to help subjects. Consequently, a different pattern of recall was expected for the two tasks. The questions were formulated so that subjects were prompted to use part of the textual organisation in their answers. By contrast, subjects were not provided with any hints that would help them reproduce the original textual structure in their recall output.

Time

The primary assumption regarding reading time was that high knowledge readers would process information more readily because they were able to match input information to their already existing schemata (Fincher-Kiefer et al., 1988). This assumption led to the fifth research question, which sets out to investigate whether prior knowledge yields a shorter reading time. To answer this question, subjects were timed to see how long it took them to read each of the three texts. Moreover, a time limit of eight minutes was set, that is, subjects could not spend more than eight minutes reading each of the texts.

PROCEDURE FOR THE READING ABILITY MEASURES

Data collection was conducted in two sessions: the first for the questionnaire, and also for the reading comprehension measures. The second session for the reading span measure.

Initially, subjects answered the questionnaire so as to survey their level of English, and reading habits. After the questionnaire, oral instructions were given in Portuguese, and the tasks being explained in the following order: reading, free written recall, and answer to comprehension questions. Moreover, subjects also received written instructions in Portuguese (appendix B). Subjects could not go back to the texts as they wrote their free recalls, but they could write their recalls in Portuguese. Subjects were not timed for the free recall task, neither was a time limit set. These same instructions were provided for the comprehension questions. For the free recall measure, subjects were told to write as much as they could remember.

After the questionnaire, the texts were presented one at a time: first, all subjects were assigned the control text. Second, the technical texts were presented. High knowledge subjects in linguistics read a text on linguistics, familiar content, and another text on electrical engineering, unfamiliar content. High knowledge subjects in electrical engineering were assigned the same two passages the former group had received. However, in this case, the opposite situation took place, that is, the text on electronics presented a familiar content, but the one on linguistics was unfamiliar. Although the texts were the same, they were presented in a different order: control, familiar, and unfamiliar text. That is, readers with high knowledge in linguistics read the text in linguistics in the first place. On the other hand, readers with high knowledge in electrical engineering read about electronics first. This order was an attempt to minimise the effects of anxiety which may arise when readers are tested on unfamiliar

contents. Put another way, the easier texts were assigned prior to the difficult ones so that readers would not feel anxious. It is noteworthy that subjects with high knowledge in linguistics and in engineering were expected to be high knowledge with respect to both domain and control texts.

Firstly, all subjects read the control text. Immediately after the reading, they received a page containing the instructions on the free recall task, then the recall protocol for the control text was collected. As soon as they finished the recall, they received another page containing instructions on the comprehension question and the comprehension question itself. Not until subjects finished their written recall were they allowed to see the comprehension question. Subjects could not look up information in their protocols to answer the questions. Secondly, the same procedure took place for the familiar text, namely, reading, recall collection, and the question on the familiar text was assigned. Thirdly, the procedure was repeated for the unfamiliar text.

THE PILOT STUDY

Before carrying out the real experiment, three readers with different background knowledge were tested on a trial basis. One of them had a degree in philosophy, the other in civil engineering, and a reader with a Ph.D. in physics. Their free recalls were collected, and they also answered the open-ended questions. This trial section was carried out in June, two months before the actual experiment took place. The trial data collection enabled the researcher to make some decisions concerning the actual experiment:

Choice of texts. Nobody presented difficulties in terms of the content of the control text, which suggested that its topic was rather general. Moreover, the reader with high knowledge in physics did pretty well on the text about electronics, which was

considered an indication that the text chosen was not concerned with a detailed topic in the area of power electronics. Moreover, the size of the texts was considered suitable for the purpose of the experiment.

Procedure for the reading ability measures. It was possible for the researcher to estimate how long it would take subjects to read each text. Taking into account readers' mean time per text, a time limit of eight minutes was considered suitable for the reading of each text. Moreover, it was also decided that a time-limit would not be established for the writing of the protocols. The trial has also contributed to the decision on the order of presentation of the texts (control, familiar, unfamiliar), and on the recall collection. The recall task was chosen to be carried out before the comprehension question. The recall collection would take place immediately after the reading of the texts so that it would be easier for subjects to recollect recently read information. Finally, it was decided that the subjects would receive brief, oral instructions prior to testing, and also written instructions before each of the tasks to let them know what they were going in for (appendix B).

Number of sessions for data collection. The trial testing enabled the researcher to decide that data collection would be conducted in two sessions. The second session would be used for the reading span test because it would require some previous training.

Procedure for the reading span test. Only the span test on engineering was tested on a trial basis. The subject, who was high knowledge in physics, was expected to have some general knowledge on the content of the sentences. As he could score quite highly, this result was considered an indication that the text chosen was at a somewhat general level. Finally, it was decided that a training session was going to take place before the real test.

MEASURES OF WORKING MEMORY SPAN

Working memory capacity was assessed by the reading span test devised by Daneman and Carpenter (1980). The span test was designed to tax both storage and processing functions of working memory as sentence comprehension takes place, and it indicates readers' processing efficiency (Daneman and Carpenter, 1980: 451). Unlike Daneman and Carpenter's study, in the present study, subjects were tested on related sentences. It was expected that knowledge would enable subjects to integrate the sentences so as to form chunks. As a result, the load on their working memory on working memory would be reduced, and subjects would present a larger span (Daneman and Carpenter 1980: 464). Three authentic texts were transformed into the span tests.

TEXTS USED IN THE SPAN TEST

Criteria for Selection

Content. The text "When to Say No to Your Kids" by Harris, M was taken from the monthly magazine, "*Reader's Digest*", (April, 1988). The criteria used for selecting the control text was based on Tomitch (1995). (1) This text deals with a topic of general interest, that is, how to bring up children in our consumer society. (2) This issue is also a current one. Both groups are expected to be high knowledge with respect to the content of the control text (appendix E).

As for the technical texts (appendix E), "Kinds of Grammar" was taken from the book *English Syntax: A Grammar for Language Professionals* by Jacobs, R. (1995), and the one on electronics, namely, "Batteries" was taken from the book *Basic Electronics for Scientists* by Brophy, J. (1972). Neither the text on linguistics, nor the one on electronics were concerned with the particularities of these areas. Indeed, the titles of

the books suggest that the texts in them were at a general level of knowledge. The title of the book on linguistics indicates that the book was written for language professionals in general, it was not particularly written for linguists. The adjective *basic* found in the title of the book on electronics qualifies the texts in this book as quite general.

Size. As the texts had to be transformed into sixty sentences, the size of the texts was another factor that weighed in the selection. It was made an attempt to find texts that would be neither too short, nor too long for the purpose of the experiment. The text had to be modified so as to comply with the requirements of the span test.

Main Changes Made

The texts had to undergo some changes in order to satisfy the requirements of the span test, namely, (a) the number of words in each sentence ranged from thirteen to seventeen (Tomitch, 1995: 41); (b) each sentence ended in a different word (p. 42); (c) the sentences ended in content words, that is, nouns, verbs, adjectives, adverbs; (d) the original texts were transformed into sixty sentences. Moreover, the final words in each sentence had at least three letters. The changes introduced in order to transform these texts into span tests did not affect their global coherence, and they are explained in appendix F. The actual span tests are presented in appendix G.

Initially, the whole text, "When to Say No to Your Kids", was transformed into seventy one sentences, but eventually it was reduced to sixty. The part of the text where the author describes how to reject a child's request, that is, the part where the author explains how to say no to a kid was transformed into a span test. However, the last three paragraphs, the part where the author advises against giving in was left out.

The whole text, "Kinds of Grammar", was transformed into a span test of sixty one sentences. One sentence which contained redundant information was omitted.

The original text on electronics describes types of batteries, namely, the dry cell, the storage battery, and the mercury battery. The description of the dry cell, and the storage battery were transformed into a span test. As for the description of the mercury battery, it was not used in order to keep the number of sentences within the limit of sixty sentences.

PROCEDURE FOR THE READING SPAN MEASURES

In order to perform the span test, subjects were required to read aloud the series of related sentences presented in appendix G, and recall the final words of each sentence (Daneman and Carpenter: 1980: 450). Sentences were presented on 13 by 21 cm blank cards, one sentence per card. Again, subjects were tested three times: a control test, linguistics, and electrical engineering. In each of these tests, a text was transformed into sixty related sentences. This total of sixty sentences was divided into sets of two, three, four, five and six sentences. In other words, three sets of two sentences, three of three, three of four, three of five, and three sets of six sentences. The cards were displayed in front of the subject, one at a time. At the end of each set, a blank, cue card was shown, then subjects were requested to say the last word for each sentence in that set. The words could be mentioned in any order, but subjects could not translate them. All three tests were carried out until the end, that is, subjects read all the sixty sentences.

Instructions were given orally in Portuguese during a training session, subjects were instructed to read the sentences aloud at their usual pace of speaking, but they could not backtrack. Subjects were also told that they could say the final words in any order. Furthermore, subjects were told that the number of sentences in the sets would increase, starting from sets of two sentences up to sets of six. The actual test was preceded by a training session with three sets of two, and three sets of three sentences.

The test carried out here to some extent differs from the Daneman and Carpenter (1980) span task. First, in their test, subjects were told to recall the final words in the same order in which they had appeared (p.454). Daneman and Carpenter tested subjects who were all native speakers of English. As for the present study, since subjects were non-native, they were allowed to say the words in any order so as to minimise the difficulty of the task. In a previous study, Harrington and Sawyer (1992), who also tested non-native subjects, the final words could be mentioned in any order (p.30). Second, in the Daneman and Carpenter task, unrelated sentences were used. However, in the present work, subjects read sixty related sentences, which formed a coherent text. Third, as for Daneman and Carpenter, their test was interrupted when subjects failed all three sets at a given level (p.454), here, subjects were tested on all sets until the real end of the test was reached. This procedure was taken in order to evaluate whether subjects would be able to perceive sentence relatedness, that is, whether sentence relatedness would have an effect on subjects' level of recall. According to Daneman and Carpenter, the level at which the subjects scored two out of the three sets was considered as the measure of their reading span (p.454). As for the present study, a half point was also given whenever subjects were correct on one out of the three sets. The total of words recalled was also taken into account.

As for the order of the span tests, first, all subjects took the control test. The second test was dependent on reader's background. Put another way, high knowledge subjects in linguistics took the test on linguistics beforehand, and then the one on electricity. The position was different for subjects with high knowledge in electrical engineering, the span test on electricity was carried out before the test on linguistics.

CHAPTER IV

RESULTS, AND DISCUSSION

Each of the research questions raised in chapter 3, section 3.2. will be retaken in this chapter. Research questions will be answered, that is, the results of the reading span test and reading comprehension tests will be discussed, and the scoring procedure will be explained.

RESEARCH QUESTION (1)

Does domain knowledge yield a larger reading span?

Scoring

As it has just been mentioned above, three span tests of sixty related sentences were applied. Each test consisted of five sets of sentences, and subjects were tested on all five sets until the end of the tests. In other words, subjects were required to read all the sixty sentences in each span test, namely, control, linguistics and engineering. The level at which the subjects scored two out of the three sets was considered as the measure of their reading span; moreover, a half point was also given whenever subjects were correct on one out of the three sets. The total number of words recalled was also counted.

Results and Discussion

As expected, domain knowledge turned out to yield a larger reading span, which means that high knowledge individuals presented more efficient processing. High knowledge subjects in linguistics presented a mean span of 3.9 for linguistics, but their

mean score for the control text was a little lower, 3.7, and even lower for engineering 3.1 (table 1, see appendix K for individual scores).

Table 1: Mean spans of subjects with high knowledge in linguistics, and mean number of words recalled.

	mean reading span	mean number of words recalled
control	3.7	45
linguistics	3.9	44
engineering	3.1	42

As for high knowledge subjects in engineering, their mean span was 3.1 for engineering, but their mean span in the control test was lower, 2.9, and even lower for linguistics, 2.8 (see table 2, see appendix K for individual scores).

Table 2: Mean spans of subjects with high knowledge in engineering, and mean number of words recalled.

	mean reading span	mean number of words recalled
control	2.9	36
linguistics	2.8	34
engineering	3.1	41

The results of subjects with high knowledge in engineering deserve further observation. Their mean span for the control test turned out to be lower than the mean of the high knowledge in linguistics in the same test. As both groups were expected to be high knowledge with respect to the content of the control test, this result can be attributed to differences in L2 proficiency. According to the answers given to the questionnaire applied prior to testing, the high knowledge in engineering turned out to be less proficient in English than the high knowledge in linguistics; moreover, except for academic purposes, they claimed that they were not in the habit of reading in English. In other words, the less proficient an individual is in a foreign language, the heavier is the burden on the processing of information, which yields a smaller working

memory capacity in the foreign language. This explanation is consistent with the results of Berquist (1997), he suggests that L2 working memory seems to be a good predictor of L2 proficiency (p.471).

Berquist (1997) drew a comparison between subjects' span in LI and L2, having concluded that subjects presented a reduced working memory span in L2. In other words, individuals were not able to process information so easily in L2 as in LI even at very advanced levels (p.472). This result was interpreted as an indication that L2 working memory capacity is related to efficiency of processing (p.472), and L2 working memory is an indicator of proficiency in L2 (p. 471). The processing efficiency explanation provided by Berquist seems to account for the present result. Indeed, the ones with high knowledge in engineering turned out to be less proficient in English than the ones with high knowledge in linguistics, which may explain why the high knowledge in engineering had a lower span in the control test. In short, due to being less proficient in English, they had greater difficulties processing the sentences in the control test.

Moreover, the mean span of each subject was also calculated (appendix K). Each subject had their three span scores, namely, control, linguistics and engineering added up, and divided by three so that the mean score of each subject was obtained. The group of subjects with high knowledge in linguistics obtained as the highest mean, 4.O, and the lowest 3.2. As for the group with high knowledge in engineering, the highest was 3.3 and the lowest 2.7. These results lend support to a processing efficiency explanation, that is, due to a better proficiency in English, the group of the high knowledge in linguistics had greater facility processing the sentences, which resulted in higher mean spans.

Results in tables 1 and 2 above also indicate that subjects with high knowledge in engineering presented a mean span of 3.1 for their domain test, which is equivalent to the mean score of the high knowledge in linguistics for the same test. This result is also surprising because subjects with high knowledge in linguistics are low knowledge in engineering, so their mean span in engineering was expected to be much lower than the span of the ones with high knowledge. This result might be attributed to the fact that the test on engineering was perhaps too basic, so even the low knowledge subjects could to some extent read it. Moreover, subjects with high knowledge in linguistics might have been low knowledge rather than no knowledge in batteries (Fincher-Kiefer et al., 1988: 424), and they also have the advantage of being more proficient in English than the ones with high knowledge in engineering.

The results found in this experiment are not entirely consistent with the ones in Fincher-Kiefer et al. (1988). They carried out two experiments. As for the first, it is similar to the one carried out in the present study. That is, subjects read sentences and recalled the last words, as in the Daneman and Carpenter's span task. In their second experiment, subjects were also required to recall the sentence contents. Fincher Kiefer et al. suggest that in the first experiment high and low knowledge subjects did not differ in their reading spans with respect to domain and control materials (p.421). According to them, in this experiment, readers might have developed a strategy to remember only the final words of sentences so as to minimise the effect of knowledge and sentence relatedness (p.421). However, in the second experiment, the difference between high and low knowledge individuals became apparent. They argue that only when the task required sentence recall the effect of knowledge turned out to be evident because task demands entailed the development of retrieval strategies (p.425).

The present study points to a different conclusion. Although the span measure in the present experiment did not include recall of sentence contents, results shown in table 1 suggest that knowledge yields a larger reading span, this is particularly true for subjects with high knowledge in linguistics. On the other hand, considering the gap between the reading spans of subjects with high knowledge in engineering, it was not so wide. As for subjects with high knowledge in linguistics, a reasonable difference can be observed between their highest mean 3.9, in linguistics, and their lowest, 3.1, in engineering. Contradicting Fincher-Kiefer's (1988) et al. previous argumentation, this result could be attributed to the fact that the subjects in this experiment were tested on related sentences, so knowledge may have enabled subjects with high knowledge in linguistics to perceive sentence relatedness in linguistics and in the control test. Consequently, they could process the information more efficiently, which resulted in a larger span in linguistics, and in the control test. In other words, knowledge might have enabled subjects to establish relations among sentences of the same set so as to integrate the text and organise the input into units, or chunks (Fincher-Kiefer et al., 1988: 417), which facilitates processing and results in a larger reading span. On the other hand, although the high knowledge in linguistics to some extent achieved a good result in engineering, they might not have been able to take advantage of sentence relatedness in engineering, so their mean span was lower. Furthermore, knowledge may have enhanced input processing by facilitating some of the component reading process. For instance, in their domain test, the high knowledge in linguistics were probably able to access the specific vocabulary with greater speed, which facilitated the processes of word recognition and derivation of word meaning (Afflerbach, 1990: 35). Consequently, there was a reduction on demands on working memory, and more cognitive resources were left available for other memory-consuming activities such as

integrating the sentences of the span test. This explanation also lends support to a processing efficiency explanation.

In relation to the mean scores of the high knowledge in engineering, although their mean span measures do differ, the gap between their spans for the control test, 2.9, and for the test on linguistics, 2.8, is very narrow (see table 2). Such narrow gap between the span measures are particularly surprising because these subjects were expected to be high knowledge in the control text, and low in linguistics. One point to bear in mind is that the subjects with high knowledge in engineering turned out to present greater difficulties processing sentences in English. Since the processing of a foreign language resulted in heavier demands on working memory of these less proficient subjects, they might have had less working memory resources available for memory consuming operations, that is, they might have failed to integrate the texts used in span tests, control and linguistics, and turned out to be as unable to take advantage of sentence relatedness in the two tests, which explains why the difference between their span scores is so small. This explanation requires further empirical investigation, that is, in order to confirm it, it would be necessary to compare the span measures of the same group of subjects using related and unrelated sentences. In the present study, only related were used.

Moreover, considering the total number of words recalled in each span test, the number of words recalled by the high knowledge in engineering in their domain test is evidently higher, 41 words, this result indicates a superior domain performance. Regarding the total number of words recalled in the control test and in linguistics, respectively, 36 and 34 words, a narrow gap still remains.

Summing up, not only is the reading span measure sensitive to knowledge differences (Fincher-Kiefer et al., 1988), that is, domain knowledge yielded a larger

reading span, but it was also sensitive to L2 proficiency (Berquist, 1997). The less proficient in English, subjects with high knowledge in engineering, turned out to present lower mean spans than the high knowledge in linguistics.

RESEARCH QUESTION (2)

Are high knowledge readers likely to make more accurate inferences than low knowledge readers?

Scales

Subjects were requested to answer three comprehension questions, namely, control, linguistics, engineering so as to enable the researcher to find out whether high knowledge readers were able to make accurate inferences. In order to score the answers to these comprehension questions, answers were rated (on a scale from 0 to 2) for subjects' ability to make the correct inference. Subjects who were able to make the correct inference were given two. Scales are presented for the three comprehension questions. They are presented in the following tables: 3 (control), 4 (linguistics), 5 (engineering).

(control question) According to the author, what's the best way to avoid the spread of the AIDS epidemic?

Table 3: Scale for assessing the accuracy of subjects' inferences.

Ability to make inferences		Inferences
Full	2	Encourage the HIV positive to take responsibility for the AIDS epidemic, and tell the truth about their condition to prospective partners.
Partial	1	Encourage the HIV positive to tell the truth about their condition.
None	0	Elaboration not including inference from the text. Elaboration not including the expected inference.

(question on linguistics) The author compares two different views on linguistics, what is the difference between them?

Table 4: Scale for assessing the accuracy of subjects' inferences.

Ability to make inferences		Inferences
Full	2	A comparison between two views on language, namely, the structural and the functional. The former focuses on the grammatical structure of sentences, which is stable, rule-governed, the latter concentrates on the communicative function a sentence has, e.g., plea, suggestion, complaint, etc., which is variable and depends on the situation and social context.
Partial	1	The answer makes reference to only one of the views either the structural or the functional view. The comparison between the two views is not mentioned.
None	0	Elaboration not including inference from the text. Elaboration not including the expected inference.

(engineering) The operation described by the author can be divided into two parts, describe them.

Table 5: Scale for assessing the accuracy of subjects inferences.

Ability to make inferences		Inferences
Full	2	The operation of the power switch can be broken up into two parts, namely, (1) power switch is on: during this time the diode is reverse biased, and current passes from input source, through the inductor to the load, and it returns to the input source. (2) power switch is off: the former current path through the input source is open-circuited, and the catch diode starts to conduct so as to maintain a close current loop through the load.
Partial	1	The answer includes only one of the periods, that is, either (1) the power switch is on, or (2) the power switch is off.
None	0	Elaboration not including inference from the text. Elaboration not including the expected inference.

Results and Discussion

In order to assess subjects' ability to make inferences, their answers to the comprehension questions were scored according to the scales in tables 3, 4, 5. As it has already been mentioned, there were two groups of subjects (five high knowledge in linguistics, and five high knowledge in engineering), and three comprehension questions (control, linguistics, engineering). Firstly, for each type of comprehension question there were five scores per group. Secondly, these initial five scores were transformed into one mean score. In other words, the five scores of each group were added up, and then divided by five. This operation took place three times because there were three types of comprehension questions. For the individual scores of each subject see appendix L. Finally, the mean results were calculated in percentage terms.

Table 6: Mean scores of subjects with high knowledge in linguistics and in engineering, these results indicate subjects' ability to answer inferential questions.

questions	high knowledge in linguistics	high knowledge in engineering
control	80%	40%
linguistics	100%	20%
engineering	zero	80%

The answer to the second research question is affirmative. Results in table 6 indicate that domain knowledge enabled subjects to answer inferential questions accurately. High knowledge subjects in linguistics scored highly in linguistics. In fact, their mean score was 100% in linguistics, which is even higher than their score in the control question (80%). On the other hand, their performance was poor in engineering, none of their answers were acceptable. In fact, all subjects claimed that they were not able to answer the questions. As they put it, "não sei" (protocol 1); "não sei" (protocol

2); "não lembro" (protocol 3); "não entendi" (protocol 4); "não consegui entender" (protocol 5).

As expected, the subjects with high knowledge in engineering scored highly in engineering, that is, 80% of their answers were correct, and their mean score was poor in linguistics, only 20% of their answers were acceptable. Since the high knowledge in engineering were not acquainted with the contents of text on linguistics, nor were they highly proficient in English, they were not expected to answer the inferential question on linguistics. However, among five subjects with high knowledge in engineering, one could answer the question on linguistics, which represents 20% of the sample. Had the size of the sample been larger, this percentage would have been smaller. Finally, as for control test, the high knowledge in engineering scored only 40% (table 6 above).

Both groups scored higher in their domain question than in the control. This result is unexpected, for both groups of subjects were expected to be high knowledge with respect to domain and control texts. As for the high knowledge in linguistics, this result could be attributed to a motivational factor, which might have led subjects to use a more efficient processing strategy to read their domain text (Fincher- Kiefer et al., 1988: 422). As a result, more accurate inferences can be observed for the domain text. As for the high knowledge in engineering not only motivation, but other factors such as reading habits, and proficiency in English should be taken into account in order to explain why their domain performance was superior to control.

The high knowledge in engineering were correctly on only 40% of the answers in the control test, while high knowledge in linguistics were correctly on 80%. Since both groups of subjects were expected to be high knowledge in the control test, such a gap can be considered rather surprising; however, the better performance of the high knowledge in linguistics is consistent with the results of the span tests. On the one hand,

the high knowledge in engineering were able to score highly in their domain text, their mean was 80%. As Ph.D. students, they are so used to reading their academic texts that they may probably access domain vocabulary with great speed, and recognise textual structure, which may also lead them to generate predictions and accurate inferences. In short, a high degree of domain knowledge may have enabled them to activate schemata, and to some extent compensate for their limited proficiency in English. On the other hand, the high knowledge in engineering claimed that they were not used to reading in English texts other than the academic ones. Although they were high knowledge with respect to the content of the control text, their language proficiency, and lack of habit may have prevented them from recognising linguistic cues, and from recognising textual signalling. As a result, they could not activate the appropriate schemata, and they turned out as unable to generate accurate inferences. Indeed, one of readers with high knowledge in engineering put to use a mistaken schemata. According to him, in order to avoid the spread of the disease, the AIDS organisations which the HIV positive call for help should provide information about the AIDS virus, and how one may contract the disease: "fornecendo as pessoas informações sobre este vírus e maneiras de transmissões" (protocol 10). This is not the correct inference, more accurately, the author claims that the AIDS organisations should encourage the HIV positive to be frank and tell the truth about their condition to prospective partners.

To sum up, as predicted in the study, domain knowledge influences subjects' ability to make inferences. However, in order to put their knowledge to good use so as to generate the accurate inference, that is, in order to activate the appropriate schemata the high knowledge readers should be able to recognise linguistic cues (Tomitch, 1991).

RESEARCH QUESTION (3)

Are high knowledge readers better able to integrate different parts of the text so as to extract the theme of the passage?

Scales

Free written recalls were collected after the reading of each text, namely, control, linguistics, and engineering so as to provide the researcher with information to judge subjects' ability to integrate the text so as to extract its theme. Recall protocols were rated (on a scale from 0 to 4) for subjects' ability to use the same pattern of organisation as the one in the original text. Subjects who were able to reproduce the structure found in the actual texts were given four. Scales are presented for each of the texts. They are presented in the following tables: 7 (control), 8 (linguistics), 9 (engineering).

(control) Table 7: Scale for assessing the use of textual structure.

Use of structure		Situation/ Problem/ Solution/ Evaluation
Full	4	Recalls should present four parts: (1) situation- system refuses to encourage people to be responsible and tell the truth. (2) Problem- silence ensures the spread of the disease. (3) Solution- emphasis on individual responsibility, and individuals should tell the truth. (4) Evaluation- responsibility and frankness are the best policy.
	3	The same as in 4; however, it includes situation, problem, solution. The evaluation of the proposed solution is not mentioned.
Partial	2	It includes only the situation and the problem, neither the solution nor the evaluation are mentioned. Or includes only the problem and the solution, neither the situation nor the evaluation are mentioned. Or includes only the situation and solution, neither the problem nor the evaluation are mentioned.
	1	It includes only the situation, or only the problem, or only the solution, or only the evaluation
None	0	Recalls present a pattern of organisation which differs from the structure of the actual text.

(linguistics) Table 8: Scale for assessing the use of textual structure.

Use of structure		Comparison/ Contrast
Full	4	Recall should include three main parts: (1) description of the structural view. (2) The functional view is explained in comparison with the structural view. (3) Further elaboration on the communicative function of the language.
	3	Recall includes a comparison between the structural and the functional views, but does not mention the communicative function of the language.
Partial	2	It includes a description of the functional and the structural view, but the idea of comparison between them is not mentioned.
	1	It includes either a description of the structural or a description of the functional view. No reference is made to the comparison between the two approaches.
None	0	Recall presents a pattern of organisation which differs from the structure of the actual text.

(engineering) Table 9: Scale for assessing the use of textual structure.

Use of structure		Description of a process
Full	4	Recall should include four main parts. (1) description of four functional components of the forward-mode switching regulators. The operation of the power switch is divided into two periods: (2) the power switch is on, (3) the power switch is off. (4) Comments on the amount of energy being delivered to the load.
	3	It includes a description of the two periods of the operation, when the power switch is on/off. The amount of energy being delivered to the load is also mentioned, but the description of the four functional components of the regulators is not included.
Partial	2	It includes only the description of the two periods of the operation, when the power switch is on/off.
	1	It includes only the description of the four functional components of the forward-mode switching regulators.
None	0	Recall presents a pattern of organisation which differs from the structure of the actual text.

Results and Discussion

In order to assess subjects' ability to integrate the parts of the texts, their free recalls were scored according to scales presented in tables 7, 8, 9. There were three types of texts, namely, control linguistics and engineering. Firstly, each group of five subjects produced five recall protocols for each of the three texts. These initial five protocols were rated so as to produce five scores. Thirdly, the scores of the five high knowledge were added up, and then divided by five; consequently, for each of the three texts, one mean score was obtained for the high knowledge in linguistics, and another mean score for the high knowledge in engineering. For a description of individual results see appendix M. Finally, the mean results were calculated in percentage terms.

Table 10: Mean scores of subjects with high knowledge in linguistics and engineering, these results indicate their ability to extract the theme of the texts.

texts	High knowledge in linguistics	High knowledge in engineering
control	90%	45%
linguistics	90%	20%
engineering	zero	80%

As expected, the answer to the third question, that is, *are high knowledge readers able to integrate different parts of the text so as to extract the theme of the passage?*, is affirmative. High knowledge subjects in linguistics were able to reproduce the textual organisation found in the following texts: linguistics and control. In fact, their means were 90% for both linguistics and control. This result also indicates that they were able to extract the theme of these texts. On the other hand, in engineering, none of the subjects with high knowledge in linguistics were able to make use of the same structure as the author to write their recalls, neither were they able to extract the theme.

As for subjects with high knowledge in electrical engineering, results indicate that they could reproduce the textual organisation found in the text on engineering, and also extract the theme of this text, their mean score was 80%. By contrast, in linguistics, their mean score was very low, only 20%, which indicates that this group had great difficulty in integrating the parts of the text on linguistics, and they were not able to extract the theme of the text either.

It is also noteworthy that the mean score of subjects with high knowledge in engineering was only 45% for the control text, and 80% in engineering. This gap tends to reproduce the result encountered in question 2, namely, the high knowledge in engineering scored 80% of the answers in engineering, and 40% in the control (see table 6, section 4.2.2). Such a gap between the results in the domain and the control tests is surprising since subjects with high knowledge in engineering were expected to be high knowledge with respect to both domain and control texts. The difference could be attributed to: first, high knowledge subjects in engineering were Ph.D. students, so they might have been highly motivated to read about engineering, but less motivated to read the control text. Second, the survey carried out prior to the test revealed that subjects with high knowledge in engineering were in the habit of reading in English only for academic purposes. Therefore, it might have been a lot easier for high knowledge subjects in engineering to read texts about engineering. In other words, they probably could access domain specific vocabulary with great speed, take advantage of textual signalling, and as electrical engineers, they might also be very used to the type of textual structure found in their academic texts on engineering, in this particular case, the description of a process. On the other hand, it was not so easy for the subjects with high knowledge in engineering to read the control test: since they are not used to reading this type of texts, and they were not highly proficient in English either.

The high knowledge in linguistics could score higher in the control test than the high knowledge in engineering. This result is consistent with the results of research questions one and two, and it was not predicted in the study because both the high knowledge in linguistics and engineering were expected to be high knowledge with respect to the control test. This result can again be attributed to differences in L2 proficiency. Indeed, the high knowledge in linguistics presented a higher span for the control text than the high knowledge in engineering, which indicates that they could process the control text with greater ease and that they also had more cognitive resources available for other memory consuming operations such as extracting the theme of the text. On the other hand, the fact that the high knowledge in engineering have a poorer proficiency in English might have led them to process the text with greater difficulty. Consequently, they were not likely to activate cognitive resources so as to integrate the control text, nor were they likely to be able to extract the theme of this text. This result is interpreted in the light of a processing efficiency explanation (Daneman and Carpenter, 1980, 1983): if L2 readers do not have the adequate proficiency in a foreign language, processing difficulties may arise; consequently, such readers tend to overtax their working memories.

RESEARCH QUESTION (4)

Are high knowledge readers able to present higher levels of recall?

Scoring

The three texts, namely, control, linguistics and engineering were divided into a set of idea units, namely, 73 for the control (appendix I), 47 for linguistics (appendix I), and 49 for engineering (appendix I). Following Carrell (1992) and Baretta (1998), a syntactic criterion was adopted in order to analyse the texts: each idea unit consisted of:

(1) a clause, main or subordinate; adverbial and relative clauses were also taken as an idea unit (Carrell 1992: 6); (2) a phrase, each infinitive, gerundive constructions, and other nominalised verb phrases were also considered as a separate idea unit (p.6); moreover, heavy prepositional phrases, and single noun phrases consisting of a long group of words.

The data were analysed in qualitative and quantitative terms. In order to assess the quality of the information recalled, the idea units were labelled according to their level of importance as main idea, or supporting idea, or detail. Each idea unit was classified according to how important it was for the organisational pattern of each text, that is, for the control text, situation-problem-solution-evaluation, for the text on linguistics, comparison/contrast, and description of a process for the text on engineering. Each recall protocol was scored for either the presence of an idea unit or for the paraphrase of the idea unit. As for the analysis in quantitative terms, the total percentage of idea units recalled was taken into account.

A method developed by Tomitch (1995) was used to score the protocols. The source texts were divided into idea units and a parenthesis was put before each division. Recall protocols were compared to the texts divided into idea units. Whenever subjects could recall the idea unit or paraphrase it, they received a check mark (see appendix J for an example).

Results and Discussion

Results indicate that domain knowledge enabled subjects to have superior recall in terms of the amount recalled, and also in terms of the quality of information recalled (see also Spilich et al., 1979, for a similar position). The data were analysed in both quantitative and qualitative terms.

Quantitative Analysis

It was possible to observe some omissions in the domain protocols, which had a negative effect upon the total amount of information recalled. Some subjects seemed to know more of their original domain texts than they actually wrote in their recall protocols. For instance, one of the subjects with high knowledge in linguistics (protocol 4) did not refer to the comparison between the structural and functional views in the recall; however, the same subject mentioned this comparison in order to answer the comprehension question. One of the subjects with high knowledge in engineering (protocol 6) did not describe the two periods of the operation of the power switch in the recall, but the same subject could answer the comprehension question correctly, that is, the subject could explain each period.

In short, more omissions were encountered in the domain recalls, than in the answers to comprehension questions. Such omissions as the ones encountered in protocols 4 and 6 could be attributed to the fact that these two readers may have been able to recognise textual structure, but it does not necessarily mean that they would use it to organise their recall protocols (Tomitch 1995). However, when they were prompted to use textual structure so as to answer the domain comprehension question they turned out as able to use it. Protocols 4 (subject with high knowledge in linguistics), and 6 (high knowledge in engineering) do not depict the overall tendency of their groups. The mean scores encountered in research question three suggest that both groups of subjects could use the same organisation of their domain texts to structure their recalls.

Quantitative analysis: recall of subject with high knowledge in linguistics. As predicted in the study, domain knowledge enabled subjects with high knowledge in linguistics to recall more idea units (table, 12, below). They were able to recall 30% of

their domain text, and 34% of the control text. The gap between control and domain recall is narrow, only 4%. In other words, the high knowledge in linguistics recalled domain and control texts with approximately equal facility. This result is not surprising, since they were expected to be high knowledge with respect to both contents, control and linguistics. Again, as expected, subjects with high knowledge in linguistics recalled only 6% of the unfamiliar text, namely, engineering. Their poor performance might be attributed to the fact that they did not possess the appropriate schemata to read the text on engineering.

Table 11: Mean scores of subjects with high knowledge in linguistics and engineering. These results indicate the amount of information recalled for the control text.

	High in linguistics	High in Engineering
Main Idea	43%	27%
Supporting	38%	25%
Detail	12%	22%
Total	34%	25%

Table 12: Mean scores of subjects with high knowledge in linguistics and engineering. These results indicate the amount of information recalled for text on linguistics.

	High in linguistics	High in Engineering
Main Idea	51%	16%
Supporting	14%	14%
Detail	-	-
Total	30%	13%

Table 13: Mean scores of subjects with high knowledge in linguistics and engineering. These results indicate the amount of information recalled for the text on engineering.

	High in linguistics	High in Engineering
Main Idea	8%	50%
Supporting	-	26%
Detail	-	11%
Total	6%	39%

Quantitative analysis: recall of subjects with high knowledge in engineering. As for the high knowledge in engineering, they recalled only 13% of the unfamiliar text, linguistics, which is a poor performance. Moreover, the percentage of idea units recalled for the control text was 25%, this result can be regarded as considerably lower in relation to the amount they recalled for their domain text, 39%.

On the one hand, as expected, domain knowledge enabled the high knowledge in engineering to recall a greater amount of their domain text. On the other hand, the gap between the amount recalled for the control and domain text was not expected. Again, such results might be attributed to the fact that subjects with high knowledge in engineering read in English only for academic purposes. Consequently, it might have been more difficult for them to comprehend and recall the control text than the domain text. As it has already been mentioned (research question three), they found it difficult to extract the theme of the control text, which indicates that they omitted some important pieces of information.

By contrast, the high knowledge in engineering could integrate their domain text and extract the theme with great ease (research question three), and the amount they recalled for the domain text was also significant (39%). These results suggest that they have such great familiarity with the content, structure, and vocabulary of their domain text that they might have activated the appropriate schemata so as to process the domain text with greater efficiency. Consequently, cognitive resources were released to other memory demanding tasks such as integrating the text, and they could also recall a reasonable amount of information.

Taking into account the scores of each subject individually, it is possible to observe a gap within the group of subjects with high knowledge in engineering. There is a considerable difference between the subject who recalled the greatest amount of idea

units for their domain text (59%), and the one who recalled the least (22%) (see appendix O for individual scores). This gap of 37% suggests that there might be differences in levels of knowledge among the subjects of the same group. In other words, the subject who recalled the most, namely, protocol 10, was probably higher knowledge in power electronics than the one who recalled the least, namely, protocol 7. Moreover, in view of the quality of information recalled, the difference is still evident, protocol 10, 67% of main idea units were recalled, but protocol 7, only 33% of main idea units (appendix O). As for subjects with high knowledge in linguistics the total amount of idea units recalled for the domain text ranges from 23%, protocol 4, to 40%, protocol 2 (see appendix O, for individual scores). Although this gap (17%) is not so wide, it may still indicate differences in levels of knowledge among the subjects with high knowledge in linguistics.

Qualitative Analysis

Qualitative analysis: recall of subjects with high knowledge in linguistics. As predicted in the study, knowledge enabled subjects to present superior recall in terms of the quality of information recalled (see Spilich et al., 1979, for a similar position). As for the subjects with high knowledge in linguistics, they recalled 43% of main idea units for the control text. However, their domain recall was superior. They recalled 51% of main idea units for the domain text. The higher percentage of main idea units indicates that the recall of the domain text was superior to the recall of the control text in terms of the quality of information recalled. On the other hand, in terms of the total amount of information recalled, their recall was slightly superior for the control text (34%), but 30% for linguistics. In short, the recall of the domain text was superior to the control in terms of quality, but not in terms of the quantity of idea units recalled: the recall of the

domain text presented a higher percentage of main idea units, but it was more concise than the recall of the control with respect to the total amount of information recalled. This result suggests that the high knowledge in linguistics could condense the most important ideas of their domain text in a shorter account. Indeed, this high percentage of main ideas recalled (51%) enabled the high knowledge in linguistics to provide an inclusive summary of their domain text.

The high knowledge in linguistics were able to recall only 8% of the main ideas of the unfamiliar text, the text on engineering. Such poor performance indicates that the high knowledge in linguistics omitted some important information in their recall protocols. Three of the subjects with high knowledge in linguistics acknowledged that they were unable to comprehend and recall the text on engineering. Indeed, they clearly stated their difficulties. As they put it: "Não entendi 'lhufas' desse texto" (protocol 2). "Só que a explicação é muito detalhada para que eu repita. De fato não tive uma boa compreensão" (protocol 3). "Não consegui lembrar frases completas, somente palavras isoladas. Não entendi nada do conteúdo" (protocol 5). This kind of comment was classified as "metastatements" by Kintsch and van Dijk (1978) and they express the readers' attitude towards the text (p.376). It is also noteworthy that the metastatements occurred in the recall of the unfamiliar text, but not in the recall of the domain text. In other words, the more difficult it was for the subjects to recall the text, the more metastatements were added to the recall protocols. Kintsch and van Dijk make a similar observation (p.384). In short, these subjects' explanations were interpreted here as justification for a very poor quality of recall.

Such difficulties faced by the high knowledge in linguistics in the recall of the unfamiliar text are consistent with the results of research questions two and three. As far as the result of research question three is concerned, none of the subjects with high

knowledge in linguistics were able to extract the theme of the text on engineering, which also indicates that their recall lacked coherence. Moreover, the result of the second research question suggests that none of the subjects with high knowledge in linguistics could answer the comprehension question on engineering. This poor performance could be attributed to the fact that the high knowledge in linguistics did not possess the appropriate schemata to read the text on engineering. In fact, the vocabulary encountered in the recall protocols revealed that none of these subjects were familiar with the area of power electronics. For instance, subjects used general words in order to refer to the operation of the power switch: "controlador de tomada" (protocol 4), "mecanismo" (protocol 1), "mecanismo regulador" (protocol 3). Another subject made an attempt to explain the operation of the power switch in terms of waste and storage of energy, which is a very vague account of operation being described "o texto, acho, que fala sobre como a energia se expande e como ela é armazenada. Fala de voltagem etc." (protocol 2). Moreover, none of the subjects were able to name the component parts of the power switch.

As already observed, the recall of the high knowledge in linguistics was greater for main ideas than for supporting idea units. As for details, they were the least recalled. This is true for the three types of recall: first, in terms of control recall, they recalled 43% of main idea units, 38% of supporting idea units, and 12% of details. Second, in terms of domain recall, they were able to recall 51% of main idea units and only 14% of supporting ideas, no details were reported. Third, in relation to unfamiliar recall, they recalled 8% of main idea units but neither supporting idea units, nor details were mentioned. The results of the control and domain recall depict the tendency of the high knowledge in linguistics to recall relevant domain and control information. In other words, as high knowledge readers, they were able to activate schemata. Consequently,

schemata activation guided them into selecting the most relevant idea units, and also into using these ideas to construct their recall protocols (Kintsch and van Dijk, 1978). Indeed, the result of research question three confirms this tendency, that is, the high knowledge in linguistics were able to recall higher-order information so as to (1) extract the theme of the control and domain texts, (2) integrate the domain and control texts. On the other hand, lower-order information such as details, which were not so essential for forming the gist of the text might have been forgotten, or simply not stated. As Kintsch and van Dijk (1978) explain, schemata activation may help readers to condense the higher-order information of a text into its theme, or gist so that many details may be lost. As for the recall of the unfamiliar text, the high knowledge in linguistics did not mention any supporting idea unit nor any detail because they might not have been able to recall them at all. Subjects with high knowledge in linguistics clearly stated in their protocols that they found it difficult to comprehend and recall the text on engineering.

Qualitative analysis: recall of subjects with high knowledge in engineering. Again, as predicted in the study, domain knowledge also enabled subjects with high knowledge in engineering to have superior recall in terms of the quality of the information recalled (see Spilich et al., 1979, for a similar position). As for the unfamiliar text, linguistics, they performed poorly, and recalled only 16% of main idea units. However, their recall was superior for the control text, they recalled 27% of main idea units. Recall was even superior for their domain text, that is, subjects recalled 50% of the information classified as main idea units. Such higher percentage of main idea units recalled for the domain text indicates that the high knowledge in engineering were able to provide a much more complete account of their domain text.

These results suggest that the high knowledge in engineering could activate the appropriate schemata so as to select and also recall the most important idea units of

their domain text (for a similar position, see Kintsch and van Dijk, 1978). By contrast, it was not so easy for them to recall the main idea units of the control text. The gap between control and domain recall can be found in the results of research questions two, and three, and also in the total amount of idea units recalled. Since subjects with high knowledge in engineering were expected to be high knowledge with respect to the contents of both texts, domain and control, these results cannot be attributed to lack of content knowledge. Instead, their disadvantage at the control recall could be attributed to a poorer proficiency in L2. Such problem probably prevented the high knowledge in engineering from using textual and linguistic cues to activate the appropriate schemata, which resulted in some mistakes.

On the one hand, the high knowledge in engineering had some general understanding of the text, that is, they could perceive that the text was about the spread of the AIDS epidemic, and the threat it represents to mankind. Cognate words such as *AIDS, HIV positive, AIDS epidemic, irresponsibility, silence* might have enabled them to activate some general schemata about AIDS. On the other hand, it also seems that they failed to activate the appropriate schemata so as to have a more sophisticated grasp of the text and extract its main idea, so their confusions were evident. It is also possible that readers' excessive trust on top-down processing might have misled them. For instance, one of the subjects with high knowledge in engineering wrote that the author of the text felt relieved after having received some pieces of advice from the AIDS organisations. "Ao procurar um grupo de ajuda recebeu a seguinte orientação: 'fale para alguns, não para todos. Sinta-se a vontade para falar quando tiver vontade ou esconder se necessário'. Desde então o personagem se sente confortado" (protocol 7). However, the author was not relieved at all, but he was rather worried because he was strongly against such advice. According to the text, AIDS organisations provided only

psychological support, but they failed to encourage the HIV positive to take responsibility for the Aids epidemic. Another subject wrote that numerous campaigns had been launched to encourage the HIV positive to break the silence, and tell the truth about their condition to potential partners. "Também relata as diversas campanhas para que as pessoas contaminadas contem sua situação a seus parceiros, de forma a conter a propagação do vírus" (protocol 9). This elaboration is mistaken. Indeed, there were no such campaigns, the author seemed to be the only person who voiced opposition to the silence. Another subject mentioned that it was important to provide information about the transmission of the AIDS virus. "O autor considera que informação sobre transmissão do vírus da AIDS é mais importante do que ajuda e consolo" (protocol 10). Again, this elaboration is not correct. The author's message did not refer to the importance of providing technical information about the transmission of the HIV virus. More accurately, the author believed that the HIV positive should inform their prospective partners about their HIV status.

On the other hand, none of the high knowledge in linguistics provided inaccurate elaborations with respect to the content of the control text, which yielded higher levels of recall both in terms of quantity and quality of information recalled. Their greater accuracy may indicate that they could use textual and linguistic cues in order to activate the appropriate schemata, which points to the interaction between bottom-up and top-down processing. The results of research question two confirm this tendency, that is, the high knowledge in linguistics could make accurate inferences with respect to the contents of the control text whereas the high knowledge in engineering turned out to be at disadvantage.

The recall of the high knowledge in engineering was greater for main idea units than for supporting ideas. As for details, they were the least recalled. This is particularly

true for their domain text: they recalled 50% of main idea units, 26% of supporting idea units, and only 11% of details. The results of domain recall depict the tendency of subjects with high knowledge in engineering to recall the most important domain information. In fact, the results of research question three confirm this tendency. In other words, the high knowledge in engineering could extract the theme of their domain text, and also recall higher- order information so as to integrate it (see Kintsch and van Dijk, 1978, for a similar position).

Regarding the recall of the control text, it was slightly greater for main idea units (27%) than for supporting idea units (25%). As for the recall of details (22%), it was slightly lower than the recall of supporting idea units (see table11 above). The narrow gap between the recall of higher- order information, and lower- order information might indicate that subjects with high knowledge in engineering failed to assign importance, that is, they might not have been able to make a distinction between the most important idea units, and the least important ones. Such failure may be interpreted as an indication that they did not activate the appropriate schemata. Indeed, their confusions and incorrect elaborations suggest that the high knowledge in engineering were not able to activate schemata to read the control text. Therefore, they were not able to select the main idea units in order to grasp the essence of the control text. The result of research question three also confirms this tendency, that is, the high knowledge in engineering found it difficult to extract the theme of the control text.

As for the text on linguistics, the high knowledge in engineering recalled 16% of the main idea units, and 14% of the supporting idea units, none of the details were recalled. The recall of the high knowledge in engineering for the unfamiliar text was considered very low in terms of quality, especially if compared to their recall for their domain text, or if compared to the recall of the high knowledge in linguistics for their

domain text. The high knowledge in engineering might not possess the appropriate schemata to read the text on linguistics. Indeed, a subject with high knowledge in engineering reported his difficulty in reading the unfamiliar text. "Para uma melhor memória do texto eu teria que ter entendido o mesmo. Como o meu nível de interpretação sobre o mesmo foi muito baixo, minha memória também foi proporcional" (protocol 10). Another subject initially stated that linguistics "depends on grammar" (my translation). Second, the same subjects rephrases what he had just written and explains that linguistics "depends on social factors and on the situation" (my translation). However, neither did the subject refer to the structural and functional approaches, nor was the subject able to explain and compare such approaches. As he puts it ,"recordo do texto lido que a lingüística depende da gramática, digo, do sistema gramatical, depende de fatores sociais e situacionais" (Protocol 8).

RESEARCH QUESTION (5)

Does domain knowledge results in shorter reading time for the domain related and the control texts ?

Scoring

The mean reading time was calculated for subjects with high knowledge in linguistics, and in engineering. For a description of individual reading time see appendix P.

Table 14: Mean reading time of subjects with high knowledge in linguistics vs. mean reading time of subjects with high knowledge in engineering.

	high knowledge in linguistics	**high knowledge in engineering**
control	5' 36''	7' 24"
linguistics	5' 36"	7' 12"
engineering	5' 48"	7' 36"

Results and Discussion

The primary assumption regarding reading time was that high knowledge readers would process information more readily because they would be able to match input information to their already existing schemata (Fincher-Kiefer et al., 1988). This assumption led to the following question: would knowledge enable subjects to read their domain and control texts faster than the unfamiliar text? As for the high knowledge in linguistics, they read the domain and control text (5' 36") a little faster than the unfamiliar text (5' 48"); however, this difference is not meaningful. In relation to the high knowledge in engineering, unexpectedly, they read the unfamiliar text (7" 12') faster than the domain text (7" 36'). Moreover, they spent 7' 24" on the control text. Again, surprisingly, they read the unfamiliar text faster than the control text, but the difference here is not significant either. Indeed, the most relevant difference is between the two groups of subjects, that is, the high knowledge in linguistics turned out to read faster than the high knowledge in engineering.

On the one hand, as for the high knowledge in linguistics, it seems that knowledge enabled them to read their domain texts faster. On the other hand, the results of the present study are inadequate to confirm this tendency because the gap between domain and unfamiliar reading time is too narrow. The difference between the reading times of domain/control and unfamiliar text is only 12". The researcher attributes this narrow gap to a problem in the design of the experiment. That is, the time allotted for the reading task was perhaps too long. A time limit of eight minutes was set so that subjects would have plenty of time to read approximately four hundred words. The researcher speculates that some of the subjects might have taken advantage of the long time allotted, and they read the texts more carefully than they usually do, almost as if they were studying the text. Some of the subjects might have reviewed the information they

found relevant, that is, they were preparing themselves for the free recall task. Indeed, subjects were told beforehand they were going to do a free recall task, being told in advance may have influenced how they approached the texts, in other words, they might have oriented to the task (see Baretta, 1998, for a similar position). Kintsch and van Dijk (1978) also say that subjects may attempt to fulfil the conditions of a given task (p.374). One subject with high knowledge in linguistics, protocol 2, spent more time on the domain text, 7', than on the unfamiliar text, 6' (see appendix P), this subject might have focused closer attention on the domain text. Two other subjects with high knowledge in linguistics, protocols 4, and 5 spent the same amount of time reading the domain, and the unfamiliar text (see appendix P). In short, the fact that subjects were given so much time to read the texts prevented the researcher from observing how long they would actually need to read each text once.

Initially, it was expected that absence of domain knowledge would result in longer reading time, in other words, high knowledge readers would read faster. However, the results of subjects with high knowledge in engineering contradicts this expectation, they took longer to read the domain text. Perhaps, due to the fact that they were high knowledge in engineering, they could focus closer attention on their domain text, and they took longer to read it. This assumption requires further empirical investigation. Nevertheless, it was possible to observe that two subjects with high knowledge in engineering actually took longer to read their domain texts than the unfamiliar texts, protocols 7, and 8 (appendix P). Two other subjects, protocols 9, and 10, took eight minutes to read the three texts, that is, they used all the time allotted. Perhaps, due to the fact that they were not so proficient in English, some of the high knowledge in engineering tended to spend more time reading in English. Or they might have been oriented to the task and spent the eight minutes (see Baretta, 1998, for a

similar position). Again, the fact that these readers took advantage of all the time allotted prevented the researcher from finding out how long they would actually need to read each text. To sum up, although it seems reasonable to assume that high knowledge readers can process information more readily, in the present study, knowledge did not necessarily lead subjects to read faster. Moreover, the researcher speculates that in this particular experiment, when it comes to reading time, other variables, not only prior knowledge might have come into play.

One of these variables may be language proficiency. The less proficient readers, the high knowledge in engineering, were definitely slower than the high knowledge in linguistics. The mean time of each subject was calculated individually, each subject had the reading time of the three texts, namely, control, linguistics, and engineering added up, then divided by three so that the mean time of each subject was obtained (appendix P). The group of subjects with high knowledge in linguistics obtained as the longest reading time 6'18", and the shortest 4'18". As for the group with high knowledge in engineering, the longest time was 8', and the shortest 6'.

A processing efficiency explanation seems to account for the longer mean time obtained by the high knowledge in engineering: due to being less proficient in English, they were not able to process L2 information so quickly, and efficiently as the high knowledge linguistics. Put another way, in comparison with the high knowledge in linguistics, the high knowledge in engineering attained a lower degree of automaticity in the L2/FL reading processes, which yielded a lower reading span (Berquist,1997), and longer reading time. Indeed, the results of research question one lend support to this explanation. The mean reading spans of each subject was calculated individually (appendix K), and the mean spans obtained by the subjects with high knowledge in engineering were inferior to the spans of the high knowledge in linguistics. In short, the

group of the less proficient in English, took longer to read, and also presented the lower reading spans.

CHAPTER V

FINAL CONSIDERATIONS, SUGGESTIONS, LIMITATIONS, AND IMPLICATIONS

FINAL CONSIDERATIONS

The main objective of this study was to investigate how prior knowledge, L2 working memory and L2 reading comprehension are related. In relation to working memory capacity in a second language, the results of the present study lend support to Berquist's (1997) claims. According to him, working memory capacity in L2 can be best explained in terms of a processing efficiency explanation rather than of a fixed physiological capacity (p. 472). In the present study, the processing of information in a foreign language imposed a heavier burden on the less proficient readers. In other words, the reading span of the high knowledge in engineering, the less proficient in English, turned out to be smaller than the reading span of the high knowledge in linguistics, the more proficient.

In relation to the interaction between domain knowledge, working memory capacity, and reading comprehension, the results indicate that knowledge in a particular domain enhanced readers' processing efficiency so as to yield a larger reading span for the domain tests. These results are consistent with the position of Afflerbach (1990), and Fincher-Kiefer et al. (1988). In other words, the processing of domain texts imposed fewer demands on readers' cognitive system. Consequently, more cognitive resources were left available for the high knowledge readers to perform higher cognitive operations, that is, the high knowledge had enough resources extract the theme of their domain texts. Such result also favours a processing efficiency

explanation. As predicted in the study, domain knowledge acted upon the quality of text processing, which resulted in higher levels of comprehension (for a similar position, see Afflerbach, 1990: 35). Indeed, both the high knowledge in linguistics and in engineering presented higher levels of comprehension and recall for their domain texts. However, in order to put domain knowledge to good use and activate the appropriate schemata, some threshold linguistic knowledge of L2 turned out to be essential. Aebersold and Field (1997) and Tomitch (1991) also mention how important it is for L2 readers to possess some threshold proficiency in the second language; otherwise, they may fail to perceive the linguistic cues, and cannot activate the appropriate schemata. In the present study, due to their proficiency in English, the high knowledge in engineering may have failed to activate the appropriate schemata to read the control texts. This failure led them to present poorer results in the control tests.

Summing up, since our ability to process information is limited, and it can be even more restricted in a second language (Berquist, 1997), it is important for L2 readers to seek greater processing efficiency, and knowledge activation may provide some compensation for our limited capacity. Indeed, the present results indicate that, on the one hand, the processing of information in a foreign language imposed a heavier burden on working memory of the less proficient, that is, the high knowledge in engineering. On the other hand, since domain knowledge enhanced readers' processing efficiency, to some extent, it compensated for the processing difficulties in a foreign language so even the less proficient readers, the high knowledge in engineering, were able to comprehend and recall their domain texts.

The results presented here indicate that to some extent a high degree of domain knowledge may compensate for an inadequate L2 proficiency; however, the researcher does not claim that domain knowledge may enable readers to overcome language

deficiencies. If readers' syntactic and vocabulary knowledge of L2 is too poor, they will be inefficient in lower level reading processes (Grabe 1991). Such processes, if not automated, will overtax readers' working memory. L2 readers need efficiency at lower level processes such as decoding, and lexical access in order to avoid processing "bottlenecks" (Spiro and Myers, 1984: 483); furthermore, they also need some basic L2 proficiency to recognise linguistic cues and activate schemata (Aebersold and Field, 1997; Tomich,1991). On the other hand, domain knowledge facilitates the component reading processes (Afflerbach, 1990), and as the present results indicate, it enhances processing efficiency. Nevertheless, it is not argued here, that domain knowledge enables L2 readers to entirely overcome inefficiencies at a linguistic level. Eskey (1988) mentions that both prior knowledge, and efficiency at lower-level processing are crucial for successful comprehension. Indeed, the high knowledge in engineering, again, the less proficient in English, presented smaller mean spans than the high knowledge in linguistics in the three span tests, and it also took them longer to read the texts used in the free written recall.

LIMITATIONS OF THE PRESENT STUDY

Subjects

Type of knowledge. Both linguistics and engineering are very broad fields of study. Consequently, it was not possible to select subjects who shared the same type of knowledge within the field of linguistics, and electrical engineering. In other words, it was not possible to ensure uniformity regarding the nature of knowledge among the subjects in each group. In order to tackle this problem, and make sure that subjects would possess the appropriate schema to read the domain texts, the texts on linguistics and engineering were at a very general level, that is, some general knowledge of

linguistics and power electronics was enough to read them. However, the reading span test on engineering was perhaps too basic, so even the low knowledge subjects could to some extent read it. Such result may also be attributed to the fact that subjects with high knowledge in linguistics were low knowledge rather than no knowledge in batteries (Fincher-Kiefer et al., 1988). In short, this result also indicates that levels of knowledge are proportional.

Level of knowledge. As levels of knowledge are proportional, it was possible to identify differences in levels of knowledge among the subjects of the same group. For instance, in research question 4, considering the scores of each subject individually, there is a considerable difference between the subject who recalled the greatest amount of idea units for their domain text, and the one who recalled the least (see appendix O). In other words, the subject who recalled the most, namely, protocol 10, was probably higher knowledge in power electronics than the one who recalled the least, namely, protocol 7. Or maybe, the one who wrote protocol 10 just has a larger memory span. The subject who wrote protocol 10 also recalled more main idea units than the subject who wrote protocol 7 (see appendix O).

Language proficiency. Although the high knowledge in engineering have some knowledge of the foreign language, enough to join the graduate courses at UFSC, that is, at least enough to read for academic purposes, they turned out as less proficient in English than the high knowledge in linguistics. According to the survey conducted prior to testing, three of the five subjects with high knowledge in engineering studied English only in High School, and four of them claimed to read in English only for academic purposes. As for the subjects with high knowledge in linguistics, the five of them have a university degree in English, all of them teach English for a living. Consequently, the

results of this study can be attribute not only to the fact that readers differ in area of expertise, but also to the fact that they differ in language proficiency.

This difference in language proficiency could have been a problem because the high knowledge in engineering were at a disadvantage in relation to the high knowledge in linguistics. Indeed, the results of the control tests confirm their handicap. However, the fact that subjects differed in proficiency has been used as an extra source of data because it has enabled the researcher to observe not only the processing efficiency of high and low knowledge readers, but also to observe the differences in the processing of information of the more proficient and the less proficient in English.

Sample. A sample of ten subjects is considered small to allow for generalisations.

Design

Tests. The main limitation of this study was that the readers were tested only in English, so this study did not allow for a comparison of working memory across languages. Although the results of the present investigation favour a processing efficiency explanation, an explanation based on the total amount of activation cannot be entirely rejected. Put another way, L1 working memory, which may be related to the total amount of activation, may affect L2 working memory. However, in order to find out how L1 and L2 memories interact, a comparative study should have been carried out.

Moreover, at the end of each span test, subjects should have been required to answer a question on the content of the span tests so as to enable the researcher to confirm whether they were really able to perceive sentence relatedness. As for the present results, they only depict a tendency, that is, the mean spans of the high knowledge in linguistics seem to indicate that perceived sentence relatedness in the

domain and control tests. The means of the high knowledge in engineering indicate a tendency to perceive that the domain sentences were related.

Correlations. The results obtained in the experiments reviewed in chapter two, namely, Daneman and Carpenter (1980,1983), Just and Carpenter (1992), Fincher-Kiefer et al. (1988) are correlational in nature. Consequently, it would have been important to calculate the correlation between the reading span tests and the reading comprehension tests. It seems that the present results hint a positive correlation. However, in order to find out whether the tests were really correlated, and the strength of the correlation, the calculations should have been done.

Choice of texts. As it has just been justified above, the domain texts were meant to be at a very general level. However, one of the texts which was transformed into a span test, namely, *Batteries*, was too basic. Consequently, both the high knowledge in linguistics, and the high knowledge in engineering presented the same mean reading span for the test on engineering. This is a surprising result since the high knowledge in engineering were expected to have a higher mean span for their domain test. Such result can also be attributed to a lack of linguistic knowledge, the mean reading spans of the high knowledge in engineering were smaller than the ones obtained by the high knowledge in linguistics.

Time limit. The time allotted for the reading comprehension tests was too long. Consequently, some of the subjects might have taken advantage of the long time allotted, and they might have read the texts more carefully than they usually would. To sum up, the fact that subjects were allotted so much time prevented the researcher from finding out whether they would read their domain texts more quickly than the unfamiliar text.

Instructions. Subjects were told prior to the reading that they were going to do a free recall task, being told in advance may have influenced the way they read the texts (Baretta, 1998). In other words, subjects may have oriented to the task and prepared themselves for a free recall task. Again, the fact that subjects might have oriented to the task, and perhaps, read the tests more carefully than they usually do also prevented the researcher from finding out how long they would actually need to read each of the texts.

SUGGESTIONS FOR FURTHER RESEARCH

Bridging the gap between L1 and L2 working memories. In the present study, individuals were tested only in L2, that is, in English. Consequently, it would be interesting to carry this discussion further and compare reading spans across languages. Berquist (1997) suggested that individuals are not able to process information so effectively in L2 as in L1 even at very advanced levels (p.472), then working memory capacity is reduced in L2. It would be worth investigating, first, whether this reduction is significant. Second, if this reduction turns out to be significant, to what extent domain knowledge can compensate for it. In short, to what extent can domain knowledge enable L2/FL readers to bridge the gap between their L1 and L2/FL working memories?

L1 and L2 working memory: How are they related? On the one hand, working memory capacity in L2/FL seems to be related to a processing efficiency explanation (Berquist, 1997), that is, working memory may vary according to readers' efficiency to perform some process such as the component reading process (Daneman and Carpenter, 1980, 1983). On the other hand, working memory capacity in L1 may be related to an activation limit: Just and Carpenter (1992), and Cantor and Engle (1993) argue that the content of working memory consists of information retrieved from long term memory; however, in order to become part of working memory, the information available in long

term memory has to be activated above some minimal threshold level. According to this framework, individuals may vary in the total amount of activation at their disposal to retrieve information from long term memory. Despite the divergence between these two explanations, working memory across languages are likely to be related because the same reading span task has been considered an index of working memory in both LI and L2 (Berquist, 1997: 471). Consequently, it also seems worth investigating to what extent L1 working memory can influence L2 processing efficiency. For instance, if a reader presents a small working memory span in LI, will this disadvantage necessarily hinder L2 processing efficiency? Can individual differences in L2 working memory capacity be interpreted only as a function of readers' proficiency in a foreign language, or is it also related to LI working memory? Harrington and Sawyer (1992) pointed to the importance of investigating this issue.

PEDAGOGICAL IMPLICATIONS

The results of the present study indicate: first, the more proficient and the less proficient in English differed in working memory capacity and reading comprehension performance; second, these differences were also observed in the performance of readers who possessed the appropriate schemata and the ones who did not. In other words, readers who were high knowledge in a particular field performed better in their domain tests, namely, the reading span and the reading comprehension tests. Such results lent support to a processing efficiency explanation, that is, the less proficient, and the ones who did not activate schemata overtaxed their cognitive system and could not read well. Is it possible for such readers to improve their performance? In other words, is it possible for them to improve processing efficiency so as to avoid overloading their working memory?

Yes, as L2 working memory is related to processing skills (Berquist:1997), it may be possible for teachers to aid readers because some processes can be improved (Tomitch, 1995). Tomitch (1995) explains that if a process turns out to be inefficient, for instance, readers fail to perceive textual organisation, instruction and practice may lead readers to recognise and make use of the textual structure (p.181). Therefore, processing efficiency will be enhanced.

Another point to bear in mind is that the component reading processes can be facilitated by knowledge activation (Afflerbach, 1990: 35). If less cognitive resources are allocated for performing the component reading processes, processing efficiency will be improved, and more resources will be released. Therefore, readers will be able to carry out higher cognitive operations, for instance, extracting the theme of a text (p.35). The results of the present study confirm Afflerbach' s claims.

This claim has an implication for teaching, not only should readers have some prior knowledge about the area of the text, but they should also be able to put this prior knowledge to good use. If a reader does not have any prior knowledge, it is important for the teacher to help her/him build up some knowledge about the topic they are going to read about. Or, as Tomitch (1991), puts it, it might also be the case of providing readers with pre-reading activities so as to activate the schema they already have. It is also noteworthy that poor proficiency in a second language may prevent readers from processing the linguistic clues and activate schemata (Tomich, 1991). Dias (1985) points to an interesting response to this problem, namely, non-linguistic elements, for instance, pictorial information. According to her, non-linguistic information should be used to help L2 readers construct meaning out of a text.

L2 proficiency may in fact be a problem because the less proficient tend to process information in L2 in a slower, less efficient way, which overtaxes working

memory. Consequently, instruction should be provided so that the processing of a second language will become more automated and faster (Berquist, 1997:472). If readers manage to process L2 with less effort, again, they will be able to release resources to other tasks. In short, on the one hand, it may be difficult to process information in L2. On the other hand, since working memory in L2 is best explained in terms of processing efficiency, there is some hope that the efficiency of a process may improve due to practice, and instruction.

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APPENDIX A - QUESTIONNAIRE

This questionnaire was conducted in order to find out whether the subjects were suitable for the purposes of the present study.

1. Você estuda inglês, ou já estudou? Onde você estuda ou estudou inglês?

2. Em que nível você está, ou até que nível você foi?

3. Há quanto tempo você estuda inglês, ou por quanto tempo você estudou?

4. Possuí algum certificado em inglês como língua estrangeira? Qual?

5. Tem alguma experiência em países de língua inglesa? Como turista, ou morou em país de língua inglesa? Por quanto tempo?

6. Tem o hábito de ler em inglês, ou lê em inglês apenas para fins acadêmicos.

APPENDIX B - INSTRUCTIONS ON THE READING COMPREHENSION MEASURES

Subjects were given three texts one at a time. Immediately after the reading of the first text they received a page containing the instructions on the free recall task. As soon as they finished the free recall task, they received another page containing instructions on the comprehension question and the question itself. This procedure took place three times, first, for the control text, control recall, and question; second, for the familiar material, third, for the unfamiliar material.

This appendix contains three instructions, namely, (1) instructions on reading, (2) instructions on the free recall task, (3) instructions on the comprehension question (in the actual Experiment the size of the type was 12).

(1) INSTRUCTIONS ON READING

These instructions were given together with the text.

1. Leia o texto abaixo, você terá no máximo oito minutos para fazer esta leitura.

2. Marque o tempo que você vai gastar para ler o texto.

Início:

Término:

(2) INSTRUCTIONS ON THE FREE RECALL TASK

2. Sem consultar o texto, escreva em português tudo o que você conseguir lembrar sobre o texto lido.

(3) INSTRUCTIONS ON THE COMPREHENSION QUESTION

These instructions were given together with the comprehension questions.

3. Sem consultar o texto, responda a seguinte pergunta em português:

APPENDIX C - TEXTS USED IN THE READING COMPREHENSION MEASURES

The original layouts, and the titles of the texts were removed, and each of them was typed in a blank page. In the actual Experiment the texts were double spaced, and the size of the type was 12.

TEXT USED IN THE READING COMPREHENSION MEASURE: CONTROL

Nearly three years ago I tested positive for HIV. Since then I have discovered a support system that steadfastly refuses to encourage responsible behavior, and a society whose silence ensures the continued spread of this disease.

Most HIV-positive people I have encountered do not voluntarily disclose their status to potential partners. Indeed, even people in long-term relationships lie about their status. These are the realities of HIV transmission today.

The people I am taking about are nothing like Nushawn Williams, the drug dealer who is believed to have infected numerous people in New York State. They did not grow up in Ghettos surrounded by street gangs. They come from stable homes in safe neighborhoods. They went to high school and college and graduate school.

They remain silent because it is difficult to tell the truth, and because their friends and community support them in their silence. Their doctors, psychiatrists, even the AIDS organizations they call for help, offer comfort and sympathy but don't necessarily encourage them to tell the truth.

We are more than 15 years into the AIDS epidemic, and I have been asked my status by prospective partner's only twice. Since testing positive, I've made a point of disclosing my status to any potential partner; all but one told me I was the first person to do so. Each believed that if he practiced safe sex, there would be no need to know.

I practiced safe sex. There is no such thing as safe sex, only levels of risk that one must choose. In making that choice, a partner's HIV status is *the* critical piece of information.

Leading advocacy groups have perpetuated the culture of irresponsibility. Last year when I called the hot line for the Gay Men's Health Crisis, one of the nation's leading AIDS services agencies, I was advised to "experiment"- informing some partners of my HIV status while remaining silent with others. In this way I could decide which was more comfortable for me.

The CDC will only "suggest that you might want to consider informing your partner," a hot-line counselor told me. Counselors at the San Francisco AIDS Foundation said it was their job to dispense information, not moral or ethical recommendations, and, again, that I must do what makes me fell comfortable.

We are not talking about comfortable here. We are taking about life and death.

The emphasis on the individual's right, without an equally strong emphasis on the individuals responsibility, is wrong and is a direct cause of the spread of this disease.

Groups such as the Gay Men's Health Crisis claim they cannot dictate behavior. Granted. But that is all the more reason that AIDS organizations have a responsibility to encourage people who are HIV positive to do what is right.

For years the AIDS community has rallied around the battle cry "Silence = Death." What it has failed to realize is that silence comes in many forms and that all are lethal.

Reference:

Mayer, A. (1998, April). The irresponsibility that spreads AIDS. *Reader's Digest*,. 113- 114.

TEXT USED IN THE READING COMPREHESION MEASURE: LINGUISTICS

The structural view of language concentrates on the grammatical system, describing ways in which linguistic items can be combined. For example, it explains the operations for producing the passive 'The window has been broken' rather than the active 'Somebody has broken the window', and describes the word-order rules that make us interpret 'The girl chased the boy' differently from 'The boy chased the girl'. Intuitive knowledge of these, and of a multitude of other linguistic facts and operations, makes up a native speaker's linguistic competence and enables him to produce new sentences to match the meanings that he needs to express.

The structural view of language has not been in any way superseded by the functional view. However, it is not sufficient on its own to account for how language is used as a means of communication. Let us take an example a straightforward sentence such as 'Why don't you close the door?'. From a structural viewpoint, it is unambiguously an interrogative. Different grammars may describe it in different terms, but none could argue that its grammatical form is that of a declarative or imperative. From a *functional* viewpoint, however, it is ambiguous. In some circumstances, it may function as a question - for example, the speaker may genuinely wish to know why his companion never closes a certain door. In others, it may function as a command -this would probably be the case if, say, a teacher addressed it to a pupil who had left the classroom door open. In yet other situations, it could be intended (or interpreted, perhaps mistakenly) as a plea, a suggestion, or a complaint. In other words, whereas the sentence's *structure* is stable and straightforward, its *communicative function* is variable and depends on specific situational and social factors.

Just as a single linguistic form can express a number of functions, so also can a single communicative function be expressed by a number of linguistic forms. For example, the speaker who wants somebody to close the door has many linguistic options, including 'Close the door please', 'Could you please close the door?', 'Would you mind closing the door?', or 'Excuse me, could I trouble you to close the door?'. Some forms might only perform this directive function in the context of certain relationships - for example, 'You've left the door open!' could serve as a directive from teacher to pupil, but not from teacher to principal. Other forms would depend strongly on shared situational knowledge for their correct interpretation, and could easily be understood (e.g. 'Brrr! It's cold, isn't it?').

Reference:

Littlewood, W. (1981). *Communicative Language Teaching- An Introduction*. Cambridge: CUP

TEXT USED IN THE READING COMPREHENSION MEASURE: ENGINEERING

Forward-mode switching regulators have as their functional components four elements: a power switch for creating the PWM waveform, a rectifier (or catch diode), a series inductor, and a capacitor. The power switch may be a power transistor or a metal oxide semiconductor field-effect transistor (MOSFET) placed directly between the input voltage and the filter section. In between the power switch and the filter section there may be a transformer for stepping up and down the input voltage as in transformer-isolated forward regulators. The shunt diode, series inductor, and shunt capacitor form an energy storage reservoir whose purpose is to store enough energy to maintain the load voltage and current over the entire off-time of the power switch. The power switch serves only to replenish the energy lost to the load during its off-time. Its function can be seen as an electrical equivalent of a mechanical piston-flywheel combination. The piston provides a pulse of energy, and the flywheel stores the mechanical energy for use by the load.

The operation of the power switch can be broken up into two periods. The first is when the power switch is on. During this period, the load current passes from the input source, through the inductor to the load, and back again through the return (or ground) lines to the input source. During this time the diode is reverse-biased. After the power switch turns off, the inductor still expects current to flow through it. The former current path through the input source is now open-circuited, and the catch diode now begins to conduct, thus maintaining a closed current loop through the load. When the power switch once again turns on, the voltage presented to the filter serves to turn off the catch diode. In short, forward current is always flowing through the inductor; hence its name.

The amount of energy being delivered to the load is controlled by the duty cycle of the power switch on-time. This may vary anywhere between 0 and 100 percent duty cycle but typically falls between 5 and 95 percent duty cycle. An approximate model of the relationship between input voltage, duty cycle, and output voltage is that the output voltage is the average of the area under the chopped voltage waveform or

$$V_{out} = V_{in} \cdot \text{duty cycle}$$

In reality this relationship applies only for light loads, but it does serve as a reasonable approximation elsewhere.

Reference:

Brown, M. (1990). *Practical Switching Power Supply Design*. San Diego, C A.: Academic Press, Inc.

APPENDIX D - COMPREHENSION QUESTIONS

Each of the questions below refer to the contents of the texts just displayed above.

(CONTROL) De acordo com o autor, qual a melhor maneira de se evitar a propagação do vírus da AIDS.

(LINGUISTICS) O autor compara duas abordagens da lingüística, qual é a diferença entre elas.

(ENGINEERING) A operação descrita pelo autor pode ser dividida em dois períodos distintos, descreva-os.

APPENDIX E - TEXTS USED IN THE READING SPAN MEASURE

TEXT USED IN THE READING SPAN MEASURE: CONTROL

When to Say No to Your Kids

From FAMILY LIFE
MARLYS HARRIS

IT'S NOT OFTEN I get the urge to reprimand somebody else's child, but the impulse seized me recently in a shoe department. There was a mother with two children, and one of them, an eight-year-old girl, made it known that she wanted a particular pair of party shoes. First demanding, then whining, wheedling, cajoling and shrieking, she pleaded relentlessly, "Mommy, I want the shoooes. Buy me the shoooes."

Her mother, trying to fit a baby brother, held her daughter off with gentle no's for about ten minutes. Then her nerves collapsed. "Bring the patent-leather party shoes," she told the salesclerk. "I can't take anymore."

Giving in to a child's demands is the path of least resistance. But doing so all the time can cause children to develop "the gimmies"—a behavior pattern characterized by demands for more and more stuff. "Television and advertising are stimulating kids' acquisitiveness," says Thomas Lickona, professor of education at the State University of New York at Cortland and author of *Raising Good Children*. "They're constantly being sold on the idea that things will buy them happiness."

How can you keep your child from developing the gimmies—or cure him if they've already set in? Here's what experts advise:

Teach kids not to rely on TV, computers and toys. If you're like most parents, such a thought sends waves of panic through you. Without their dolls, action figures, videos and electronic games, won't your kids drive you crazy?

Not if you engage them in meaningful activities, Lickona says, such as work that helps the family. Traditionally, he points out, kids on farms would milk cows, collect eggs and perform other duties, even at a very young age. Nowadays, however, we ask almost nothing of our children.

Lickona says parents can fend off the gimmies by creating a schedule of chores. Even four-year-olds can help clear breakfast dishes, feed the cat, water the plants and so on. Older children can make beds, work in the garden and sort laundry.

Don't feel it's up to you, however, to keep your child busy. Growing children have to figure out how to entertain themselves without expensive toys—or adults' help. If you restrict TV and computer time, they'll eventually discover something to do that doesn't require buying more things.

Don't buy goodies for your kids every time you go shopping. This is a practice often brought about by guilt. "Parents who work feel that because they're unavailable to their children so much of the day, they should somehow make it up to them," says New York City psychologist Dennis Shulman.

Buying gifts habitually may make you feel generous, but your children may begin to feel entitled to treats and demand them all the time.

Explain that money is a consideration. Make clear to your child right from the start that what you buy for him is a matter of heavy decision-making. Give him some idea of the financial thinking that goes into deciding whether you will buy him a bicycle.

But don't give children the "we're too poor" excuse if you can afford the item. If they see you indulging your own whims, they figure that you should indulge theirs too. Remind them that owning a lot of things is not crucial to happiness. Emphasize that some things are trashy and not worth buying. Drawing distinctions for your children will ultimately

transform them into savvy consumers and disciplined savers later on.

If you think your child's request is worthwhile, give him a chance to earn the money to buy the item. Say something like, "I can't buy those designer jeans today. But I will if you help me in the kitchen every night this month." This also encourages your child to develop initiative and drive.

If you reject a child's request, keep your explanation simple. One day at a supermarket, I heard a father explain to his four-year-old son that the bag of potato chips the boy wanted was "not a good option because they aren't nutritious and contain fat and salt and are harmful to your health." At a drugstore, a mother told her daughter that she couldn't have a pack of barrettes because "having so many barrettes is irresponsible."

Such explanations sound civilized to adults, but to a child they are confusing and indefinite. Better to deliver a firm "no" and then offer the simplest explanation you can think of: "They're not good for you." Such a flat rejection gives a child no reason to think that crying, fussing or yelping will get him anywhere.

Once you say no, stick to it. Your response to the gimmies teaches children something important: "how things are gained and not gained," Shulman says. Letting a child have her own way after crying and whining tells her she can get ahead by making other people's lives miserable.

If you find yourself usually giving in, examine your own motives. "The primary reason is to avoid a scene," Shulman says. But keeping the peace comes at a high price—it teaches your child that fussing works. "You're much better off letting a scene happen," Shulman advises. "Even if your child cries piteously and onlookers think you're the Wicked Witch of the West, you must stand by your decision."

"If necessary, leave the store," advises family therapist Michele Weiner-Davis of Woodstock, Ill. "Sometimes you have to inconvenience yourself to prove a point."

YOUR JOB AS A PARENT is to help your children decide what's worth getting and then show them the right way to go about it. The important lesson they'll learn is that getting takes more effort than saying, "Gimme."

Reprints of this article are available. See page 208.

TEXT USED IN THE READING SPAN MEASURE: LINGUISTICS

KINDS OF GRAMMARS

The term *grammar* is used in a number of different senses. Here it is of interest to distinguish three senses, or three kinds of grammars.

Grammar is used to refer to the rules and principles native speakers use in producing and understanding their language. These rules and principles are almost all acquired in childhood and are "in the heads" of native speakers. Such a grammar might be called a *mental grammar*. No one knows the precise form a mental grammar takes because it cannot be directly observed. What can be observed is the *output* of a mental grammar—the utterances that speakers use and recognize as sentences of their language.

The term *grammar* is also used to refer to the set of generalizations (and exceptions to them) formulated by grammarians, who examine grammatical utterances, perhaps compare them with other logically possible strings of words, and then try to determine the properties that differentiate the well-formed strings of words (or sentences) from those that speakers reject as ill formed. This kind of account of the language is referred to as a *descriptive grammar*. Descriptive grammars are attempts by grammarians to provide visible analogs to the invisible mental grammars of native speakers.

In a third sense, the term *grammar* refers to certain kinds of language rules not necessarily based on usage by the ordinary native speaker but on the kind of English believed characteristic of the most educated speakers of the language. Sometimes these rules have less to do with English usage than with the grammar of Latin, notions of logic, or even irrational feelings as to how we should speak and write. This kind of grammar is known as *prescriptive grammar*, because the grammarian is attempting to *prescribe* certain ways of speaking and writing. Prescriptive grammars have their uses, especially in education, where they are often referred to as school grammars. School grammars, if based on accurate observation of contemporary educated usage, can be helpful in guiding writers toward clearer expression. Textbooks for non-native speakers and grammars for computers processing a particular human language require a prescriptive approach. They are really telling us what the learners or computers ought to say if they are to use English as a well-educated native speaker would.

But this prescriptive approach to grammar can be abused by those who seek to impose outdated conventions or what the prescriber thinks a form ought to mean rather than the meaning understood in general usage.

How might a prescriptive grammarian set about imposing a convention? Suppose he or she, perhaps biased by Latin grammar, disapproves of the use of *me* in this sentence:

> *It's me!*

preferring instead this version:

> *It is I!*

The grammarian might formalize this preference—and this notion of what "good" English should be—as a grammatical rule such as the following, which excludes the *me* sentence and similar forms:

> When personal pronouns occur after forms of the copula verb *be*, the nominative forms *I, he, she, we, they* should be used instead of the objective forms *me, him, her, us, them*.

Our second example of a prescriptive rule is one in which a grammarian prescribes what she thinks a form ought to mean rather than the meaning understood in general usage. This example comes from a grammar text addressed to native speakers of English. The author, discussing this sentence:

> *I'm going to try to help the victim.*

makes the following comment:

> A variation that is common in colloquial English substitutes *and* for *to*, the sign of the infinitive: I'm going to try *and* help the victim. In this case *and* is simply inaccurate: the usage is inappropriate in Standard Written English.[2]

The author has in mind some semantic distinction between *to* and *and* constructions that doesn't really apply to this idiom with *try*. The rule itself, but not the explanation, does in fact capture one minor characteristic of a formal dialect of *written* English. Note that both this prescriptive rule and the one requiring *It is I* go against current spoken usage by educated speakers of English.

The prescriptive approach can be seriously abused when the rules are based on the spoken English of the privileged and powerful. Those who speak dialects of English more common among minorities or the poor are too often not hired if they have not also acquired a prestige dialect. The problems, as we have seen, are not *inherent* in prescriptive grammar, but arise rather from its abuse.

Since prescriptive grammars are really grammars for learning and teaching some version of a language, they serve *pedagogical* or teaching function, and are often referred to by grammarians as *pedagogical grammars*. The better grammars of this type provide an understanding of English language principles and processes and are based on research in the descriptive, scientific tradition; but, for good pedagogical reasons, they do not offer comprehensive coverage of the grammar of the language. Furthermore, because such a grammar has to be selective and easily understood, its generalizations are often "tidied up" and abbreviated.

TEXT USED IN THE READING SPAN MEASURE: ENGINEERING

Batteries According to Joule's law, electric energy is dissipated in any conductor when it carries a current. In simple dc circuits the source of this energy, which must be supplied in order to maintain the current, is often a chemical *battery*. Other sources of dc electric power will be considered in a later chapter. In a battery, chemical energy is converted into electric energy, and the chemical reactions maintain a potential difference between the battery terminals whether or not a current is present. This potential difference is commonly referred to as an *electromotive force*, abbreviated *emf*, in order to distinguish it from the potential difference which appears across a resistance in accordance with Ohm's law. As a battery continues to supply the energy necessary to maintain current in a circuit, the chemical constituents eventually become depleted and the battery is said to be *discharged*. Depending upon the particular chemical nature of the battery, it may be possible to *charge* it, that is, return it to its original chemical composition, by passing a current between its terminals in a direction opposed to the internal emf. The symbol for a battery in circuit diagrams, Fig. 1-7, consists of a short heavy line parallel to a longer thin line. It is always assumed, if not explicitly indicated, that the longer line represents the higher, or positive, terminal of the internal emf. Since the internal emf is a potential difference, its unit is the volt.

FIGURE 1-7 Conventional circuit symbol for a battery.

The carbon-zinc battery is by far the most common, and least expensive, source of electrical energy. Although it is conventionally referred to as a *dry cell*, it actually consists of a moist paste of zinc chloride, ammonium chloride, and manganese dioxide (called the *electrolyte*) contained between a zinc electrode and a carbon electrode. The zinc and carbon electrodes serve as the terminals of the battery. The operation of such a cell is briefly as follows. At the zinc electrode, zinc atoms are dissolved into solution as doubly charged zinc ions. The zinc electrode becomes negatively charged because each zinc atom leaves behind two electrons. At the carbon electrode ammonium ions reacting with manganese dioxide withdraw electrons from the carbon, and thus it becomes charged positively. If the negative zinc electrode is connected externally through a circuit to the positive carbon electrode, electrons can flow between them to complete the chemical reaction.

Notice that in order for the chemical reaction to continue, zinc ions must move away from the negative electrode and the reaction products near the positive terminal must likewise move away from the carbon electrode. Thus, current is carried internally to the battery by means of ions moving in the electrolyte, and this is a source of internal resistance. Current in the internal resistance has the effect of reducing the terminal voltage of the battery. The terminal voltage of the dry cell slowly decreases with use as the internal resistance increases because of depletion of the manganese dioxide. The internal resistance eventually becomes so large that the battery is useless.

If the dry cell is left idle for some time before it is completely discharged, the internal resistance gradually reduces because of internal diffusion of the ions. On the other hand, if a dry cell is allowed to age for extended periods (more than one year) internal ionic diffusion increases the internal resistance so much that the cell becomes inoperative, even though it may never have been used. The emf of a freshly prepared dry cell is 1.5 V. Higher voltages are conventionally obtained by connecting a number of individual units (Fig. 1-8); in fact the term *battery* originated from just such assemblies. Dry-cell batteries of 1.5, 9, 22.5, 45, 67.5 and 90 V are most commonly available.

The familiar lead-acid *storage battery* used in automobiles is an example of a battery that can be repeatedly recharged. The positive electrode of a fully charged storage battery is a porous coat of lead dioxide on a grid of metallic lead. The negative electrode is metallic lead, and both electrodes are immersed in a liquid sulfuric acid electrolyte at a specific gravity of about 1.3. During discharge the lead dioxide is converted to lead sulfate, which is poorly soluble and clings to the positive plate. This reaction withdraws electrons from the electrode, thus charging it positively. At the negative electrode, sulfate ions from solution produce lead sulfate and release electrons. Again the lead sulfate adheres to the electrode and at discharge both electrodes are nearly entirely converted to lead sulfate. The loss of sulfate ions from solution during discharge reduces the specific gravity to about 1.16, so that the condition of the battery may be determined by measuring the specific gravity of the electrolyte.

These chemical reactions are easily reversible, and current directed into the positive terminal acts to return the electrodes to their original chemical composition. Charging requires an external source to furnish

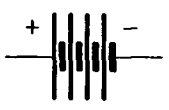


FIGURE 1-8 Four batteries connected in series.

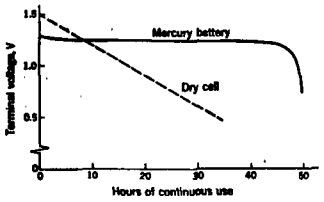


FIGURE 1-9 Discharge curve of carbon-zinc dry cell compared with that of mercury battery.

electric energy, after which the battery again can supply energy during discharge. Thus, the storage battery may be said to store electric energy in chemical form. In addition, the internal resistance of the lead-acid battery is very low and the battery is capable of delivering currents of several hundred amperes for short times. The fully charged cell has an emf of about 2.1 V, and commercial units are available as 6-, 12-, and 24-V batteries. It is important to maintain an idle storage battery fully charged, for otherwise the electrodes slowly become converted to a sulfate which cannot be returned to the original chemical composition by a charging current. In this condition, the electric energy capacity of the battery is reduced.

The internal resistance of the recently developed *mercury battery* does not change appreciably during discharge. This means that the terminal voltage remains essentially constant throughout the useful life. It then falls precipitously when the battery is exhausted, as illustrated in Fig. 1-9. The constant-voltage characteristic of mercury batteries is important in those electronic applications where the proper operation of a circuit depends critically upon the battery voltage. Such situations are not uncommon in vacuum-tube and transistor circuits. In addition, the constant-voltage feature means that the mercury battery is useful as a voltage standard in electrical measurement circuits. The mercury battery has a zinc amalgam for one electrode and mercuric oxide and carbon for the other. The chemical reactions at the electrodes are somewhat similar to those of the dry cell, and the potential developed is 1.35 V.

Other recent battery types include the *alkaline* battery and the *nickel-cadmium* battery. The alkaline battery is chemically quite similar to the dry cell, but has a strongly basic electrolyte between the electrodes. This, together with a modified electrode structure, lowers internal resistance, increases energy capacity, and improves shelf life. The nickel-cadmium battery can be repeatedly recharged like the lead storage battery, but is completely sealed, since gas evolution during charging acts as a self-regulating mechanism to prevent the buildup of a large gas pressure. This feature, and the fact that a liquid electrolyte is not required, compensates for the high cost of this battery. Typical modern batteries are illustrated in Fig. 1-10.

APPENDIX F - MAIN CHANGES MADE IN THE TEXTS USED FOR THE READING SPAN MEASURES

MAIN CHANGES MADE IN THE CONTROL TEXT IN ORDER TO TRANSFORM IT INTO A SPAN TEST

Text: "When to Say No to Your Kids"

The text "When to Say No to Your Kids" by Harris, M. was taken from a monthly magazine, *"Reader's Digest"*, April (1998). Initially, this whole text was transformed into seventy one sentences, but eventually it was reduced to sixty. The part of the text which the author describes how to reject a child's request, that is, the part which the author explains how to say know to your kid was transformed into a span test. However, the last three paragraphs, the part which the author advises against giving in was left out. The changes were introduced in order to transform this text into a span test will be mentioned below.

(1) Subordinate sentences were divided into a dependent and an independent clause so as to comply with the requirements of at most seventeen words in each sentence, e.g., sentences one and two.

(2) Co-ordinate sentences were also divided into two independent clauses, again, to satisfy the requirements of at most seventeen words in a sentence, e.g., sentences three and four.

(3) Sentences are expected to end in content words, e.g., in sentence fifteen the pronoun *you* was replaced by the noun *mind.* In sentence thirty eight, the information encapsulated in pronoun *theirs* was also recovered. Indeed, the word *whim* was used instead of the pronoun. Another example can also be mentioned: sentence thirteen would end in a phrasal verb, that is, in a preposition, *in.* To avoid that a sentence ended in a preposition, the information contained in the last clause was paraphrased so that sentence thirteen ends in a noun, *problem.*

(4) Sentences ending in a two-letter word were modified. For instance, in the original text, sentence twenty five would end in *something to do,* but this short clause was replaced by *something they enjoy doing.* One point to bear in mind is that each final word has at least three letters.

(5) Additional information, which paraphrases previously given information, was added to some sentences. For instance in sentence 19, an additional independent clause, *problems often arise* was eventually added to the former clause in order to avoid repeating the word *children* in the final position of a sentence.

(6) The order of words in sentence thirty was changed and a comma was also introduced so that this sentence ended in a common noun, *psychologist* rather than in a proper noun, *Shulman.*

MAIN CHANGES MADE IN THE TEXT ON LINGUISTICS IN ORDER TO TRANSFORM IT INTO A SPAN TEST

Text: "Kinds of Grammar"

The text "Kinds of Grammar" was taken from the book *English Syntax: A Grammar for Language Professionals,* by Jacobs, R. (1995) and the whole text was transformed into a span test of sixty one sentences. The modifications introduced are the following:

(1) As the number of words in each sentence ranges from thirteen to seventeen, sometimes, words had to be omitted or added. Whenever words had to be omitted, preference was given to adverbs, such as frequency adverbs, e. g., in sentences seventeen and eighteen the adverb *sometimes* was omitted. Moreover, if two words conveyed the same idea, for instance, *rules* and *principles* in sentence four, one of them was omitted, in this case principles. Whenever words were added, preference was given to adverbs or adverbial phrases such as *in fact* in sentence five, and *in linguistics* in sentence one. If an extra word, and some additional information were introduced, they would often convey emphasis, or paraphrase previously given information.

(2) There are sixty sentences in each span test, and each sentence has to end in a different word. Therefore, when two different sentences ended in the same word, this last word was replaced by a synonym, for instance, *language* was replaced by *mother tongue* in sentence eight. Furthermore, some pieces of information were paraphrased so as to avoid repeating a final word.

(3) Moreover, the sentences also have to end in content words such as nouns, adjectives, verbs, adverbs. Consequently, whenever a sentence ended in a pronoun, or preposition, or modal verbs it had to be modified. For instance, sentence thirty three would end in the pronoun *I,* then an extra piece of information was added to this sentence so as to avoid that the sentence ended in a pronoun.

(4) The original text was transformed into sixty one sentences, one sentence had to be omitted so that the whole the test has sixty sentences. The sentence omitted contained redundant information.

(5) Often, the information encapsulated in a pronoun had to be recovered, e.g. in sentence twenty seven, the nouns *learners* and *computers* were used instead of the pronoun *they*. Pronouns were recovered either to satisfy the requirements of the number of words per sentence, or to make the sentences clear.

(6) Some ellipses were also recovered in the span test, e.g. sentences seventeen and eighteen have the same subject. However, in the original text the subject appeared in the former sentence, but was implicit in the latter. Again, these ellipses were recovered either to comply with the requirements of the number of words per sentence, or to make the sentence clear.

MAIN CHANGES MADE IN THE TEXT ON ENGINEERING IN ORDER TO TRANSFORM IT INTO A SPAN TEST

Text: "Batteries"

The text "Batteries" was transformed into a span test, and it was taken from the book *Basic Electronics for Scientists* by Brophy, J. (1972). In this text, the author describes three types of batteries, namely, the dry cell, the storage battery, and the mercury battery. The description of the first, and second batteries were transformed into a span test. As for the description of the mercury battery, it was not used in order to keep the number of sentences within the limit of sixty sentences. Some of the modifications introduced are the following:

(1) Adverbial phrases such as *in fact* were added so as to comply with the requirement of at least thirteen words in a sentence, e.g., sentence two.

(2) A subordinate sentence consisting of two clauses was split so that the dependent and independent clause were kept apart, again, to satisfy the requirement of at most 17 words in each sentence, e.g., sentences twenty five and twenty six.

(3) In a co-ordinated sentence, the position of two independent clauses was inverted, e. g., sentence nine, so as to avoid repeating a final word that had been previously used.

(4) Information encapsulated in a pronoun was recovered: as all sentences ended in content words, in sentence ten, the pronoun *it* was replaced by the noun *device*. Another example, *it*, in sentence eleven has also been replaced by the noun *battery* so as to make sentence eleven clear.

(5) Some final words were replaced by a synonym to avoid the repetition of a final word in different sentences, e.g., *composition* was replaced by *condition* in sentence eleven.

(6) In sentence fifteen, a noun phrase was split by a comma, then the word qualifying the head noun was placed after the comma, again, to avoid repeating a word in a final position of a sentence.

APPENDIX G - READING SPAN TESTS

READING SPAN TEST: CONTROL

Text: "When to Say No to Your Kids"

1 It is not often I get the urge to reprimand somebody else's child. (13 words)
2 But the impulse to reprimand somebody else's child seized me recently in a shoe department. (15 words)
3 There was a mother with two children, and one of them, an eight-year-old girl, (14 words)
4 The girl made it known that she wanted a particular pair of party shoes. (14 words)
5 First demanding, then whining, wheedling, cajoling and shrieking, she pleaded relentlessly, "Mommy I want..." (14 words)
6 Her mother held her daughter off with gentle no's for about ten minutes. (13 words)
7 Then her nerves collapsed "bring the patent leather party shoes", she told the salesclerk. (14 words)
8 Indeed, giving in to a child's demand is the path of least resistance. (13 words)
9 But doing so all the time can cause children to develop "the gimmies"- a behaviour pattern. (16 words)
10 "The gimmies"- a behaviour pattern characterized by demands for more and more stuff. (14 words)
-
11 "Television and advertising are stimulating kid's acquisitiveness", says Thomas Lickona, author of *Raising Good Children.* (15 words)
12 "They're constantly being sold on the idea that things will buy them happiness" (13 words).
13 How can you keep children from developing the gimmies- or cure them if they have this problem? (17 words)
14 Here is what experts advise: Teach kids not rely on TV, computers and toys. (14 words)
15 If you are like most parents, such a thought sends waves of panic through your mind. (16 words)
16 Without their dolls, action figures, videos and electronic games, won't your kids drive you crazy? (15 words)
17 Not if you engage them in meaningful activities, such as work that helps the family. (15 words)
18 Traditionally kids on farms would milk cows, collect eggs and perform other duties. (13 words)
19 Nowadays, however, we ask almost nothing of our children, so problems often arise. (13 words)
20 Thomas Lickona says parents can fend off the gimmies by creating a schedule of chores. (15 words)
21 Even four-year-olds can help clear breakfast dishes, feed the cat, water the plants. (13 words)
22 Older children can make beds, work in the garden and they can sort laundry. (14 words)
23 Don't feel it's up only to you, however, to keep your child busy. (13 words)
24 Growing children have to figure out how to entertain themselves without expensive toys or adults' help. (16)
25 If you restrict TV and computer time, they'll eventually discover something they enjoy doing. (14)
26 They will eventually discover something to do that does not require buying more things. (14 words)
27 Another piece of advice: don't buy goodies for kids every time you go shopping. (14 words)
28 Most experts believe that this is a practice often brought about by guilty. (13 words)
29 "Parents who work feel that because they're unavailable to their children so much of the daytime... (16 words)
30 "...they should somehow make it up to them," says Dennis Shulman, a psychologist. (13 words)
31 Buying gifts may make you feel generous, but your children may begin to feel entitled to treats. (17 words)
32 But your children may begin to feel entitled to treats and always demand presents. (16 words)
33 Explain that money is a consideration, make it clear to your child right from the start. (16 words)
34 Make clear to your child that what you buy for him is a matter of decision making. (17 words)
35 It is important to give him some idea of the financial thinking that goes into deciding. (16 words)
36 The financial thinking that goes on into deciding whether you will buy him a bicycle. (15 words)
37 But don't give children the "we're too poor" excuse if you can afford the item. (15 words)

38 If they see you indulging your own whims, they figure that you also should indulge their whims. (17 words)
39 Remind them that owning a lot of things is not crucial to become a happy person. (16 words)
40 It is important to emphasise that some things are trashy and not worth buying. (14 words)
41 Drawing distinctions for your children will ultimately transform them into savvy consumers and disciplined savers. (15 words)
42 If you think your child's request is worthwhile, give him a chance to earn the money. (16 words)
43 Give him the chance to earn the money to buy the item they like. (14 words)
44 You should say something like "I can not buy those designer jeans today... (13 words)
45 But if you help me out in the kitchen every night this month". (13 words)
46 This is a good idea because it encourages your child to develop initiative and drive. (15 words)
47 Another piece of advice; if you reject a child's request keep your explanation simple. (14 words)
48 One day at a supermarket, I heard a father explain something to his four-year-old young. (15 words)
49 According to him, the bag of potato chips the boy wanted was "not a good option... (16 words)
50 ..because they aren't nutritious and contain fat and salt and are harmful to your health". (15 words)
51 At a drugstore, a mother told her daughter that she couldn't have a pack of barrettes. (16 words)
52 She couldn't have a pack of barrettes because "having so many barrettes is irresponsible". (14 words)
53 Such explanations sound civilized to adults, but to a child they are confusing and indefinite. (15 words)
54 Better to deliver a firm "no" and, then offer a very simple explanation. (13 words)
55 Offer the simplest explanation you can think of: "they are not good for kids". (14 words)
56 Such a flat rejection gives a child no reason to think that fussing will get him anywhere. (17 words)
57 Once you say no stick to it, your response to the gimmies teaches children something important: (16 words)
58 Shulman says, "Your response to gimmies teaches children something important: how things are gained and not gained". (17 words)
59 Letting a child have her own way after crying and whining tells her she can get ahead. (17 words)
60 It tells a child she can get ahead by making other peoples lives miserable. (14 words)

READING SPAN TEST: LINGUISTICS

Text: "Kinds of Grammar"

1 In linguistics, the term *grammar* is used in a number of different senses. (13 words)
2 Here it is of interest to distinguish three senses, or three kinds of grammars. (14 words)
3 *Grammar* refers to the rules native speakers use in producing and understanding their language, in conveying meaning. (17 words)
4 These rules are almost all acquired in childhood and are "in the heads" of native speakers. (16 words)
5 In fact, such a grammar might be called a *mental grammar* by linguists. (13 words)
6 No one knows the precise form a mental grammar takes because it cannot be directly observed. (16 words)
7 What can be observed is the *output* of a mental grammar, that is, its final product. (16 words)
8 In other words, the utterances that speakers use and recognize as sentences of their mother tongue. (16 words)
9 *Grammar* is also used to refer to sets of generalisations, and exceptions to them, formulated by grammarians. (17 words)
10 Grammarians examine grammatical utterances, perhaps compare them with other logically possible strings of words. (14 words)
11 Grammarians determine the properties that differentiate the well-formed sentences from those that speakers reject as ill formed. (17 words)
12 Indeed, this kind of account of the language is referred to as *descriptive*. (13 words)
13 Descriptive grammars are attempts to provide visible analogs to the invisible mental grammars that native speakers possess. (17 words)
14 Thirdly, *grammar* refers to certain language rules not necessarily based on usage by the ordinary native. (16 words)
15 These rules are based on the kind of English believed most characteristic of the most educated classes. (17 words)
16 Sometimes, these rules have less to do with English usage than with the grammar of Latin. (16 words)
17 These rules have less to do with English usage than with notions of logic. (14 words)
18 These rules have even less to do with English usage than with irrational feelings. (14 words)
19 To explain it better, irrational feelings as to how we should speak and write. (14 words)
20 This kind of grammar is known as *prescriptive grammar*, because the grammarian is attempting to prescribe. (16 words)
21 *Prescriptive grammar*, because the grammarian is attempting to prescribe certain ways of writing and taking. (15 words)
22 Prescriptive grammars are often referred to as school grammars, and they have their uses in education. (16 words)
23 School grammars, if based on accurate observation of contemporary educated usage, can be helpful. (14 words)
24 In this case, school grammars can be helpful in guiding writers toward clearer expression. (14 words)
25 Textbooks for non-native speakers and grammars for computers processing a particular human language require a prescriptive approach. (17 words)
26 They are really telling us how the learners or computer ought to communicate. (13 words)
27 If learners or computers are to use language as a well educated native speaker would employ. (15 words)
28 But this prescriptive approach to grammar can be abused by those who seek to impose outdated conventions. (17 words)
29 Or by those who seek to impose what the prescriber thinks a form ought to mean. (16 words)
30 What the prescriber thinks a form ought to mean rather than the meaning understood in general usage. (17 words)
31 A question remains, how might a prescriptive grammarian set about imposing a rule? (13 words)
32 Suppose the grammarian, perhaps biased by Latin grammar, disapproves of the use of *me* in this sentence: (17 words)

33 Disapproving of: *It's me!* But, preferring instead: *It is I!*, that is, preferring instead a nominative pronoun. (17 words)
34 The grammarian might formalise this preference and this notion of "good and bad " English. (15 words)
35 The grammarian might formalize this preference as a grammatical rule such as the following: (14 words)
36 A grammatical rule such as the following, which excludes the *me* sentences and the similar kinds. (16 words)
37 When personal pronouns occur after forms of the copula verb *be*, the nominative forms should be used. (17 words)
38 After forms of the verb be, the nominative forms should be used instead of the objective forms. (17 words)
39 Our second example of a prescriptive rule is one in which a grammarian prescribes what she thinks. (17 words)
40 In our second example, a grammarian prescribes the meaning a form ought to convey. (14 words)
41 What she thinks a form ought to mean rather than the meaning understood by everybody. (15 words)
42 This example comes from a grammar text addressed to native speakers of English, for instance. (15 words)
43 The author, discussing this sentence: *I'm going to try to help the victim* makes the following comment: (17 words)
44 A variation that is common in colloquial English substitutes *and* for *to, the* sign of infinitive: (16 words)
45 Prescriptive grammarians say, *I'm going to try and help the victim*, in this case *and* is inaccurate. (17 words)
46 In this case, *and* is simply inaccurate in standard written English because the usage is inappropriate. (16 words)
47 The author has in mind some semantic distinction between *to* and *and* constructions. (13 words)
48 Some semantic distinction between *to* and *and* constructions doesn't really apply to this particular idiom. (15 words)
49 The rule, but not the explanation, captures one minor characteristic of a formal and written dialect. (16 words)
50 This rule and the one requiring *It is I* go against current spoken usage by the educated. (17 words)
51 Prescriptive approaches can be seriously abused when the rules are based on English of the privileged. (17 words)
52 Those who speak dialects of English more common among minorities are too often not hired. (15 words)
53 The poor are too often not hired if they have not also acquired a prestige variety. (16 words)
54 The problems are not inherent in prescriptive grammar, but arise rather from its abuse. (14 words)
55 Since prescriptive grammars are really grammars for learning and teaching some particular version of a language. (16 words)
56 Prescriptive grammars serve *pedagogical* or teaching function, and are often referred to by grammarians as *pedagogical*. (15 words)
57 The better grammars of this type provide an understanding of English language principles and processes. (15 words)
58 They are based on research in the descriptive, scientific tradition; but, for good pedagogical reasons. (15 words)
59 But, for good pedagogical reasons, the grammar of the English language may not be offered comprehensive coverage. (17 words)
60 Because this grammar has to be easily understood, its generalizations are "tied up" and abbreviated. (15 words)

READING SPAN TEST: ENGINEERING

Text: "Batteries"

1 According to Joule's law, electric energy is dissipated in any conductor when it carries a current. (16 words)
2 In fact, in simple dc circuits the source of this energy must be supplied. (14 words)
3 This energy which must be supplied in order to maintain the current is a chemical battery. (16 words)
4 In batteries, chemical energy is converted into electric energy, and the chemical reactions maintain a potential difference. (17 words)
5 Chemical reactions maintain a potential difference between the battery terminals whether or not a current is present. (17 words)
6 In fact, this potential difference is commonly referred to as an *emf* or electromotive force. (16 words)
7 To distinguish it from the potential difference which appears across a resistance in accordance with Ohm's law. (17 words)
8 As a battery continues to supply the energy necessary to maintain a current in a circuit. (16 words)
9 The battery is said to be discharged when the chemical constituents eventually become depleted. (14 words)
10 Depending upon the particular chemical nature of the battery it may be possible to charge this device. (17 words)
11 That is, it may be possible to return the battery to its original chemical condition. (15 words)
12 By passing a current between its terminals in a direction opposed to the internal *emf*. (15 words)
13 The symbol for a battery in circuit diagrams consists of two lines in parallel. (14 words)
14 The symbol for a battery consists of a short heavy line parallel and a longer thin line. (17 words)
15 The longer line represents the higher or positive terminal of the emf, internal. (13 words)
16 Since the internal emf is a potential difference, its unit is the volt. (13 words)
17 Although the carbon-zinc battery is referred to as a dry cell, it actually consists of a moist paste. (17 words)
18 A paste of zinc chloride, ammonium chloride, and manganese dioxide, the electrolyte, as this paste is called. (17 words)
19 It consists of a moist paste contained between a zinc electrode and a carbon electrode, the terminals. (17 words)
20 The zinc and carbon electrodes serve as the terminals of a battery, the operation is as follows. (17 words)
21 At the zinc electrode, zinc atoms are dissolved into solution as doubly charged zinc ions. (15 words)
22 The zinc electrode becomes negatively charged because each zinc atom leaves behind two electrons. (15 words)
23 At the carbon electrode ammonium ions reacting with manganese dioxide withdraw electrons from the carbon, an element. (17 words)
24 At the carbon electrode electrons are withdrawn from the carbon, and thus it becomes positively charged. (16 words)
25 If the negative zinc electrode is connected externally through a circuit to the positive carbon electrode, (16 words)
26 Electrons can flow between the positive and negative electrode to complete the chemical reaction. (14 words)
27 For the chemical reaction to continue, zinc ions must move away from the electrode, the negative. (16 words)
28 The reaction products near the positive terminal must likewise move away from the other electrode, the carbon. (17 words)
29 Thus, current is carried internally to the battery by means of ions moving.(13 words)
30 By means of ions moving in the electrolyte, and this is a source of internal resistance. (16 words)
31 Current in the internal resistance has the effect of reducing the terminal voltage. (13 words)
32 The terminal voltage of the dry cell slowly decreases with use as the internal resistance increases. (16 words)

33 The terminal voltage decreases as the internal resistance increases because of depletion of the manganese dioxide. (16 words)
34 Indeed, the internal resistance eventually becomes so large that the battery is useless. (13 words)
35 If the dry cell is left idle for some time before it is completely discharged. (15 words)
36 The internal resistance gradually reduces because of internal diffusion of the ions, this reduction can be noticed. (17 words)
37 On the one hand, if a dry cell is allowed to age for extended periods. (15 words)
38 Internal ionic diffusion increases the internal resistance so much that the cell becomes inoperative.(14 words)
39 In this case, the cell becomes inoperative, even though it may never have been used. (15 words)
40 The emf of a freshly prepared dry cell is 1.5V, and higher voltages can be obtained. (16 words)
41 Higher voltages are obtained by connecting individual units, the term battery originated from just such assemblies. (16 words)
42 The lead-acid storage battery used in automobiles is an example of a battery that can be recharged. (17 words)
43 The positive electrode of a fully charged storage battery is a porous coat. (13 words)
44 The positive electrode is a porous coat of lead dioxide on a grid of metallic lead. (16 words)
45 The negative electrode is metallic lead, and both electrodes are immersed in a sulphuric acid electrolyte, liquid. (17 words)
46 Both electrodes are immersed in a liquid sulphuric acid electrolyte at a specific (1.3) gravity. (15 words)
47 During discharge the lead dioxide is converted to lead sulphate, which is poorly soluble. (14 words)
48 It is converted to lead sulphate which is poorly soluble and clings to the positive plate. (17 words)
49 In fact, this reaction withdraws electrons from the electrode, thus charging it positively. (13 words)
50 At the negative electrode, sulphate ions from solution produce lead sulphate and electrons are released. (15 words)
51 The lead sulphate adheres to the electrode and at discharge both electrodes are converted to lead sulphate. (17 words)
52 The loss of sulphate ions from solution during discharge results in a reduction. (13 words)
53 The loss reduces the specific gravity to 1.16, so the condition of the battery may be determined. (17 words)
54 The condition of the battery may be determined by measuring the specific gravity of the electrolyte. (16 words)
55 Indeed, these chemicals reactions which have been just explained above are easily reversible. (13 words)
56 And current directed into the positive terminal acts to return the electrodes to their original chemical composition. (17 words)
57 Charging requires an external source to furnish electric energy, after which the battery again can supply energy. (17 words)
58 Thus, the storage battery may be said to store electric energy in chemical form. (14 words)
59 In addition to it, the internal resistance of the lead-acid battery is very low. (14 words)
60 And the battery is capable of delivering currents of several hundred amperes for short times. (16 words)

APPENDIX H - WORDS TO BE RETAINED IN THE SPAN TESTS

CONTROL

1	child
2	department
3	girl
4	shoes
5	want
6	minutes
7	salesclerk
8	resistance
9	pattern
10	stuff
11	children
12	happiness
13	problem
14	toys
15	mind
16	crazy
17	family
18	duties
19	arise
20	chores
21	plants
22	laundry
23	busy
24	help
25	doing
26	things
27	shopping
28	guilty
29	daytime
30	psychologist
31	treats
32	presents
33	start
34	making
35	deciding
35	bicycle
36	item
37	whims
38	person
39	buying
40	savers
41	money
42	like
43	today
44	month
45	drive
46	simple
47	young
48	option
49	health
50	barrettes
51	irresponsible
52	indefinite
53	explanation
54	kids
55	anywhere
56	important
57	gained
59	ahead
60	miserable

WORDS TO BE RETAINED IN THE SPAN TESTS

LINGUISTICS

1	senses
2	grammars
3	meaning
4	speakers
5	linguists
6	observed
7	product
8	tongue
9	grammarians
10	words
11	formed
12	descriptive
13	possess
14	native
15	classes
16	Latin
17	logic
18	feelings
19	write
20	prescribe
21	talking
22	education
23	helpful
24	expression
25	approach
26	communicate
27	employ
28	conventions
29	mean
30	usage
31	rule
32	sentence
33	pronoun
34	English
35	following
36	kinds
37	used
38	forms
39	thinks
40	convey
41	everybody
42	instance
43	comment
44	infinitive
45	inaccurate
46	inappropriate
47	constructions
48	idiom
49	dialect
50	educated
51	privileged
52	hired
53	variety
54	abuse
55	language
56	pedagogical
57	process
58	reasons
59	coverage
60	abbreviated

WORDS TO BE RETAINED IN THE SPAN TESTS

ENGINEERING

1 current
2 supplied
3 battery
4 difference
5 present
6 force
7 law
8 circuit
9 depleted
10 device
11 condition
12 emf
13 parallel
14 line
15 internal
16 volt
17 paste
18 called
19 terminals
20 follows
21 ions
22 electrons
23 element
24 charged
25 electrode
26 reaction
27 negative
28 carbon
29 moving
30 resistance
31 voltage
33 increases
34 dioxide
35 useless
36 discharged
36 noticed
37 periods
38 inoperative
39 used
40 obtained
41 assemblies
42 recharged
43 coat
44 lead
45 liquid
46 gravity
47 soluble
48 plate
49 positively
50 released
51 sulphate
52 reduction
53 determined
54 electrolyte
55 reversible
56 composition
57 energy
58 form
59 low
60 times

APPENDIX I - CATEGORISATION OF IDEA UNITS

CONTROL

Text: "The Irresponsibility that Spreads AIDS"

M- Main Idea

Si- Supporting Idea

D- Detail

(D1) Nearly three years ago
(Si2) I tested positive for the HIV
(D3) Since then
(M4) I have discovered
(M5) a support system that steadfastly refuses to encourage responsible behavior,
(M6) and a society whose silence ensures the continued spread of this disease.
(M7) Most HIV-positive people I have encountered
(M8) do not voluntarily disclose their status
(M9) to potential partners.
(Si10) Indeed, even people in long-term relationships lie about their status.
(M11) These are the realities of HIV transmission today.
(D12) The people I am talking about are nothing like Nusham Williams,
(D13) The drug dealer who is believed to have infected numerous people in New York State.
(D14) They did not grow up in Ghettos
(D15) surrounded by street gangs.
(D16) They come stable homes
(D17) in safe neighborhoods.
(D18) They went to high school and college and graduate school.
(M19) They remain silent
(M20) because it is difficult to tell the truth
(M21) because their friends and community support them
(M22) in their silence.
(M23) Their doctors, psychiatrists, even the AIDS organization they call for help, offer comfort and sympathy
(M24) but don't necessarily encourage them
(M25) to tell the truth.
(D26) We are more than 15 years into the AIDS epidemic,
(Si27) and I have been asked my status by prospective partner's only twice.
(D28) Since testing positive,
(Si29) I've made a point of disclosing my status
(Si30) to any potential partner;
(Si31) all but one told me
(Si32) I was the first person to do so.
(D33) Each believed that
(D34) if he practiced safe sex,
(D35) there would be no need to know.
(Si36) I practiced safe sex.
(M37) There is no such thing as safe sex,
(M38) only level of risk
(M39) that one must choose.
(M40) In making that choice,
(M41) a partners HIV status is *the* critical piece of information.
(M42) Leading advocacy groups have perpetuated the culture of irresponsibility.

(D43) Last year
(Si44) when I called the hot line for the Gay Men's Health Crisis,
(D45) one of the nation's leading AIDS services agencies,
(Si46) I was advised to "experiment"-informing some partners of my HIV status
(Si47) while remaining silent with others.
(Si48) In this way I could decide
(Si49) which was more comfortable for me.
(Si50) The CDC will only "suggest that you might want consider informing your partner"
(D51) A hot line counselor told me.
(Si52) Counselors at the San Francisco AIDS Foundation said
(Si53) it was their job to dispense information
(Si54) not moral or ethical recommendations,
(Si55) and, again, that I must do makes me fell comfortable.
(M56) We are not talking about comfortable here,
(M57) We are taking about life and death here.
(M58) The emphasis on the individual's right,
(M59) without an equally strong emphasis on the individuals responsibility,
(M60) is wrong
(M61) and is a direct cause of the spread of this disease.
(Si62) Groups such as the Gay Men's Health Crisis claim
(Si63) they cannot dictate behavior.
(Si64) Granted.
(Si65) But that is all the more reason
(M66) that AIDS organizations have a responsibility
(M67) to encourage people who are HIV positive
(M68) to do what is right.
(D69) For years
(M70) the AIDS community has rallied around the battle cry "Silence = Death".
(M71) What it has failed to realize
(M72) is that silence comes in many forms
(M73)and that all are lethal.

CATEGORISATION OF IDEA UNITS: LINGUISTICS

Text: "Structural and Functional Views on Language"

M- Main Idea

Si- Supporting Idea

D- Detail

(M1) The structural view of language concentrates on the grammatical system
(M2) describing ways in which linguistic items can be combined.
(Si3) For example, it explains the operations for producing the passive 'The window has been broken'
(Si4) rather than the active 'Somebody has broken the window',
(Si5) and describes the word-order rules
(Si6) that make us interpret 'The girl chased the boy' differently from 'The boy chased the girl'.
(D7) Intuitive knowledge of these
(D8) and of a multitude of other linguistic facts and operations,
(D9) makes up a native speaker's linguistic competence
(D10) and enables him to produce new sentences
(D11) to match the meanings that he needs to express.
(M12) The structural view of language has not been in any way superseded by the functional view.
(M13) However, it is not sufficient
(M14) on its own
(M15) to account for how language is used
(M16) as a means of communication.
(M17) Let us take an example a straightforward sentence such as 'Why don't you close the door?'.
(M18) From a structural viewpoint, it is unambiguously an interrogative.
(Si19) Different grammars may describe it in different terms,
(Si20) but none could argue that its grammatical form is that of a declarative or imperative.
(M21) From a *functional* viewpoint, however, it is ambiguous.
(M22) In some circumstances, it may function as a question -
(Si23) for example, the speaker may genuinely wish to know
(Si24) why his companion never closes a certain door.
(M25) In others, it may function as a command -
(Si26) this would probably be the case if, say, a teacher addressed it to a pupil
(D27) who had left the classroom door open.
(M28) In yet other situations, it could be intended (or interpreted, perhaps mistakenly) as a plea, a suggestion, or a complaint.
(M29) In other words, whereas the sentence's *structure* is stable
(M30) and straightforward,
(M31) its *communicative function* is variable
(M32) and depends on specific situational
(M33) and social factors.
(M34) Just as a single linguistic form can express a number of functions,
(M35) so also can a single communicative function be expressed by a number of linguistic forms.
(Si36) For example, the speaker who wants somebody to close the door has many linguistic options,
(Si37) including 'Close the door please',
(Si38) 'Could you please close the door?',
(Si39) 'Would you mind closing the door?',
(Si40) or 'Excuse me, could I trouble you to close the door?'.
(M41) Some forms might only perform this directive function
(M42) in the context of certain relationships -
(Si43) for example, 'You've left the door open!'
(Si44) could serve as a directive from teacher to pupil,
(Si45) but not from teacher to principal.
(M46) Other forms would depend strongly on shared situational knowledge for their correct interpretation,
(D47) and could easily be understood (e.g. 'Brrr! It's cold, isn't it?').

CATEGORISATION OF IDEA UNITS: ENGINEERING

Text: "Forward-Mode Switching Regulators"

M- Main Idea

Si- Supporting Idea

D- Detail

(M1) Forward-mode switching regulators have as their functional components four elements:
(M2) a power switch
(M3) for creating the PWM waveform,
(M4) a rectifier (or catch diode),
(M5) a series inductor,
(M6) and a capacitor.
(Si7) The power switch may be a power transistor or a metal oxide semiconductor field-effect transistor (MOSFET)
(Si8) placed directly between the input voltage and the filter section.
(Si9) In between the power switch and the filter section there may be a transformer
(Si10) for stepping up and down the input voltage
(D11) as in transformer-isolated forward regulators.
(M12) The shunt diode,
(M13) series inductor,
(M14) and shunt capacitor
(M15) form an energy storage reservoir
(M16) whose purpose is to store enough energy
(M17) to maintain the load voltage and current over the entire off-time of the power switch.
(M18) The power switch serves only to replenish the energy
(M19) (the energy) lost to the load
(M20) during its off-time.
(D21) Its function can be seen as an electrical equivalent of a mechanical piston-flywheel combination.
(D22) The piston provides a pulse of energy,
(D23) and the flywheel stores the mechanical energy
(D24) for use by the load.
(M25) The operation of the power switch can be broken up into two periods.
(M26) The first is when the power switch is on.
(M27) During this period, the load current passes from the input source,
(M28) through the inductor
(M29) to the load,
(M30) and back again through the return (or ground) lines
(M31) to the input source.
(M32) During this time the diode is reverse-biased.
(M33) After the power switch turns off,
(M34) the inductor still expects current to flow through it.
(M35) The former current path through the input source is now open-circuited,
(M36) and the catch diode now begins to conduct,
(M37) thus maintaining a closed current loop through the load.
(M38) When the power switch once again turns on,
(M39) the voltage presented to the filter serves to turn off the catch diode.
(Si40) In short, forward current is always flowing through the inductor;
(D41) hence its name.
(M42) The amount of energy being delivered to the load is controlled by the duty cycle of the power switch on-time.
(D43) This may vary anywhere between 0 and 100 percent duty cycle
(D44) but typically falls between 5 and 95 percent duty cycle.
(M45) An approximate model of the relationship between input voltage, duty cycle, and output voltage
(D46) is that the output voltage is the average of the area under the chopped voltage waveform

(M47) or V out = V in . duty cycle
(Si48) In reality this relationship applies only for light loads,
(Si49) but it does serve as a reasonable approximation elsewhere.

APPENDIX J - AN EXAMPLE OF THE RECALL PROTOCOLS PRODUCED BY ONE SUBJECT AND THEIR RESPECTIVE SCORING IN TERMS OF IDEA UNITS RECALLED

This appendix is organised in the following way: first, the subject's written protocol is presented, second, the source text divided into idea units. There is a parenthesis before each idea unit division. Whenever the subject recalled an idea unit or paraphrased it, he scored one mark, which is indicated by a check mark (X). This method was developed by Tomitch (1995).

RECALL PROTOCOL OF THE CONTROL TEXT
Subject 10: High Knowledge in Engineering

O autor descobriu há três anos que é portador do vírus HIV. Existem outras pessoas portadoras do vírus e que transmitem propositalmente o vírus. Estas pessoas não são necessariamente indigentes nem pessoas da classe baixa (referencia a guetos). Mas sim pessoas que possuem certas condições financeiras (referência a high school). É dito também que eles fazem isso porque não são aceitos pelos amigos e até familiares mesmo sendo confortados pelos mesmos. Existem instituições a ajudar os portadores do vírus HIV como a hot-line (?) do movimento gay e a CDC que oferecem ajuda médica e psicológica. O autor considera que a informação sobre o vírus da AIDS é mais importante do que ajuda e consolo. É dito que a desenformarão sobre este fato é igual a morte.

PROPOSITIONAL SCORING
Text: "The Irresponsibility that Spreads AIDS"

(X) Nearly three years ago (X) I tested positive for the HIV ( ) Since then ( ) I have discovered ( ) a support system that steadfastly refuses to encourage responsible behavior,( ) and a society whose silence ensures the continued spread of this disease.( ) Most HIV-positive people I have encountered ( ) do not voluntarily disclose their status ( ) to potential partners.( ) Indeed, even people in long-term relationships lie about their status.( ) These are the realities of HIV transmission today.(X) The people I am talking about are nothing like Nusham Williams,( ) The drug dealer who is believed to have infected numerous people in New York State.(X) They did not grow up in Ghettos ( ) surrounded by street gangs.(X) They come stable homes ( ) in safe neighborhoods.(X) They went to high school and college and graduate school.( ) They remain silent ( ) because it is difficult to tell the truth (X) because their friends and community support them ( ) in their silence.(X) Their doctors, psychiatrists, even the AIDS organization they call for help, offer comfort and sympathy ( ) but don't necessarily encourage them ( ) to tell the truth.( ) We are more than 15 years into the AIDS epidemic, ( ) and I have been asked my status by prospective partner's only twice.( ) Since testing positive,( ) I've made a point of disclosing my status ( ) to any potential partner;( ) all but one told me ( ) I was the first person to do so.( ) Each believed that ( ) if he practiced safe sex,( ) there would be no need to know.( ) I practiced safe sex.( ) There is no such thing as safe sex, ( ) only level of risk ( ) that one must choose.( ) In making that choice, ( ) a partners HIV status is *the* critical piece of information.( ) Leading advocacy groups have perpetuated the culture of irresponsibility.( ) Last year (X) when I called the hot line for the Gay Men's Health Crisis,( ) one of the nation's leading AIDS services agencies, ( ) I was advised to "experiment"-informing some partners of my HIV status ( ) while remaining silent with others.( ) In this way I could decide ( ) which was more comfortable for me.(X) The CDC will only "suggest that you might want consider informing your partner" ( ) A hot line counselor told me. (X) Counselors at the San Francisco AIDS Foundation said (X) it was their job to dispense information ( ) not moral or ethical recommendations, ( ) and, again, that I must do makes me fell comfortable. ( ) We are not talking about comfortable here, ( ) We are taking about life and death here. ( ) The emphasis on the individual's right, ( ) without an equally strong emphasis on the individuals responsibility, ( ) is wrong ( ) and is a direct cause of the spread of this disease. ( ) Groups such as the Gay Men's Health Crisis claim ( ) they cannot dictate behavior. ( ) Granted. ( ) But that is all the more reason ( ) that AIDS organizations have a responsibility ( ) to encourage people who are HIV positive ( ) to do what is right. ( ) For years ( ) the AIDS community has rallied around the battle cry

"Silence = Death". ( ) What it has failed to realize ( ) is that silence comes in many forms ( )and that all are lethal.

RECALL PROTOCOL OF THE TEXT ON LINGUISTICS
Subject 10: High Knowledge in Engineering

Existem formas ativas e passivas de estruturas. Muitas formas lingüisticas podem ser descritas por uma função e muitas funções podem ser descritos pelas formas lingüisticas . Em situações estáveis a estrutura da frase varia conforme o grau social

*Para uma melhor memória do texto eu teria que ter entendido o mesmo. Como o meu nível de interpretação sobre o mesmo foi muito baixo , minha memória também foi proporcional

PROPOSITIONAL SCORING
Text: "Structural and Functional Views on Language"

The structural view of language concentrates on the grammatical system ( ) describing ways in which linguistic items can be combined. ( ) For example, it explains the operations for producing the passive 'The window has been broken' ( ) rather than the active 'Somebody has broken the window', ( ) and describes the word-order rules ( ) that make us interpret 'The girl chased the boy' differently from 'The boy chased the girl'.( ) Intuitive knowledge of these ( ) and of a multitude of other linguistic facts and operations, ( ) makes up a native speaker's linguistic competence ( ) and enables him to produce new sentences ( ) to match the meanings that he needs to express.( ) The structural view of language has not been in any way superseded by the functional view. ( ) However, it is not sufficient ( ) on its own( ) to account for how language is used ( ) as a means of communication. ( ) Let us take an example a straightforward sentence such as 'Why don't you close the door?'. ( ) From a structural viewpoint, it is unambiguously an interrogative.( ) Different grammars may describe it in different terms,( ) but none could argue that its grammatical form is that of a declarative or imperative.( ) From a *functional* viewpoint, however, it is ambiguous. ( ) In some circumstances, it may function as a question - ( ) for example, the speaker may genuinely wish to know ( ) why his companion never closes a certain door. ( ) In others, it may function as a command -( ) this would probably be the case if, say, a teacher addressed it to a pupil ( ) who had left the classroom door open. ( ) In yet other situations, it could be intended (or interpreted, perhaps mistakenly) as a plea, a suggestion, or a complaint. ( ) In other words, whereas the sentence's *structure* is stable( ) and straightforward, ( ) its *communicative function* is variable ( ) and depends on specific situational ( ) and social factors. ( ) Just as a single linguistic form can express a number of functions, ( ) so also can a single communicative function be expressed by a number of linguistic forms.( ) For example, the speaker who wants somebody to close the door has many linguistic options, ( ) including 'Close the door please', ( ) 'Could you please close the door?',( ) 'Would you mind closing the door?', ( ) or 'Excuse me, could I trouble you to close the door?'. ( ) Some forms might only perform this directive function ( ) in the context of certain relationships - ( ) for example, 'You've left the door open!' ( ) could serve as a directive from teacher to pupil, ( ) but not from teacher to principal. ( ) Other forms would depend strongly on shared situational knowledge for their correct interpretation, ( ) and could easily be understood (e.g. 'Brrr! It's cold, isn't it?').

RECALL PROTOCOL OF THE TEXT ON ENGINEERING
Subject 10: "High Knowledge in Engineering"

O conversor referido pelo autor possui quatro componentes básicos, uma chave, um capacitor, um indutor, um diodo. A chave pode ser um transístor ou um transístor MOSFET (transístor de efeito de campo de oxido metálico). Pode existir ainda um transformador entre a chave e o filtro para adequar os níveis de tensão bipolares de carga. O sistema é similar a um pistão mecânico com contra peso. O sistema pode ser dividido em duas etapas. Com a chave fechada e com a chave aberta. Com a chave fechada tem-se a energia fluindo pelo indutor indo a carga, sendo daí o nome conversor. Neste instante o diodo esta reversamente polarizado e o capacitor acumula energia. Com a abertura da chave tem-se a corrente fluindo pelo diodo desmagnetizando o indutor e mantendo a tensão da carga. O fluxo de energia é controlado pela razão cíclica que significa o tempo que a chave esta fechada em um período de operação. (em

percentagem). Teoricamente este tempo pode ser de 0% a 100% , porém na prática de 5% a 95%. A função de transferencia do conversor é dado pela média de tensão chaveada. A função de transferência do conversor é dada pela média de tensão chaveada. A função de transferência é Vo/VI = D sendo está fórmula válida somente para o modo contínuo de operações, ou seja diminuindo muito a corrente está fórmula não é válida.

PROPOSITIONAL SCORING
Text: "Forward-Mode Switching Regulators"

(X) Forward-mode switching regulators have as their functional components four elements: (X) a power switch (X) for creating the PWM waveform, (X) a rectifier (or catch diode), (X) a series inductor, (X) and a capacitor. (X) The power switch may be a power transistor or a metal oxide semiconductor field-effect transistor (MOSFET) ( ) placed directly between the input voltage and the filter section. (X) In between the power switch and the filter section there may be a transformer
(X) for stepping up and down the input voltage ( ) as in transformer-isolated forward regulators. ( ) The shunt diode, ( ) series inductor, (X) and shunt capacitor (X) form an energy storage reservoir ( ) whose purpose is to store enough energy ( ) to maintain the load voltage and current over the entire off-time of the power switch. ( ) The power switch serves only to replenish the energy ( ) (the energy) lost to the load ( ) during its off-time. (X) Its function can be seen as an electrical equivalent of a mechanical piston-flywheel combination. ( ) The piston provides a pulse of energy, ( ) and the flywheel stores the mechanical energy ( ) for use by the load.(X) The operation of the power switch can be broken up into two periods. (X) The first is when the power switch is on. (X) During this period, the load current passes from the input source,(X) through the inductor (X) to the load, ( ) and back again through the return (or ground) lines ( ) to the input source.(X) During this time the diode is reverse-biased. (X) After the power switch turns off, (X) the inductor still expects current to flow through it. (X) The former current path through the input source is now open-circuited, (X) and the catch diode now begins to conduct, (X) thus maintaining a closed current loop through the load. ( ) When the power switch once again turns on, ( ) the voltage presented to the filter serves to turn off the catch diode. ( ) In short, forward current is always flowing through the inductor; ( ) hence its name.(X) The amount of energy being delivered to the load is controlled by the duty cycle of the power switch on-time. (X) This may vary anywhere between 0 and 100 percent duty cycle (X) but typically falls between 5 and 95 percent duty cycle. (X) An approximate model of the relationship between input voltage, duty cycle, and output voltage ( ) is that the output voltage is the average of the area under the chopped voltage waveform (X) or V out = V in . duty cycle (X) In reality this relationship applies only for light loads, ( ) but it does serve as a reasonable approximation elsewhere.

APPENDIX K - SCORES ON THE READING SPAN TEST

This appendix is organised in the following way: the first table presents the span scores. The second table presents the total number of words the subjects could retain in the span tests. Finally, a graph comparing the span measures of the two groups will also be presented.

mean = (last line on the bottom) the mean spans of each subject
(last column on the right) the mean spans of the whole group in each test

SUBJECTS WITH HIGH KNOWLEDGE IN LINGUISTICS

Table 15: Span scores

test	S1	S2	S3	S4	S5	mean
cont	3.5	4	4	4	3	3.7
ling	3.5	4	4	3	5	3.9
eng	2.5	3.5	4	3	2.5	3.1
mean	3.2	3.8	4	3.3	3.5	

Table 16: Number of words retained

test	S1	S2	S3	S4	S5	mean
cont	40	46	47	45	46	45
ling	39	49	48	31	53	44
eng	41	44	45	37	41	42
mean	40	46	47	38	43	

SUBJECTS WITH HIGH KNOWLEDGE IN ENGINEERING

Table 17: Span Scores

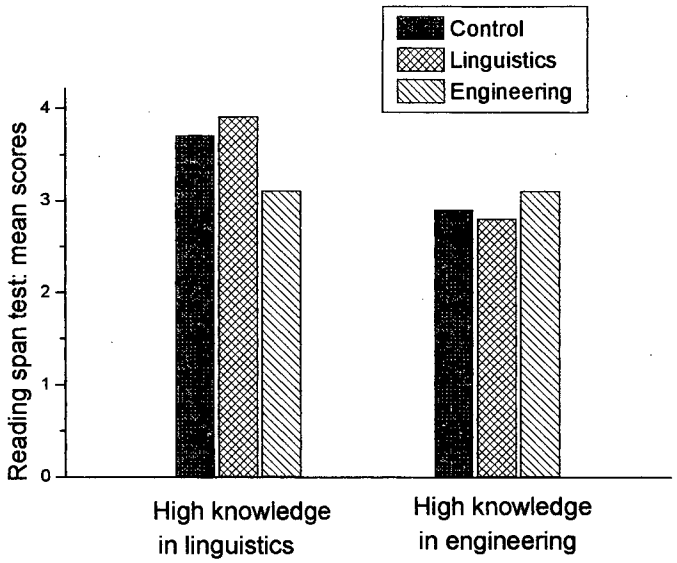
test	S6	S7	S8	S9	S10	mean
cont	2.5	4	2.5	3	2.5	2.9
ling	4	2.5	2.5	2.5	2.5	2.8
eng	4	3	3	2.5	3	3.1
mean	3.3	3.2	2.7	2.7	2.7	

Table 18: Number of words retained

	S6	S7	S8	S9	S10	mean
cont	39	38	37	37	31	36
ling	43	30	34	32	29	34
eng	45	41	45	32	41	41
mean	42	36	39	34	34	

(continues next page)

Graph 1: HK in linguistics vs. HK in engineering: mean scores on the reading span tests.



APPENDIX L - SCORES ON ACCURACY OF INFERENCES

Results of the comprehension questions, answers were rated on a scale from 0 to 2.

mean = mean scores of the whole group in each comprehension question.

SUBJECTS WITH HIGH KNOWLEDGE IN LINGUISTICS

Table 19: Accuracy of inferences

questions	S1	S2	S3	S4	S5	mean
cont	2,0	2,0	2,0	zero	2,0	1,6/ 80%
ling	2,0	2,0	2,0	2,0	2,0	2,0/ 100%
eng	zero	zero	zero	zero	zero	zero

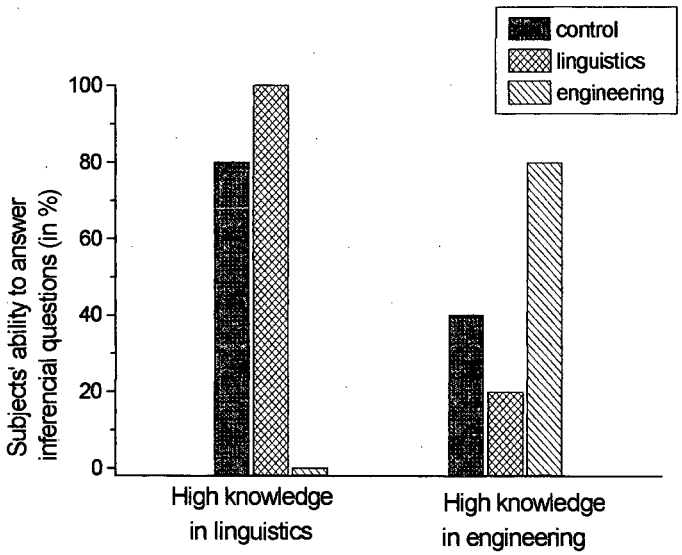
SUBJECTS WITH HIGH KNOWLEDGE IN ENGINEERING

Table 20: Accuracy of inferences

questions	S6	S7	S8	S9	S10	mean
cont	1	1	1	1	zero	0.8/ 40%
ling	zero	1	zero	zero	zero	0.4/ 20%
eng	2	zero	2	2	2	1.6/ 80%

(continues next page)

Graph 2: HK in linguistics vs. HK in engineering: mean scores on answers to inferential questions.



APPENDIX M - SCORES ON THE ABILITY TO EXTRACT THE THEME OF THE TEXT

These data were extracted from the recall protocols, answers were rated on a scale from 0 to 4.

mean = mean scores of the whole group in each text.

SUBJECTS WITH HIGH KNOWLEDGE IN LINGUISTICS

Table 21: Ability to extract the theme of the texts

texts	S1	S2	S3	S4	S5	mean
cont	3	4	4	3	4	3,6/ 90%
ling	3	4	4	3	4	3,6/ 90%
eng	zero	zero	zero	zero	zero	zero

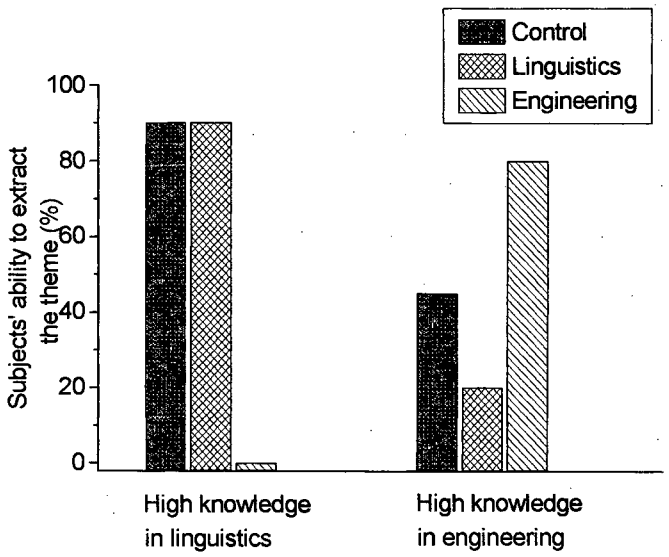
SUBJECTS WITH HIGH KNOWLEDGE IN ENGINEERING

Table 22: Ability to extract the theme of the texts

texts	S6	S7	S8	S9	S10	mean
cont	3	2	2	2	zero	1.8/ 45%
ling	1	3	zero	zero	zero	3.2/ 20%
eng	3	2	3	4	4	0.8/ 80%

(continues next page)

Graph 3: HK in linguistics vs. HK in engineering: mean scores on the ability to extract the theme of the texts.



APPENDIX N - RAW SCORES ON THE IDEA UNIT ANALYSIS

M = Main Idea
Si = Supporting Idea
D = Detail
P = protocol
total = total amount of idea units recalled.
mean = mean scores of the whole group.

SUBJECTS WITH HIGH KNOWLEDGE IN LINGUISTICS

Table 23: Recall for the control text

	P1	P2	P3	P4	P5	mean
M	9	17	14	16	15	14
Si	6	9	8	9	10	8
D	2	1	4	4	-	2
total	17	27	26	29	25	25

Table 24: Recall for the text on linguistics

	P1	P2	P3	P4	P5	mean
M	9	13	12	11	14	12
Si	3	6	-	-	3	2
D	-	-	-	-	-	-
total	12	19	12	11	17	14

Table 25: Recall for the text on engineering

	P1	P2	P3	P 4	P 5	mean
M	3	2	1	3	4	3
Si	-	-	-	-	-	-
D	-	-	-	-	-	-
total	3	2	1	3	4	3

(continues next page)

Table 26: Recall for the control text

	P6	P7	P8	P9	P10	mean
M	13	15	7	8	2	9
Si	6	13	1	2	5	5
D	6	4	3	1	6	4
total	25	32	11	11	13	18

Table 27: Recall for the text on linguistics

	P6	P7	P8	P9	P10	mean
M	6	7	2	3	-	4
Si	6	1	3	2	-	2
D	-	-	-	-	-	-
total	12	8	5	5	-	6

Table 28: Recall for the text on engineering

	P6	P7	P8	P9	P10	mean
M	13	11	17	19	22	16
Si	1	-	1	3	4	2
D	-	-	1	1	3	1
total	14	11	19	23	29	19

APPENDIX O - PERCENTAGES OF READERS' SCORES ON THE IDEA UNIT ANALYSIS

M = Main Idea
Si = Supporting Idea
D = Detail
P = Protocol
total = total amount of idea units recalled.
mean = mean scores of the whole group.

SUBJECTS WITH HIGH KNWOLEGE IN LINGUISTICS

Table 29: Recall for the control text

	P1	P2	P3	P4	P5	mean
M	27%	51%	42%	48%	45%	43%
Si	27%	41%	36%	41%	45%	38%
D	11%	5%	22%	22%	-	12%
total	23%	37%	35%	40%	34%	34%

Table 30: Recall for the text on linguistics

	P1	P2	P3	P4	P5	mean
M	39%	57%	52%	48%	61%	51%
Si	18%	35%	-	-	18%	14%
D	-	-	-	-	-	-
total	26%	40%	26%	23%	36%	30%

Table 31: Recall for the text on engineering

	P1	P2	P3	P 4	P 5	mean
M	9%	6%	3%	9%	12%	8%
Si	-	-	-	-	-	-
D	-	-	-	-	-	-
total	6%	4%	2%	6%	8%	6%

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SUBJECTS WITH HIGH KNOWLEDGE IN ENGINEERING

Table 32: Recall for the control text

	P6	P7	P8	P9	P10	mean
M	39%	45%	21%	24%	6%	27%
Si	27%	60%	4%	9%	23%	25%
D	33%	22%	17%	5%	33%	22%
total	34%	43%	15%	15%	18%	25%

Table 33: Recall for the text on linguistics

	P6	P7	P8	P9	P10	mean
M	26%	30%	9%	13%	-	16%
Si	35%	6%	18%	12%	-	14%
D	-	-	-	-	-	-
total	26%	17%	11%	11%	-	13%

Table 34: Recall for the text on engineering

	P6	P7	P8	P9	P10	mean
M	40%	33%	52%	57%	67%	50%
Si	14%	-	14%	43%	57%	26%
D	-	-	11%	11%	33%	11%
total	28%	22%	39%	47%	59%	39%

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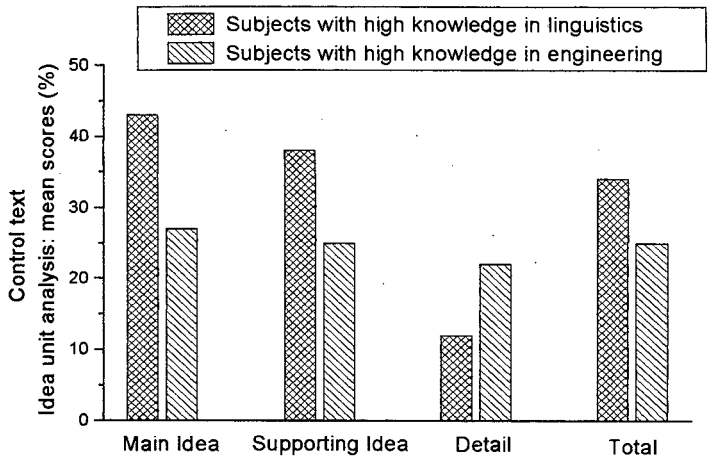
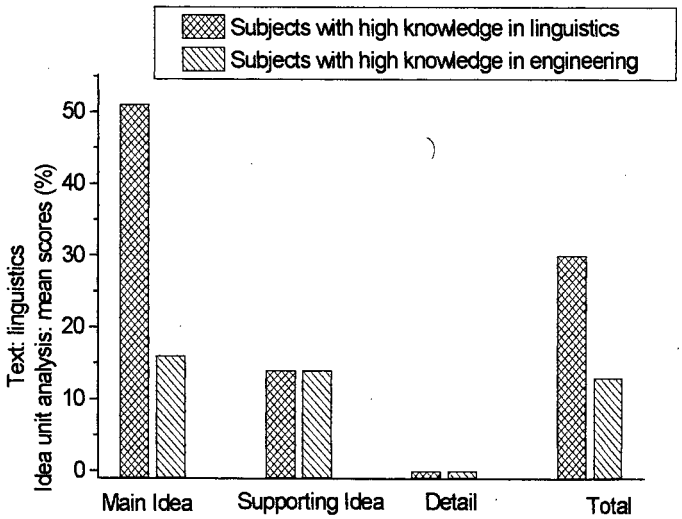
The three graphs below compare the percentages of subjects' scores on the idea unit analysis.

Graph 4: HK in linguistics vs. HK in engineering: recall performance for the control text.



Graph 5: HK in linguistics vs. HK in engineering: recall performance for the text on linguistics.



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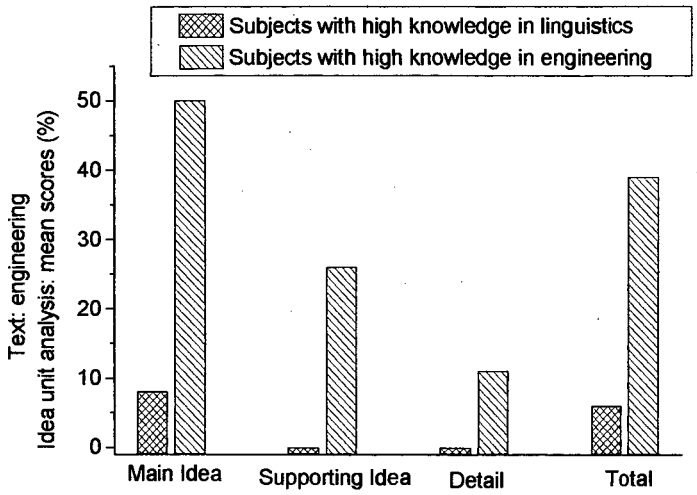
Graph 6: HK in linguistics vs. HK in engineering: recall performance for the text on engineering.



APPENDIX P - READING TIME

meantime = (last line on the bottom) the meantime of each subject.
(last column on the right) the meantime of the whole group in each text.

SUBJECTS WITH HIGH KNOWLEDGE IN LINGUISTICS:

Table 35: Reading time

text	S1	S2	S3	S4	S5	meantime
cont	8'	6'	4'	5'	5'	5' 36"
ling	4'	7'	4'	5'	7'	5' 36"
eng	5'	6'	5'	6'	7'	5' 48"
meantime	5' 36"	6' 18"	4' 18"	5' 36"	6' 18"	

SUBJECTS WITH HIGH KNOWLEDGE IN ENGINEERING

Table 36: Reading time

text	S6	S7	S8	S9	S10	meantime
cont	8'	8'	5'	8'	8'	7' 24"
eng	7'	8'	7'	8'	8'	7' 12"
ling	8'	6'	6'	8'	8'	7' 36"
meantime	7' 12"	7' 18"	6'	8'	8'	

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Graph 7: HK in linguistics vs. HK in engineering: meantime.