

UNIVERSIDADE FEDERAL DE SANTA CATARINA  
PÓS-GRADUAÇÃO EM LETRAS / INGLÊS E LITERATURA CORRESPONDENTE

**WORKING MEMORY CAPACITY AND READER'S PERFORMANCE ON  
MAIN IDEA CONSTRUCTION IN L1 AND L2**

por

Ana Cecília da Gama Torres

Tese submetida à Universidade Federal de Santa Catarina em cumprimento parcial dos  
requisitos para obtenção do grau de

**DOUTOR EM LETRAS**

**FLORIANÓPOLIS**

Março 2003

To my parents,  
and my fiancée,  
with gratitude

## ACKNOWLEDGEMENTS

I am indebted to:

Dr. Lêda Maria Braga Tomitch, for being an EXCELLENT advisor. I could not have worked without your feedback.

Dr. Loni Cabral and Dr. Mailce Borges Mota Fortkamp, for reading my work carefully, for their professionalism, and for their feedback when I presented my dissertation proposal.

Dr. Maria Lúcia Vasconcellos and Dr. José Luís Meurer, who were in my entrance committee, for their suggestions and comments.

Dr. Loni Taglieber, for her advice during my “estágio de docência”.

Dr. Viviane Heberle, for helping me pilot this study.

From UFMG, Dr. Herzila Bastos, and Adriana Maria Tenuta, for all the important things they taught me.

My judges, Marilea Matos and Dóris Maes, for their support, their generosity and for the time they spent on my work.

My colleagues Rosane Silveira, Neide Cruz, Maria Ester, Mariana Matos, for being available to help me.

Sônia Ferreira, Vilmar Ferreira, Celso Tumolo, for their encouragement when I first presented my results.

In Florianópolis, Clara Dorneles, Daniela Mendonça, Claudia Mesquita, Felix and Genilda Azeredo. In Londrina, Renato and Hissaco Sugahara, Cacilda Maezima, Sandra Ruben. In Belo Horizonte, Juliana Grunzinger, Carolina Safar, Dulce Lima, Maria da Graça, Alessandra Oliveira, for their friendship and support.

My brothers, my nephews and nieces, for being always present.

Eduardo, for his unfailing support.

Marcos, for coming all the way from Belo Horizonte just to visit me, for caring about me.

Maurílio and Sheila, for being far from my sight but close to my heart.

All the participants, for anonymously contributing to make my study possible.

March 21, 2003

## ABSTRACT

WORKING MEMORY CAPACITY AND READER'S PERFORMANCE ON MAIN  
IDEA CONSTRUCTION IN L1 AND L2

ANA CECÍLIA DA GAMA TORRES

UNIVERSIDADE FEDERAL DE SANTA CATARINA

2003

Supervising Professor: Dr. Lêda Maria Braga Tomitch

The present study has three aims. Firstly, it sets out to investigate whether there is a relationship between working memory capacity and reader's performance on a main idea construction task (L1 and L2) when the main idea is undersignalled. Secondly, it describes the process of main idea construction (L1 and L2). Thirdly, it investigates whether readers' profile of strategy use (L1 and L2) relates to their working memory capacity.

The participants were 18 MA and PhD students at Universidade Federal of Santa Catarina, all of them had Brazilian Portuguese as L1 and English (advanced level) as L2. Participants read two texts (L1 and L2) and provided verbal reports which were scored for the presence of main ideas. In addition, working memory capacity was measured by the Reading Span Test in L1 and L2. Results indicated that working memory capacity, as measured in L1, correlated with reader's ability to construct the main ideas in L1 as well as in L2; working memory capacity, as measured in L2, correlated with reader's ability to construct the main idea in L2.

The process of main idea construction (L1 and L2) was investigated by analysing the verbal reports of readers. Main idea construction strategies were described along with strategies for assigning importance to information.

The third aim was to investigate whether high and low-working memory readers presented a different or a similar profile of strategy use to construct the main idea of the texts (L1 and L2). To conduct the latter investigation, data was displayed on frequency tables and two statistical techniques, namely, the Simple Correspondence Factor Analysis and the Cluster Analysis were performed (Escofier & Pàges, 1992). This part of the study is descriptive and exploratory in nature, and the following results only indicate a trend. While reading in L1, high-working memory readers had enough resources to use an integrative strategy. As a result, they might have been able to keep their interpretation open and wait to make a final judgement till more text was read. In short, through using an integrative strategy, such readers managed to construct the main idea after reading the texts. By contrast, low-working memory readers tended to anticipate content, committing themselves to an early interpretation, which they often failed to update. While reading in L2, high-working memory readers tended to associate the strategy use of general knowledge with the strategy correct behaviour. This association indicated that high-span readers activated prior knowledge, but were aware of the need to update their knowledge-base assumptions. As a result, they avoided committing themselves to an early interpretation based only on prior knowledge.

Number of pages: 207

Number of words: 61 417

## RESUMO

CAPACIDADE DE MEMÓRIA DE TRABALHO E DESEMPENHO DE LEITORES  
NA CONSTRUÇÃO DE IDÉIAS PRINCIPAIS EM L1 E L2

ANA CECÍLIA DA GAMA TORRES

UNIVERSIDADE FEDERAL DE SANTA CATARINA

2003

Professora Orientadora: Dra. Lêda Maria Braga Tomitch

Este estudo tem três objetivos. O primeiro é investigar se há uma relação entre a capacidade de memória de trabalho e o desempenho na tarefa de construção de idéias principais em textos mal sinalizados (L1- português/ L2- inglês). O segundo é descrever o processo de construção de idéias principais. O terceiro objetivo é verificar se há uma relação entre o perfil de escolha de estratégias usadas na construção de idéias principais e a capacidade de memória de trabalho dos leitores.

Os participantes deste estudo foram 18 alunos do curso de Pós-Graduação em Inglês, mestrandos e doutorandos, da Universidade Federal de Santa Catarina. Todos os participantes tinham português como L1 e inglês como L2 (nível avançado). A capacidade da memória de trabalho foi avaliada através do Reading Span Test (tarefa de alcance de leitura) ministrada em L1 e L2. A construção de idéias principais foi examinada por meio de protocolos verbais fornecidos pelos participantes enquanto liam textos em L1 e L2. Os resultados indicaram uma correlação positiva entre o teste de alcance de leitura (L1) e o desempenho na tarefa de

construção de idéias principais (L1 e L2); entre o teste de alcance de leitura (L2) e o desempenho na tarefa de construção de idéias principais (L2).

A fim de descrever o processo de construção de idéias principais, as estratégias para construí-las e para atribuir importância à informação foram identificadas e classificadas a partir dos protocolos verbais.

O terceiro objetivo era verificar se haveria uma relação entre as estratégias usadas na construção de idéias principais e a capacidade de memória de trabalho. Para cumprir este objetivo, os leitores foram divididos em dois grupos de acordo com o seu desempenho no Reading Span Test (leitores de maior ou menor capacidade de memória), e as estratégias foram distribuídas em tabelas de frequência. Além disso as técnicas estatísticas Simple Correspondence Factor Analysis e Cluster Analysis foram utilizadas para detectar se haveria uma relação entre o perfil de escolha de estratégia dos leitores e sua capacidade de memória de trabalho. Esta etapa do estudo é exploratória e os resultados que seguem indicam tendências, mas não podem ser considerados definitivos. Ou seja, enquanto liam em L1, os leitores de maior capacidade de memória tendiam a usar estratégias que possibilitavam a integração do texto. Conseguiram adiar a construção da idéia principal até que tivessem obtido informação suficiente para integrar o texto, evitando se comprometer com uma interpretação precipitada. Ao passo que leitores de menor capacidade, tendiam a formular hipóteses precipitadas e a extrair a idéia principal antes do final do texto. Enquanto liam em L2, os leitores de maior capacidade de memória associavam estratégias de ativação de conhecimento prévio à estratégias de correção. Esta associação indica que os leitores de maior capacidade de leitura ativaram o conhecimento prévio necessário à construção de hipóteses, mas foram capazes de corrigir suas hipóteses e evitar conclusões precipitadas.

Número de páginas: 207

Número de palavras: 61 417

## TABLE OF CONTENTS

<b>1 INTRODUCTION .....</b>	<b>1</b>
1.1 Preliminaries	1
1.2 Statement of Purpose	2
1.3 Significance of the Study	3
1.4 Organization of the Thesis	5
<b>2 REVIEW OF LITERATURE.....</b>	<b>7</b>
2.1 On Working Memory Capacity	7
2.1.1 Short-term Memory.....	7
2.1.2 The Multiple Component Model.....	10
2.1.3 Working Memory as a Constraint on Language Comprehension.....	19
2.1.4 Working Memory Capacity and Qualitative Differences in Comprehension Processes.....	30
2.1.5 Working Memory as an Activated Portion of Long-term Memory.....	34
2.1.6 Working Memory as the Capacity for Controlled Attention.....	43
2.1.7 Working Memory Capacity and L2 Performance.....	51
2.1.8 A Gap in the Research Relating Working Memory Capacity to L2 Reading Performance.....	55
2.1.9 Working Memory: General Discussion.....	57
2.2 On Main Idea Construction	61
2.2.1 Models of Reading and Assignment of Importance to Information.....	61
2.2.2 Defining the Term Main Ideas.....	67
2.2.3 Defining the Term Strategy.....	76
<b>3 METHOD.....</b>	<b>80</b>
3.1 Participants	80
3.2 Instruments for Data Collection	81
3.3 Working Memory Measures	82
3.4 Reading Ability Measures	85
3.5 Assessment of Reader's Ability to Extract the Main Idea of the Texts	89
3.5.1 Scales for Assessing Reader's Ability to Extract the Main Idea of the L1 Text ( <i>Existência Tumultuada: Como Nascem, Vivem e Morrem as Estrelas?</i> ).....	91
3.5.2 Scales for Assessing Reader's Ability to Extract the Main Idea of the L2 Text ( <i>Drug Delivery: Getting Under the Skin</i> ).....	94
3.6 Procedures	96
3.7 Pilot Study	98
3.7.1 Working Memory Measures.....	98
3.7.2 Reading Ability Measures.....	99
3.8 Description of Reader's Strategies	101
3.9 Data Analysis	106
<b>4 RESULTS AND DISCUSSION.....</b>	<b>110</b>
4.1 Working Memory Measures and Reading Ability Measures: A Statistical Analysis	111
4.1.1 Descriptive Statistical Analysis.....	111
4.1.2 Correlational Analysis.....	113
4.2 Descriptive Analysis	124
4.2.1 Main Idea Construction Task - before, during and after Reading:.....	124
4.2.2 Assignment of Importance.....	132
4.2.3 Working Memory Management Process.....	142
4.3 Individual Differences in Working Memory Capacity and Readers' Profile of Strategy Use	146
4.3.1 General Comprehension Strategies – Portuguese (L1).....	152
4.3.2 Discussion.....	158
4.3.3 General Comprehension Strategies – English (L2).....	165
4.3.4 Discussion.....	172
4.4 Working Memory as Efficiency at Processing Information or as a General Capacity?	180
4.5 What Would Be the Resources Underlying Working Memory Capacity?	183
<b>5 FINAL REMARKS, LIMITATIONS, SUGGESTIONS, AND IMPLICATIONS.....</b>	<b>185</b>



5.1	Final Remarks	185
5.1.1	<i>Results of Statistical Correlational Analyses on the Reading Span Test and Reading Comprehension Measures</i>	186
5.1.2	<i>Description of the Strategies Used by Readers in order to Construct the Main Idea before, during and after Reading a Text</i>	187
5.1.3	<i>Knowledge – Based Cues as a Key Factor in Assignment of Importance</i>	189
5.1.4	<i>Text-based Cues as a Key Factor in Assignment of Importance</i>	189
5.1.5	<i>How Readers’ Profile of Strategy Relates to Differences in Working Memory Capacity</i>	190
5.1.6	<i>Strategy Associations</i>	193
5.1.7	<i>The Resources Underlying Working Memory Capacity</i>	195
5.2	Limitations of the Study	196
5.3	Suggestions for Further Research	203
5.4	Pedagogical Implications	205
<b>6</b>	<b>REFERENCES</b>	<b>208</b>

## LIST OF ILLUSTRATIONS

Figure 4.1: Scatterplot: L1 General Main Ideas X L1 Working Memory.....	114
Figure 4.2: Scatterplot: L2 General Main Ideas X L2 Working Memory.....	116
Figure 4.3: Scatterplot: L2 General Main Idea X L1 Working Memory.....	117
Figure 4.4: Scatterplot: L1 General Main Idea X L2 Working Memory.....	118
Figure 4.5: Scatterplot: L2 Working Memory X L1 Working Memory.....	120
Figure 4.6: Scatterplot: L1 General Main Ideas X L2 General Main Ideas.....	123
Figure 4.7. Projection of General Comprehension Strategies (L1) and participants.....	154
Figure 4.8. Identifying Two Groups of Participants (Red X Green).....	156
Figure 4.9. Grouping Readers as a Function of their Working Memory Capacity.....	157
Figure 4.10. Projection of General Comprehension Strategies (L2) and Participants.....	166
Figure 4.11. Projection of General Comprehension Strategies (L2) and Participants.....	167
Figure 4.12. Grouping participants as a function of their working memory capacity.....	169

## LIST OF TABLES

Table 3.1 General Main Idea.....	91
Table 3.2 First paragraph/ The birth of a star.....	92
Table 3.3 Second paragraph / The youth .....	92
Table 3.4 Third paragraph/ The middle-aged years.....	92
Table 3.5 Fourth paragraph / The maturity.....	92
Table 3.6 Fifth paragraph / The death .....	93
Table 3.7 General Main Idea.....	94
Table 3.8 First Paragraph / Situation.....	95
Table 3.9 Second Paragraph / Problem.....	95
Table 3.10 Third Paragraph / First Solution.....	95
Table 3.11 Fourth Paragraph / Evaluation.....	95
Table 3.12 Fifth Paragraph / Second Solution.....	96
Table 3.13 Sixth Paragraph.....	96
Table 3.14 Seventh Paragraph.....	96
Table 4.1 Descriptive statistics for the Reading Span Test in L1 and L2.....	111
Table 4.2 Descriptive statistics for the measures of reading ability in L1 and L2.....	112
Table 4.3 Pearson Product Moment Correlations between the Reading Span Test (RST) and general ability to construct the main ideas in L1 and L2.....	118
Table 4.4 Frequency Table: Subjects x General Strategies (Portuguese).....	148
Table 4.5. Frequency Table: Subjects x General Strategies (English).....	149
Table 4.6 Row Profiles Subjects x General Strategies (Portuguese).....	150
Table 4.7 Row Profiles Subjects x General Strategies (English).....	151

## LIST OF APPENDICES

Appendix A:	Verbal Protocols .....	216
Appendix B:	General Instructions On The Reading Ability Measures.....	267
Appendix C:	Instructions On The Reading Span Tests.....	269
Appendix D:	Texts Used For The Reading Ability Measures .....	270
Appendix E:	Sentences Of The Reading Span Test L1 - Portuguse .....	275
Appendix F:	Sentences Of The Reading Span Test L2 – English .....	277
Appendix G:	Words To Be Remembered In The Reading Span Test – Portuguese - L1 .....	279
Appendix H:	Words To Be Remembered In The Reading Span Test – English - L2 .....	279
Appendix I:	Words Remembered In The Reading Span Test - L1 - Portuguese .....	279
Appendix J:	Words Remembered In The Reading Span Test - L2 – English.....	280
Appendix K:	Correlations: Pearson And Spearman.....	282
Appendix L:	Working Memory Groups: High And Low Span Readers.....	288

## CHAPTER 1

### 1 INTRODUCTION

#### 1.1 Preliminaries

What is working memory? What function does working memory serve? It has become extremely difficult to define the term working memory: in fact, this term has been used within several areas of cognitive science including mainstream cognitive psychology, neuropsychology, neuroimaging, and computational modelling (Baddeley, 2000). The difficulty remains, even if we focus on a particular area such as cognitive psychology. Within this area, the term working memory has been used in a number of different ways so as to reflect different theoretical assumptions (Logie, 1996; Shah & Miyake, 1999).

Despite this difficulty, some researchers within the area of cognitive psychology have made an attempt to narrow the scope of the term working memory through addressing more specific questions: (1) what role does working memory play in complex cognitive tasks (Engle, 1996)?; (2) what is the nature of the limitation in working memory capacity that leads to individual differences in performance of cognitive tasks (Cantor & Engle, 1993)?; (3) is the working memory system assumed to underlie complex span tasks specific to language processing or does it reflect a general limited-capacity system (Turner & Engle, 1989)? Again, there is no simple answer to these questions, but at least there is some general consensus within the area: the construct working memory has functional significance. Of course, the three questions are interrelated, but for the present discussion, the important point is that viewed from a functional perspective, working memory has proved itself to be a productive construct. Research has shown that working memory plays a key role in a range of real-world cognitive tasks such as language comprehension (Just & Carpenter, 1992), reading (Tomitch, 1995, 1996, 1998, 2000a), vocabulary learning (Daneman & Green, 1986),

following directions (Engle, Carullo & Collins, 1991), L2 speech production (Fortkamp, 2000). Taking a functional approach, this study aims to investigate the relationship between individual differences in working memory capacity and reading comprehension performance in L1 and L2. More specifically, the current study sets out to investigate how working memory relates to readers' ability to construct the main idea of a text (L1 and L2) when the main is not explicitly stated.

Constructing a main idea is an essential aspect of reading comprehension; yet, it is a difficult task. When the main idea of a text is not overtly stated, readers are not able to select it from the statements available in the text. As a result, they might try to construct a statement to represent the main idea (Afflerbach, 1990b; Kintsch, 1998; van Dijk & Kintsch, 1983). The present investigation is based on conflicting demands, on the one hand, the attentional resources of working memory are limited; on the other hand, constructing the main idea of a text can be a resource-demanding process. In short, the present study investigates how the constraints of limited attentional resources interact with the task of main idea construction in difficult texts in which the main idea is not explicitly stated.

## 1.2 Statement of Purpose

The basic assumption underlying this study is that when the main idea is not obviously stated, the process of main idea construction is deautomated. As a result, readers will try to construct the main idea through using strategies. That is, the main idea construction stops being an automatic process thus becoming a process executed under cognitive control (Afflerbach, 1990b). In this situation, the construction seems to be a working-memory demanding process.

The present study focuses on three objectives. It sets out to investigate (a) to what extent the ability to form the main idea of a difficult text (L1 and L2) relates to individual differences in working memory capacity; (b) how the main idea is formed during comprehension when readers are faced with difficult texts (i.e. the main ideas are undersignalled); (c) whether the strategies readers use to construct the main ideas are related to working memory capacity. Our purpose is the assessment, not only of the comprehension product (whether readers have the ability to construct the main idea or not), but also some of the variables related to the construction process, that is, to describe the strategies readers use to construct the main ideas, to assign importance to information, and how such strategies relate to their working memory capacity.

### 1.3 Significance of the Study

Tomitch (2000b) raised the point that main ideas are not being properly taught. She found out that (EFL/ESL) material writers provide readers with practice at tasks involving main ideas, but do not provide them with explicit instruction on how to extract the main ideas. She went on to argue that those readers who do not possess this skill are not being taught it; as a result, they cannot acquire it. Another point brought up by Tomitch is that skilled readers are able to identify and construct the main ideas of a text, but find it difficult to verbalize their criteria for identification and construction. However, it is important to make these criteria explicit in order to help those less skilled readers, who often fail to construct the main ideas. That is, once the criteria have become explicit, it can serve as a guideline for the less skilled readers to carry out the construction task. Given that, there is a need to investigate more carefully how readers conceive the task of constructing the main idea of a text, and what are the textual cues they pay attention to in order to identify important information.

It is also expected that the present study will contribute to existing research on the relationship between individual differences in working memory capacity and reading performance. While this relationship has been investigated extensively in L1, few studies have been conducted in L2. In addition, some of these L2 studies have limitations. For instance, Harrington and Sawyer (1992) took performance on the TOEFL (Test of English as a Foreign Language) Reading and Grammar sections as general measures of L2 reading skill. This kind of measure does not offer insights into how the specific reading processes (decoding, lexical access, parsing, inferencing, and integrating) relate to memory capacity. It is true that Miyake and Friedman (1998) have tried to offer more specific insights. However, if one compares these two attempts to the several studies that have already been carried out in L1, one will certainly find out that research on working memory has not paid a great deal of attention to the relation between working memory capacity and the specific reading processes in L2. Indeed, Harrington and Sawyer argue that there is a need for studies which investigate this relation more carefully, as they put it,

the adequacy of working memory capacity as an explanatory construct in L2 reading depends to a large measure on identifying which of these processes are sensitive to working memory capacity differences and how this sensitivity is manifested in the development of reading ability (p.33).

Furthermore, few studies have measured working memory in L2, so there is still room for research. Berquist (1997), Harrington and Sawyer (1992), and Yoshida (2000) measured working memory capacity in L2. These researchers explained individual differences in working memory capacity in terms of reader's processing efficiency (there is a trade-off between processing and storage: since skilled readers have more efficient processing skills,



they have more residual working memory resources available for further processing and for storing the partial products of comprehension). Miyake and Friedman, who also measured working memory capacity in L2, view individual differences in working memory capacity from another perspective. They explain individual differences in terms of an overall supply of resources which constrains language comprehension (readers differ in terms of the limited supply of resources – activation – they have available for processing and storing information). Although these former assumptions are reasonable, none of these authors have included ability to control attention as a possible explanation for individual differences in working memory capacity (measured in L2). It is true that Fortkamp (2000) goes a step beyond these former studies, explaining that L2 speech production at the level of grammatical encoding involves the ability to control attention, and relating speech production to individual differences in working memory capacity. However, Fortkamp is particularly concerned with speech production, she does not focus on reading comprehension.

To conclude, the results of the present study are expected (a) to shed light on how readers conceive the task of constructing the main idea of a text (L1 and L2) when the main idea is not explicitly stated; (b) to provide specific insights into the relationship between individual differences in working memory capacity and the task of main idea construction (L1 and L2); (c) to confirm working memory capacity as an explanatory construct in L2 reading comprehension.

#### 1.4 Organization of the Thesis

In addition to the present chapter, this dissertation comprises 4 chapters. Chapter 2 is concerned with the review of literature on working memory capacity and a definition of the term main ideas.

In Chapter 3, the method used to assess working memory capacity and reading ability is presented. This chapter also presents the hypotheses and research questions addressed in the study.

In chapter 4, firstly, the results of the descriptive statistics, and the correlational analysis were presented for measures of working memory span and reading ability. Secondly, the strategies used for the main idea construction task are also described. To describe these strategies, the chapter presents and analyses data which consist of excerpts from the think-aloud protocols. Thirdly, the results of two statistical techniques, namely the Simple Correspondence Factor Analysis and the Cluster Analysis (Escofier & Pagès, 1992) were presented. The latter techniques were used to investigate whether reader's profile of strategy choice is related to working memory capacity.

Chapter 5 presents and comments on a summary of the main findings of this study. In addition, it reports the limitations of the study, and mentions suggestions for further research. Finally, the chapter also includes the pedagogical implications of the results obtained in the present investigation.

## CHAPTER 2

### 2 REVIEW OF LITERATURE

#### 2.1 On Working Memory Capacity

This chapter starts by reviewing the current uses of the term working memory order to set the context for the present discussion. The review is organised in the following way: (a) I explain how the concept of working memory has developed from the concept of short-term memory; (b) the multiple component model of working memory, as proposed by Baddeley (1990, 1992, 1996, 2000), Baddeley and Hitch (1994), Baddeley and Logie (1999); (c) a correlational approach to working memory, which regards working memory as a constraint on language comprehension (Daneman & Carpenter, 1980, 1983; Just & Carpenter, 1992; Miyake, Just & Carpenter, 1994; Tomitch, 1995, 1996, 1998, 2000b; among others); (d) I also review authors who equate the capacity of working memory with the capacity to control attention (Engle, Kane, & Tuholski, 1999; Engle, Tuholski, Laughlin & Conway, 1999; Kane, Bleckely, Conway & Engle, in press); (e) the studies relating the working memory construct to L2 performance (Berquist, 1997; Fortkamp, 2000; Harrington & Sawyer 1992; Miyake & Friedman, 1998); (f) I shall go on to point out the limitations in current research, and suggest points which deserve to be further investigated; finally, (g) I define the term main idea based on the theory of macrostructure (Kintsch & van Dijk, 1978, van Dijk & Kintsch, 1983; Kintsch, 1998).

##### 2.1.1 Short-term Memory

Research on short-term memory played an important part in the development of experimental psychology in the 1950s, '60s and early '70s, in fact, most recent views on working memory have developed from the traditional conception of short-term memory (Engle & Oransky, 1999). Although both terms are used to refer to a system of limited capacity which temporarily retains information, historically, each of them has addressed different aspects of human cognition: (a) the term short-term memory was coined before, and it refers to a unitary memory system whereas working memory, as Baddeley and Logie (1999) conceive it, comprises distinct components; (b) short term memory was regarded as a passive storage buffer while working memory functions as controlling a system, having an important role in higher-level cognition (for a review, see Baddeley, 1990; Engle & Oransky, 1999; Fortkamp, 2000; Logie, 1996; Richardson, 1996; Tomitch, 1995).

A typical example which illustrates the concept of short-term memory (STM) is the storage of a telephone number between the time that a person looks up the number in a directory and the time that the person dials it (Just & Carpenter, 1992). From this illustration, it is possible to infer that short-term memory is traditionally considered a storage buffer which allows a person to hold a limited number of items such as words, or digits for a brief period of time. Information in STM is transient, and quickly forgotten, but the memory trace can be kept through rehearsal.

Research findings indicate that short-term forgetting arises from different types of limitations: (a) limits on the storage capacity (Miller, 1956). According to this view, STM comprises a fixed set of slots ( $7 \pm 2$ ) for storing information. Grouping more pieces of information into a single unit in order to form chunks is the means of overcoming this limitation, for instance, grouping letters into words; (b) limits on how long the memory trace can be maintained in short-term store (Peterson & Peterson, 1959, as cited in Baddeley, 1990).

Waugh and Norman (1965) agree with Miller (1956) that there is a limit to the number of items that can be kept in STM at any one time. They also add that once this limit has been exceeded, there is some displacement of old information by new information due to interference. As a result, old information is forgotten. As Waugh and Norman put it, “unrehearsed verbal stimuli tend to be quickly forgotten because they are interfered with by later items in a series and not because their traces decay in time” (p.89).

A very influential model of human memory was proposed by Atkinson and Shiffrin (1968, as cited in Atkinson & Shiffrin, 1971). According to them, information would first go through a range of sensory buffers in parallel. These first buffers would communicate with a limited capacity short-term store (STM) which would eventually transfer information to a long-term store (LTM). Besides storing information, another function was attributed to STM, it would also perform some control functions such as rehearsal: it was rehearsal that would enable the transfer of information from STM to LTM, the more an item was rehearsed in short-term memory, the easier it would be for the item to reach LTM.

The Atkinson and Shiffrin’s model became obsolete: (a) the assumption that STM was the path to LTM could not be supported; (b) there was no empirical support for the assumption that rehearsal would guarantee the transfer of information from STM to LTM (Tulving, 1966, as cited in Baddeley, 1990). These problems led researchers to rethink the Atkinson and Shiffrin’s model.

Although the Atkinson and Shiffrin’s (1971) model ended up falling out of favour, two features of their model are still present in the current literature on working memory. The assumption that STM is responsible for both temporary storage and processing of information, and that STM functions as a controlling system, having an important role in human cognition. As they put it, “the short-term memory is considered a working memory: a system in which decisions are made, problems are solved and information flow is directed” (p. 83). However,

by the late 1960s, there was little empirical evidence for this assumption. Not until the early 1970s did Baddeley and his associates start to investigate whether STM could really function as a system in charge of controlling cognitive processes.

### 2.1.2 The Multiple Component Model

Baddeley and Hitch (1974, as cited in Baddeley, 1990; Baddeley & Hitch, 1994) set out to investigate whether there was a unitary immediate memory system or separate subsystems. They used a concurrent task technique to test the following hypothesis: if there were a unitary limited-capacity memory responsible for all cognitive performance, when memory was loaded by a simple digit task, subjects would not be able to perform concurrent complex tasks such as reasoning or comprehension. Or, if there were distinct subsystems for simple and complex tasks, keeping a digit load would not cause reasoning or comprehension loss. They found that a small digit load did not impair performance on the concurrent complex tasks. However, a heavier digit load caused a greater degree of impairment, but this was not so great as to entirely break down reasoning and comprehension. This finding indicates that the storage of a small digit load and the performance of complex tasks do not depend entirely upon the same memory system. This view is consistent with the recent conception of working memory proposed by Engle, Tuholski, Laughlin and Conway (1999), cited below.

Findings from studies investigating the concurrent-task performance, and neuropsychological evidence from patients suffering from brain damage led Baddeley and his associates to propose a three-component model. According to Baddeley and Logie (1999), the original working memory model comprised a supervisory system, the central executive, and specialised slave systems, the phonological loop and the visuospatial sketchpad. Both of the slave systems inherited features from the earlier models of STM, namely a passive store, and

an active rehearsal system for maintenance of information. Lately, Baddeley (2000) has added a fourth component to the model, the episodic buffer (cited below).

The central executive. The central executive is responsible for control operations in working memory, such as the co-ordination of the slave systems, the capacity to control attention, and to activate information from LTM. In earlier versions of the model, it was assumed that the central executive was responsible for either supporting control processes or supplementing storage. However, more recently, Baddeley and Logie (1999) have argued that the central executive does not have storage capacity. According to them, when there is any increase in storage capacity exceeding that of a given slave system, either LTM or other subsystems are accessed.

The central executive is essentially an attentional system often linked to the functioning of the frontal lobes. The aspect of attention that is closest to the central executive, concerns the control of action (Baddeley & Logie, 1999). It is beyond the scope of this review to provide a thorough account of the literature on attention. However, because Baddeley (1990, 1996, 2000; Baddeley & Logie, 1999) are being presently reviewed, it is important to elucidate the manner in which Baddeley and his associates use the term attention, and what they mean by equating attention to control of action. It is noteworthy that although Baddeley's work has been strongly influenced by the attentional literature, he himself does not define the term attention. He borrows a model developed by Norman and Shallice (1986).

In trying to formulate the functioning of the central executive, Baddeley drew upon a model developed by Norman and Shallice (1986, as cited in Baddeley, 1990; Engle & Oransky, 1999; Shallice & Burgess, 1993). According to such model, action can be controlled in two ways: schema activation guides routine or automatic activities; and an attentional controller, the Supervisory Attentional System (SAS), intervenes in order to prevent one from

being trapped by habitual response patterns when it is necessary to initiate new or non-routine behaviour.

The model assumes that actions are accomplished through the activation of schemas. For routine and well-learned actions, schema activation goes on automatically, triggering sequences of actions. One is able to activate several schemas simultaneously. However, a situation may arise in which schemas come into conflict. In this case, there are two levels of control to solve conflicts. First, one of the schemas takes precedence over the others, thus becoming the most activated. The choice of which schema(s) become(s) the most activated at a time is carried out by contention-scheduling (Shallice & Burgess, 1993). This mechanism is used to solve conflicts through the inhibition of independently activated schemas. Contention scheduling is involved in routine choices between competing, but well-learned schemas. Since this type of choice is relatively automatic, it does not demand that one makes a great deal of effort to control attention. Second, when one has to cope with novelty, the attentional controller comes into play, the Supervisory Attentional System (SAS). This system intervenes to regulate the operation of contention scheduling by increasing or inhibiting the activation of competing schemas.

Shallice and Burgess (1993) review evidence from cognitive neuropsychology to see whether it supports the distinction between routine and non-routine processing as it is conceived in the Norman and Shallice (1986) model. Specifically, they investigated whether there are patients whose difficulties arise from any impairment to the SAS. Their investigation was based on the assumption that a particular type of patient (frontal-lobe injured patients) with a defective SAS would not be able to regulate the operation of the contention-scheduling. In other words, they investigated how a patient whose contention-scheduling operating alone would behave in specific situations. They concluded that the elimination of the SAS would give rise two different types of behaviour: response perseveration and distractibility.



Response perseveration occurs when (a) dominant schema(s) remain(s) strongly activated, even when a response to a situation requires inhibition of this/these schema(s). Distractibility occurs when no relevant schema is strongly activated by a stimulus, thus some form of random behaviour can be observed. Frontal-lobe patients carried out two tests: one to tap perseveration, and another to tap distractibility. These tests were only weakly correlated, suggesting a rather low relationship between performance on the two tests. In other words, perseveration and distractibility reflect independent effects of SAS damage on performance. These independent effects might indicate that the Supervisory System does not act as a unitary mechanism, and is probably associated with the functioning of different areas of the frontal lobes.

In addition to evidence from neuropsychological studies, psychometrical tasks have also been used to tap the functioning of the central executive (Baddeley, 1996; Gathercole & Baddeley, 1993). More specifically, a random generation task has been used. The assumption underlying this task is the following: if one becomes able to perform a given task automatically, the task demands on the central executive will decrease. In contrast, a task that cannot be performed automatically will make heavier demands on the central executive. For instance, a task in which participants have to produce sequences of letters, making the order as random as possible. Participant's already existing alphabetic schema will lead them to produce stereotyped sequences such as ABCD, MNOP, etc. It is even more difficult to make the order random under rapid paced conditions. In order to produce random sequences of letters, the SAS is required. That is, the SAS will intervene to prevail over the habitual and well-learned schemata, which leads participants to generate stereotyped and non-random sequences of letters. According to this model, the more rapid the rate of production, the less random (and more stereotyped) the output. In addition, the performance of a concurrent task while participants produce the letter sequences will also make the output less random. The

latter result might indicate that random generation competes for the same limited capacity that is necessary for performance of a concurrent task. In short, if the generation task either is too demanding of the limited resources of the central executive or shares resources with a concurrent load, the efficiency of the central executive (or SAS) to control the production of random sequences will decrease (Gathercole & Baddeley, 1993)

Baddeley (1996) and Baddeley and Logie (1999) have started to assume a number of executive functions that might be attributed to the central executive, namely capacity to focus attention, to switch attention, and to activate representations within LTM. However, it is still open to debate whether the central executive is a system which comprises a cluster of executive functions interacting independently from each other, or whether the central executive acts as a unitary system, a single dominant controller. With respect to this issue, Gathercole and Baddeley (1993) raised a crucial point: it is misleading to identify the central executive with a single dominant mechanism or model such as the Supervisory Attentional System. In short, for Baddeley and his associates, the debate is far from settled. On the other hand, other researchers such as Engle, Kane, and Tuholski (1999) have already committed themselves to a position: they suggest that there is some common basis or a unifying mechanism that controls the executive functioning, and they equate the organisation of such mechanism to intelligence. As they put it, "...we suggest that working memory/attention may be organised similarly to intelligence..., that is, as a hierarchical structure with a general domain-free factor overarching several subordinate domain-specific factors (p.125)" (Engle's et al views are discussed further below).

More recently, Miyake, Friedman, Emerson, Witzki, and Howerter (2000) report an individual differences study of executive functions. Specifically, they examine three executive functions that have often been mentioned in the literature: shifting between tasks or mental sets, updating and monitoring of working memory representations, and inhibition of dominant

or prepotent responses. Their study aims to specify the extent to which these three target executive functions are unitary or separable. Their results indicate that the three target functions are clearly separable but are correlated to one another, thus sharing some degree of communality. That is, Miyake's et al. results point to both unity and diversity of executive functions. Concerning the unity of executive functions, Miyake et al. raise an important question: "what might the source (s) of communality be" (p.88)? He offers two possible answers, (1) the nine tasks selected to tap the three executive functions have some common task requirements, that is, the maintenance of goal and context information in working memory; (2) the three executive functions require some sort of inhibitory process to operate properly: updating requires suppressing no longer relevant information; shifting requires suppressing an old mental set to switch to a new set; inhibiting requires the inhibition of prepotent responses. Concerning the diversity of executive functions, Miyake et al. raises a point that deserves further research: it is important to investigate how best to specify executive functions before making any further assumptions.

The episodic buffer. The three-component model of working memory (central executive, verbal and visual slave systems) offers a reasonable account for wide range of data. However, there are some phenomena that the original model fails to explain. With the aim of capturing the phenomena that does not fit into the original model, Baddeley (2000) has recently added a fourth component to model, the episodic buffer. Next, the phenomena will be outlined and then the episodic buffer will be described.

Baddeley (2000) addresses the effect of articulatory suppression. Consider, first, the slave system involved with this effect, the phonological loop. It comprises a temporary phonological store which is aided by an articulatory rehearsal process. It is assumed that the limitation in phonological loop is due to trace decay. The memory traces within the phonological store are assumed to decay over a period of a few seconds unless revived by the

articulatory rehearsal process. This process is also capable of translating visually presented items into a phonological code and registering them in the phonological store. The loop is suited to retain serial information, and this function is tapped by the simple memory span tasks. In order to fulfil these tasks, subjects must recall and repeat back immediately a sequence of digits or unrelated words in the order of presentation.

The phonological loop hypothesis gives a reasonable account for the effect of articulatory suppression on digit recall (Baddeley, 1990, Baddeley, 2000). This effect occurs in the following situation: a subject repeatedly utters some irrelevant sound, e.g. the word 'the, the...', while trying to recall a sequence of visually presented digits. According to the model, the articulation of an irrelevant sound will keep the rehearsal process busy, thus preventing it from translating visually presented digits into a phonological code. As a result, the digits will not be registered into the store, and recall is expected to be substantially lower. Indeed, articulatory suppression has a significant effect on subsequent digit recall. However, against the expectation, this effect is far from substantial. That is, despite articulatory suppression, subjects still manage to recall more digits than it is predicted by the model. In addition, patients suffering from grossly impaired short-term verbal memory, whose auditory memory span is one digit, can manage to recall about four digits with visual presentation (Baddeley, Vallar & Wilson, 1987, as cited in Baddeley, 2000). Given that patients' short-term verbal memory is grossly impaired, a question was raised: how can they store such digits (Baddeley 2000)?

Baddeley (2000) points out that the integration of information from the phonological loop and from LTM poses further problems for the current model. According to the phonological loop hypothesis, there is a limit to the number of unrelated words a subject is able to recall, subjects begin to make mistakes once they reach the limit of five or six words. However, there is a means of overcoming this limitation. If subjects manage to integrate

words into a meaningful sentence, they form chunks, then it is possible to reach a span of sixteen or more words (Miller, 1956). In this case, the limitation is set by the number of chunks rather than the number words. In order to make sense out of the words and integrate them into a meaningful chunk, it is necessary to bring auxiliary information from LTM. This integrative process has led Baddeley to raise the following questions: “how information from different sources is integrated, ...where the chunks are stored: are they held in the phonological loop, in LTM, or in some third back-up store (p. 41)”.

Baddeley (2000) points further problems with his original working memory model: the observation that densely amnesic patients are able to demonstrate normal immediate recall of a prose passage, but complete absence of delayed recall (Wilson & Baddeley, 1988, as cited in Baddeley 2000). More specifically, there is an important component of many clinical measures of memory, namely the immediate recall of a prose passage, comprising some 15-20 idea units. Patients are required to recall a passage twice, immediately after hearing it, and after a 20-minute delay. Densely amnesic patients perform very poorly on delayed prose recall. However, their immediate recall tends to be preserved. The preserved information does not seem to be kept in the phonological loop for the following reasons: the amount of recalled information is far greater than the capacity of the phonological loop, in addition, the process of recall would disrupt information already in the phonological store. Neither could preserved information be kept in the central executive because this is assumed to be an attentional control system and does not have any storage capacity. Given that, a question was raised: where could the preserved information be maintained?

As an attempt to answer the unresolved issues cited just above, Baddeley (2000) proposes the episodic buffer.

To conclude, the original working memory model has given a reasonable account of a wide range of data. However, evidence from resistance in serial recall to articulatory

suppression, from patients with impaired short-term verbal memory, and from amnesic patients who demonstrate normal immediate recall of prose, all suggest the need for updating the model. According to Baddeley (2000), these pieces of evidence indicate the need to assume a further back-up store. Given that, he goes on to propose the episodic buffer. This is a limited capacity temporary store that is capable of drawing information both from the slave systems and from LTM, holding this information in some integrated form, and using it over a time scale beyond the assumed capacity of the verbal and visual slave systems. The episodic buffer is controlled by the central executive, which is responsible for integrating information from different sources into coherent episodes so that these episodes can be retrieved consciously. The buffer is to some extent similar to the concept of episodic LTM (this type of LTM allows individuals to become aware of their identity and existence through recollection of episodes, the individual is often aware of the information stored in episodic LTM, but not of its origin, Tulving, 1985). However, the episodic buffer differs from the episodic LTM in that it is temporary in nature, and is intact in amnesic patients with impaired episodic LTM.

There is a final and important comment on the development of the multiple component model of working memory. The development of such model has relied on both experimental data and neuropsychological evidence from patients suffering from brain damage. More recently, ranges of brain-imaging techniques have also lent support to the model. These three sources of information are complementary, and have been equally important to the development of the model.

Concerning the brain-imaging studies, Miyake and Shah (1999) raise an important point. According to them, there is some consensus among researchers that several areas of the brain including the prefrontal cortex (PFC) contribute to generate the working memory phenomena (emphasis added). This is an important point because the brain-imaging studies should not be mistakenly interpreted as attempts to locate specific places or “box(es)” in the

brain dedicated to temporary storage of information (p.444). Instead, these studies should be regarded as attempts to shed light on a range of distributed neural systems that taken together contribute to the accomplishment of the working memory processes.

### 2.1.3 Working Memory as a Constraint on Language Comprehension

While Baddeley and his associates have proposed a multiple component model of working memory, another approach has been developed. The other approach is correlational in nature, and assumes that working memory capacity is a good predictor of individual differences in reading comprehension performance (Daneman & Carpenter, 1980, 1983; Daneman & Merikle, 1996; Tomitch, 1995, 1996, 1999, 2000a, among others).

Researchers such as Daneman and Carpenter (1980) argued that in the task of reading, working memory performs two functions: it both stores information for a limited period of time and performs processing functions. Briefly, the stream of incoming information from the text, plus the recently read information, plus the information retrieved from long-term memory is processed in working memory and then stored as part of an evolving product of comprehension. Such procedure is crucial for constructing a coherent interpretation and for integrating new information with already known information activated from long term memory.

A test was developed by Daneman and Carpenter (1980) to tap both the processing and the storage demands of working memory, the Reading Span Test. According to Engle (1996), “Daneman and Carpenter (1980) developed the first task that seems to be a valid measure of the capacity of working memory” (p.89). This measure comprises two components and joins the demands of sentence comprehension (processing component) to the storage and retrieval of the sentence final words (storage component). To perform such test,

the subject is required to read aloud increasingly longer sets of sentences, and at the end of each set the subject tries to recall the final word of each sentence in the set. The span is considered as the maximum number of sentences the subject can read aloud while recalling the final words in the order of presentation. In some studies, a comprehension check was added to the processing component of the task. In the study of Daneman and Carpenter (1980), after reading (or listening) to each sentence, participants had to make a true/false judgement about the sentence. The comprehension check was included in the test to make sure that participants would really process the entire sentence and would not only focus on the final words of the sentences. The Reading Span Test differs from the traditional digit and word span measures because the latter are single tasks, involving only storage, and do not correlate significantly with higher-level cognitive tasks such as reading comprehension (Daneman & Carpenter, 1980).

Differing from traditional span measures, the Reading Span Test has consistently correlated with standardised and specific tests of reading ability, namely, tests that measure reader's ability to retrieve the antecedent referent for a pronoun (Daneman & Carpenter, 1980); ability to perceive and revise lexical ambiguity in "garden path" sentences (Daneman & Carpenter, 1983); ability to use contextual cues to extract the meaning of a new word (Daneman & Green, 1986); ability to parse complex syntactic structures (King & Just, 1991); ability to put together different parts of a passage to make appropriate inferences (Masson & Miller, 1983); ability to maintain multiple meanings for a lexical ambiguity in the absence of strong contextual cues (Miyake, Just & Carpenter, 1994); ability to perceive text structure (Tomitch, 1995); ability to recall predictive signals and predicted elements (Tomitch, 2000a). Moreover, the reading span test also correlated with standardised measures of reading comprehension, namely, the Verbal Scholastic Aptitude Test (VSAT) (Daneman & Carpenter, 1980). A correlation is not a cause-and-effect relationship, but the strength of the correlations



reported above, and the fact that they have been replicated across several studies indicate that working memory capacity, as measured by the Reading Span Test, is a good predictor of reading performance.

In short, the Daneman and Carpenter's Reading Span test has been well recognised as a valid measure of working memory capacity and as a good predictor of language comprehension (Daneman & Merickle, 1996). However, the original version of the RST was not without its limitations. Rothe-Neves (2000) points out that the original version failed to control for some variables such as syntactic complexity of sentences. In addition, the original version only took into account that the limitation in short-term memory capacity arises because there is a limit to the amount of information one may keep in working memory at any one time. However, it did not consider that this limitation also arises from the length of time it takes the memory trace to decay (see Rothe-Neves, 2000, for a discussion of the variables that should be controlled in the reading span test in Portuguese).

Daneman and Carpenter (1980) argue that efficiency at the specific reading comprehension processes is a source of individual differences in working memory capacity. As they put it, working memory performs processing and storage functions that share the same pool of limited resources. Inefficient processing consumes a great deal of the available resources, thus wasting resources that could be used to store information in working memory. In reading comprehension, unskilled readers devote more capacity to perform the reading process (decoding, lexical access, parsing, inferencing, and integrating), as a result, they have less residual capacity for storing information and for further processing (Daneman & Carpenter, 1980).

Some controversies in the field. Daneman and Carpenter's (1980) views were challenged by Turner and Engle (1989): for Daneman and Carpenter, together with Daneman and Green (1986), the capacity of working memory is task-specific, depending on a person's

processing efficiency at the specific task to which working memory is being related. In other words, skilled, or more efficient readers will present a higher working memory span when carrying out reading comprehension tasks.

On the other hand, for Turner and Engle (1989), skilled readers present a larger general working memory capacity than do unskilled readers independent of the task being carried out. In short, a person might be a skilled reader due to a larger working memory capacity but not simply due to more efficient reading skills. In order to test this assumption, Turner and Engle devised two working memory tasks, but in their tasks, the processing component was not reading-related: one task required subjects to solve strings of arithmetic operations then recall a word which followed each operation (the Operation Word Span Test), another task required subjects to solve strings of arithmetic operations then recall a digit answer (the Operation Digit Span Test). Their results indicated that performance on the Operation-Word and Operation-Digit tasks correlated with measures of verbal comprehension such as the Nelson Denny Standardised Reading Comprehension test. Nevertheless, the magnitude of the correlation was higher for the task involving the recall of words (the Operation-Word span task). Most importantly, Turner and Engle also compared the correlation between the Operation-Word task and the Nelson Denny and between the Sentence-Word task (analogue of the Reading Span test) and the Nelson Denny. Results indicated that the correlations of Nelson Denny with Operation-Word and Sentence-Word tasks were not statistically different. On the basis of this result, Turner and Engle argued that skilled readers have more capacity available for processing and storage than do unskilled readers whether carrying out a reading or a non-reading related task.

It is noteworthy that there is a procedural difference between the span tasks developed by Turner and Engle (1989), on the one hand, and the span task devised by Daneman and Carpenter (1980), on the other hand. Engle and his associates developed the Operation-Word

span task in which first, participants had to perform an arithmetic operation  $(4/2) - 1 = \dots$ , then they had to read a word after the operation, e.g. SNOW. After a series of operation-word strings had been displayed, for example,  $(4/2) - 1 = \dots$  SNOW,  $(3 \times 1) + 4 = \dots$  TABLE, participants had to recall the words that followed each operation, that is, SNOW and TABLE. It is noteworthy that the storage component of this task is not part of the processing component, the word is independent from the operation. By contrast, in the Reading span test developed by Daneman and Carpenter, first, participants had to read the sentences, then had to remember the last word of each sentence. It is noteworthy that the word-to-be-remembered was part of the sentence they had previously read, that is, the processing and storage components are not separable. For example, participants had to read sentences such as “The taxi turned up Michigan avenue where they had a clear view of the lake”, and then remember the last word “lake” (Daneman & Carpenter, p.453). The important point is that despite this procedural difference both span tests have proved themselves to be reliable measures of working memory capacity (see also Daneman & Merikle, 1996 for a similar position).

Daneman and Tardiff (1987) attempted to review the processing efficiency explanation. They conducted an experiment to investigate the relationship between verbal ability and three types of span measures: a verbal span, a math span, and a spatial span. In the first section of their experiment, each span task comprised a storage and a processing component. They found that verbal ability correlated highly with verbal span, and correlated significantly with math span, but it did not correlate with spatial span. On the basis of this result, they assumed that there are separate working memory resources, one for processing verbal-symbolic information and another for processing spatial information. In the second section of their experiment, Daneman and Tardiff eliminated the storage component of the working memory span tasks, that is, they used span tasks which aimed to measure only processing efficiency (storage-free tasks). Their results indicate that (verbal and math)

storage-free tasks correlated with verbal ability. According to them, the most important finding was that processing performed in the verbal and math storage-free tasks correlated with verbal ability as strongly as processing performed when storage was required. Given that, they claimed that processing efficiency, not storage, is the real source of individual differences in working memory capacity and in verbal ability. Later, Daneman and Tardiff's results were challenged by Engle, Cantor and Carullo (1992). Engle et al. went on to reject both the task-specific view and the processing efficiency explanation (cited below).

Regardless of how this debate will be settled, the important point for the current discussion is that working memory capacity puts a constraint on language comprehension.

Just and Carpenter (1992) went on to explain individual differences in working memory in terms of a general capacity for language, or a budget of activation. According to this framework, working memory is a portion of long-term memory activated above some threshold, and individuals differ in the total amount of activation available for performing the two functions, storage and processing. Higher-capacity individuals have a larger budget of activation, so they can cope with heavier processing and storage loads while individuals with a smaller budget are at a disadvantage.

Just and Carpenter (1992) assumed that working memory capacity is constrained by the limited budget of activation. Capacity is flexibly allocated within the limits of this budget, but once the cognitive demands of a task have exceeded the supply of activation (WM capacity), the level of activation is reduced, as a result, processing slows down and information is lost. This occurs because storage and processing share the same pool of limited resources, namely the same supply of activation. More specifically, in text comprehension, when a task makes heavy demands on working memory capacity, the processing of incoming information may become inefficient, it may become difficult to maintain the representations of earlier parts of the text in working memory, and to connect incoming information to

previously read information; as a result, important pieces of information may be forgotten and readers fail to achieve a reasonable standard of coherence. Another interesting feature of the budget-of-activation hypothesis is that as one goes on reading a long text and gathers more information, they either have to distribute their available resources more thinly or more carefully, or they have to bring more resources to the task (e.g. by increasing the level of concentration).

Just and Carpenter (1992) found that individual differences in working memory capacity are manifest only if the reading comprehension task is demanding. They do not explain this finding in terms of efficiency at the processes of reading because, according to them, efficiency differences would appear regardless of task demands. Instead, this finding is explained in terms of individual differences in general capacity for language, they argue that working memory limitations have an effect upon performance only when the task is so demanding as to strain capacity. Although this specific finding is interpreted in terms of a general capacity, Just and Carpenter do not rule out the possibility that working memory capacity can also be related to efficiency at specific processes. For Just and Carpenter, making a choice between these two explanations is a matter of deciding which explanation best accounts for the data at hand. In short, they claim that the two assumptions are compatible, that is, individual differences in working memory capacity may reflect differences in an inherent general capacity for language, or differences in processing efficiency, or both.

An assumption made by Just and Carpenter (1992) has recently been disputed: working memory in their conception “corresponds approximately to the part of the central executive in Baddeley’s theory that deals with language comprehension” (p.123), and the central executive would perform both the storage and the processing functions of working memory. However, Baddeley and Logie (1999) together with Engle, Tuholski, Laughlin and

Conway (1999) have given up the assumption that the central executive stores information, they argue that storage and processing do not share the same pool of resources.

Fodor (1983, as cited in Just and Carpenter, 1992) considered the syntactic processing of language to constitute an independent module that is separate from non-syntactic information (e.g. pragmatic information). To use Fodor's term, syntactic processing is "encapsulated" from non-syntactic information. Just and Carpenter re-interpreted syntactic encapsulation in terms of individual differences in working memory capacity. They argue that readers with small working memory capacity are not able to maintain non-syntactic information activated while the syntactic computations are being processed. That is, the syntactic processing of low-span readers is encapsulated due to a capacity constraint. By contrast, readers with a large working memory capacity can manage to maintain both syntactic and non-syntactic information activated. Consequently, the syntactic processing of high-span readers is more likely to be influenced by non-syntactic information.

The empirical support for Just and Carpenter's (1992) position comes from a task in which readers could avoid being misled by a garden path only by taking advantage of non-syntactic information (a pragmatic cue). Readers were classified as high or low-span readers by means of the Reading Span Test (Daneman & Carpenter, 1980). Results indicate that high-span subjects were able to make use of the non-syntactic information as initially interpreting syntactic ambiguity that is, their parsing was influenced by the pragmatic cue. The syntactic processing of these high-span readers was not encapsulated, but interactive. In this case, the interaction involved keeping and using pragmatic information while syntactic information was being processed. By contrast, only the low-span subjects presented some evidence for encapsulation, that is, they initially processed a single, syntactically preferred interpretation without taking into account the pragmatic cue. In short, low-span reader's syntactic processing tends to be more modular than high-span's syntactic processing. According to this

view, the degree of modularity is influenced by differences in working memory capacity, not by some structural separation between syntactic and pragmatic modules.

Just and Carpenter's approach was not without controversy: Waters and Caplan (1996, as cited in Just, Carpenter & Keller, 1997) argued against a single pool of resources. According to them, there are at least two types of working memory resources underlying language use. Waters and Caplan claim that there is one pool of resources for the psycholinguistic unconscious processes which occur during on-line comprehension (i.e. syntactic parsing, lexical accessing, determination of sentential semantic values such as thematic roles, topic and coherent coreference). There is also a second pool of resources, that is, a pool for supporting conscious, controlled, and verbally mediated processes (i.e. explicit reasoning). In addition, Waters and Caplan suggest that the reading-span task does not draw upon the first pool of resources (which is specialized in psycholinguistic processes) so it should not be related to individual differences in processing supported by the first pool. For Waters and Clapan, the reading span test taps the resources for conscious controlled processing.

According to Just, Carpenter and Keller (1997), Waters and Caplan's division is not clear-cut and it ends up bringing together two criteria, namely, (a) the type of process, (b) process's automaticity (automatic vs. controlled). Just et al. argue that whether a process is automatic or not may depend on the circumstances. For instance, lexical access for a short and familiar word tends to be automatic, but it is not for a very infrequent word. The question raised by Just et al. is which pool would support non-automatic lexical access. Just et al. (1997) pointed out another problem with Water and Caplan's assumptions. The latter considered automaticity as a dichotomous variable. Indeed, it seems that language processing is characterized by a continuum between automatic and controlled processes.

For Just et al. (1997), the assumption that there is a special psycholinguistic class of processes also seems to be inconsistent. They mentioned pieces of evidence indicating that sentence comprehension is affected by non-psycholinguistic information such as frequency and pragmatic knowledge. Just et al.'s position comes from an interactive (not modular) view of the processes underlying comprehension. This researcher does not subscribe to Water and Caplan's position.

In line with Just and Carpenter (1992), other studies have investigated how capacity limitations constrain specific processes of language comprehension such as the parsing of complex syntactic structures (King & Just, 1991) and the resolution of lexical ambiguity (Miyake, Just & Carpenter, 1994).

Miyake, Just and Carpenter (1994) proposed a model to explain how working memory capacity puts a constraint on a reader's ability to maintain multiple interpretations of a lexical ambiguity during reading comprehension. According to their model, readers with a large working memory capacity would be better able to maintain multiple interpretations of an unresolved lexical ambiguity than those with a small working memory capacity. In other words, readers with a large working memory could maintain the multiple interpretations longer. Reader's working memory was assessed by the Reading Span test (Daneman & Carpenter, 1980). In Experiment 1, subjects read two types of sentences in which a homograph was preceded by neutral contexts and disambiguated much later (e.g. "Since Ken really liked the boxer, he took a bus to nearest sports arena to see the match", the most frequent or dominant interpretation, p.181; "Since Ken really liked the boxer, he took a bus to the nearest pet store to buy the animal", the less frequent or subordinate interpretation, p. 181). The purpose of Experiment 1 was twofold: (a) it investigated how working memory capacity constrained reader's ability to maintain multiple interpretations of lexically ambiguous words; (b) it also investigated how the interpretation of a homograph was



influenced by the disparity between the frequencies of usage of the homograph's two interpretations, that is, the disparity between the frequencies of the dominant and the subordinate interpretation. As predicted by the model, high-span readers presented little effect of ambiguity as they found the disambiguation point even when the target homograph had one highly frequent meaning. For the high-span readers, it did not matter which interpretation of the homograph, dominating or subordinate, was correct. This result indicates that high-span readers had both interpretations readily available in working memory, that is, they were able to keep both interpretations up to the moment they found the disambiguating point. By contrast, low-span readers presented a large ambiguity effect when the resolution of the ambiguity favoured the subordinate interpretation. This result indicates that low-spans failed to keep the less frequent interpretation (the subordinate interpretation) active, that is, they were able to keep only the dominant interpretation. Consequently, they tended to present a garden path effect for the subordinate resolution when noticing the inconsistency between the disambiguating information and the interpretation currently available in their working memory.

In Experiment 2, Miyake et al. varied the working memory demands between two experimental conditions processed by the same participant (all participants were mid-span readers). The distance between the target homograph and the disambiguating word was different for each condition so that Miyake et al. could investigate how the distance manipulation would have an effect upon readers' ability to maintain multiple interpretations of the homograph (e.g. "Since Kelly liked the boxer very much, he went to the nearest pet store to buy the animal", p.191. "Since Kelly liked the boxer, he went to the pet store to buy the animal", p.191). According to Miyake's et al. model, maintaining multiple interpretations up to the disambiguating point depends on the amount of working memory resources that the reader has available to maintain the interpretations. If the disambiguating point appears later

in the sentence, the reader will have to allocate more resources to process incoming information and store partial products of comprehension. Therefore, the longer the distance between ambiguity and resolution, the harder it is to retain both interpretations of a homograph. In fact, results indicate that mid-span readers are better able to maintain both interpretations available in their working memory when the disambiguating point appears earlier rather than later. This result could be observed when biased homographs were tested (i.e. biased homographs: when a homograph has one highly frequent interpretation). Taken together, the two experiments reported by Miyake et al. support the claim that working memory capacity constrains reader's ability to solve lexical ambiguities.

#### 2.1.4 Working Memory Capacity and Qualitative Differences in Comprehension Processes

Other types of ambiguities such as discourse-level ambiguities are also constrained by working memory capacity (Whitney, Ritchie & Clark, 1991). Whitney et al. set out to investigate whether individual differences in working memory capacity relate to how readers use inferences to comprehend an ambiguous text. Working memory capacity was assessed by the reading span test (Daneman & Carpenter, 1980), then subjects were divided into two groups as low or high-span readers. Subjects read ambiguous passages which did not allow them to put an accurate interpretation on what was happening, and provided 'thinking aloud protocols' of their interpretations as they read. The protocols were divided into idea units representing simple sentences. Each idea unit was classified so as to make a distinction between those idea units which expressed a general or a specific inference. Results indicated that the proportion of specific inferences by low-span readers is twice as many as that of high-span readers. In short, low-span readers tended to be more concrete in their interpretation. Whitney et al. have also examined the positions of specific inferences in the protocols.

Results indicate that high-span readers produced the most specific inferences towards the end of the passage. That is, high-span readers kept their interpretation open till they had received enough information to be sure of their interpretation. As a result, they were able to avoid committing themselves to a premature interpretation. By contrast, low-span readers constructed specific inferences more evenly throughout their protocols. These readers either committed themselves to a single and early interpretation or interpreted each passage event quite specifically but one event as independent from another. In addition, low-span readers seemed to face a trade-off between constructing either global or local coherence.

In order to elucidate the latter finding of Whitney et al., it is important to comment on Kintsch and van Dijk's (1978) notion of global and local coherence (see also van Dijk & Kintsch, 1983; Kintsch, 1998). According to these authors, readers tend to maintain the most recently processed information in working memory in order to make a connection between adjacent clauses. In other words, maintenance of information in working memory may contribute to the construction of coherence at a local level. In addition, texts are also coherent at a global or thematic level. Therefore, readers should also maintain thematic information in working memory in order to be able to construct coherence at a global/thematic level. In short, integration of information in working memory takes place both at a local and at a global thematic level. However, in some situations, readers do not have enough resources to maintain both local and thematic information in working memory; thus, they face trade-offs, for instance, the low-span readers in Whitney's et al. study. That is, such readers were either able to make-sentence-to-sentence connections or able to focus on the overall theme of the passage.

Overall, the results reported by Whitney, Ritchie and Clark (1991) indicate that individual differences in working memory capacity are related to qualitative differences in text-comprehension processes. This result is corroborated by a study developed by Budd,

Whitney, and Turley (1995). They conducted a series of three experiments to investigate whether readers with different working memory spans would place similar emphasis on theme-specific, detail-specific or relational processing. More specifically, Budd et al. expected that readers would employ three types of processes to retain information in working memory, namely, specific processing of the topic sentence which would lead readers to keep the theme of the passage; specific processing of details which would lead readers to focus on detail information; and relational processing which would lead them to relate details to the theme of the passage. In short, they investigated whether emphasis on each of these three processes would vary with working memory capacity.

Budd, Whitney, and Turley used expository passages with a two-level hierarchical structure, that is, the passages comprised a topic sentence in initial position followed by detail sentences. The topic sentence stated the general theme and was supported by the detail sentences. The passages were displayed on a computer screen and participants could control their reading through a sentence-by-sentence, self-paced procedure. Sentence reading times were measured. In Experiment 1, participants were presented with probe questions on line during reading. In Experiments 2 and 3, researchers measured how long it took participants to read each sentence (topic and detail) and how accurate they were to answers theme and detail questions. In addition, working memory capacity was measured by an adapted version of the Sentence-Word span test developed by Turner and Engle (1989). First, subjects had to read the sentences and judged whether they made sense or not, after rating the sentences, subjects tried to recall the last word of each sentence.

Budd, Whitney, and Turley report the following: in Experiment 1, participants were presented with questions about thematic and detail information and investigated whether readers would keep thematic information in working memory throughout the reading of an expository passage. Results indicate that readers across the range of working memory span

were able to maintain thematic information. In Experiment 2, when thematic processing was made more difficult by deletion of the topic sentence, there was an improvement in thematic processing. For higher-span subjects, this result was an indication of their attempt to construct a thematic statement. However, for lower-span subjects, such improvement in thematic processing resulted in a specific trade-off (see also Whitney et al., 1991, above). That is, when lower-span readers were presented with a more difficult task such as constructing the theme in a topic-absent condition, they had difficulties in retaining details. In short, lower span readers were not able to construct a thematic statement and process specific details concurrently when the task was demanding. The results of Experiments 1 and 2 lend support to the claim that performance differences between higher and lower span readers are not relevant when the comprehension task is easy (Experiment 1). Nevertheless, when the task is difficult, differences are manifest (Experiment 2) (for a similar position, see Just & Carpenter, 1992). In Experiment 3, the main idea statement was explicit and researchers wanted to find out whether readers would adjust their comprehension processes to answer comprehension questions about specific details. Budd et al. found that when retention of details was emphasized, higher span readers reacted by improving thematic processing. It seems that higher span readers were able to use a relational strategy to connect thematic and detail information whereas lower span readers were not able to employ such strategy. Results indicate that thematic processing, retention of thematic information and details improve as the level of working memory span improves.

Two findings reported by Budd, Whitney, and Turley are of particular relevance. First, their results are consistent with the assumption that readers tend to keep thematic propositions in working memory in order to preserve the global coherence of a passage (see also Whitney et al., 1991, van Dijk & Kintsch, 1983). Second, global coherence processes or as Budd et al. put it, “relational thematic processing”, may enhance the retention of details of a text, but this

result was obtained when two conditions were met: (a) the task was made more difficult; and (b) readers possessed sufficient working memory resources. According to the results reported above, lower span readers were not able to improve the retention of details when assigned a difficult comprehension task. These readers might have failed to perform relational processing, that is, they were unable to connect details with the theme in working memory.

#### 2.1.5 Working Memory as an Activated Portion of Long-term Memory.

Besides Just and Carpenter (1992), Cantor and Engle (1993), and Engle, Cantor and Carullo (1992) developed a model which explains individual differences in working memory in terms of a general inherent capacity. On the one hand, their models have similarities: they assume that working memory is a portion of long-term memory temporarily activated above some threshold level, and they explain that individuals differ in the total amount of activation available for coping with cognitive demands. On the other hand, their models differ: (a) Just and Carpenter include a processing efficiency view, while Cantor and Engle, and Engle et al. reject it. (b) Just and Carpenter developed a model of working memory capacity specific to the domain of language, whereas the other researchers do not mention a specific domain.

Engle, Cantor and Carullo (1992) argued against the processing efficiency view and the task-specific hypothesis. They measured the time subjects spent performing the processing component of a version of the Sentence-Word span and the Operation-Word span tasks (Turner & Engle, 1989). In the Operation-Word span task, the processing component of the task is not reading-related, so this type of span task has been used to test whether the relationship between working memory span and reading ability is task-specific or not. Subjects paced themselves through components of each span task by means of a moving window technique, the time between keypresses was recorded. After going through several

sentence-word and operation-word items, subjects tried to recall the final words. The time spent on the processing component of the span tasks (the time spent on sentences or operations) was used as a measure of processing efficiency. According to Engle's predictions, the processing efficiency hypothesis would be supported if the following event occurred: the correlation between the working memory span tasks and the reading comprehension test (Verbal Scholastic Aptitude Test, VSAT) would diminish or disappear when the contribution of the processing component was removed. An analysis of partial correlations revealed that when the contribution of the processing-time-measure was removed, the correlations between the span tasks (Sentence-Word and Operation-Word) and the Verbal Scholastic Aptitude Test were still significant and undiminished. This result was taken as evidence against the processing efficiency view and the task-specific hypothesis. On the other hand, finding that the reading comprehension test correlated with the Operation-Word span and that the correlation remained significant, even when the processing time for the operation was partialled out was taken to support the general capacity hypothesis. From this perspective, the capacity of working memory is domain-free, that is, individual differences in working memory capacity are manifest in demanding cognitive tasks, no matter what the processing domain.

Later, Daneman and Merikle (1996) conceded that Engle and his associates had a point: they accepted that in order to predict reading comprehension, the processing component of the working measure does not need to be reading-related, that is, a math processing component can be used as well. Given that, Daneman seem to have given up the task specific view. Still, Daneman and Merikle assumed that comprehension ability relates to efficiency at processing symbolic information (i.e. words or digits). This assumption is in line with Just and Carpenter's (1992) position, the latter assume that working memory capacity is specific to cognitive domains such as language.

Earlier, Engle and his associates used to investigate whether the working memory system assumed to underlie the reading span task (Daneman & Carpenter, 1980) was specific to language processing or reflected a more general limited-capacity system. More recently, Engle et al. have been investigating the nature of the limitation in capacity that brings about individual differences in working memory span.

Cantor and Engle (1993) make two assumptions about the nature of individual differences in working memory capacity. First, working memory reflects the temporary activation of information retrieved from LTM. Individual differences in working memory capacity are driven by differences in the total amount of LTM activation available to the system for performing cognitive demanding task. In other words, there is a limit to the total amount of activation available to working memory, and high- and low-capacity individuals, as classified on the basis of working memory span tests, differ in their activation limit. Second, the working memory span tests are considered a reliable measure of this limit because of their cognitive demand, that is, such tests demand that subjects switch attention between reading sentences (or solving math strings) and storing words. This attention-switching feature is the key element of working memory span tests. For instance, in the Operation-Word span test, subjects have to solve several math strings before trying to recall the final words. The assumption underlying this test is that for each operation-word pair of a trial, subjects initially focus attention on an operation, and then switch attention to the to-be-remembered word. At this time, they might also retrieve other words of the to-be-remembered set. When a new operation string is presented, it triggers another switch of attention (this time, attention is taken away from the word set to the new operation). Consequently, the activation of the word set tends to go below the working memory threshold. In this case, in order to recall the set of words, Cantor and Engle assumed that subjects would need to retrieve this set from LTM.



Cantor and Engle (1993), on the one hand, and Daneman and Carpenter (1980), on the other hand, propose different explanations of why the working memory span tasks are reliable measures of working memory capacity. As stated just above, Cantor and Engle assume that in the Operation-Word Span test when a new operation string is presented, there is a switch of attention (attention is taken away from the word set to the new operation). In short, according to Cantor and Engle, the attention-switching feature between the processing and storage requirements is the key element of the span task. This assumption is different from Daneman and Carpenter's (1980) earlier position (cited above). The latter claim that the Reading Span test reflects working memory capacity because it taps both processing and storage concurrently. That is, for Daneman and Carpenter, one tries to maintain the words-to-be remembered in working memory while a new sentence is being processed. Given a trade-off between storage and processing, the amount of words that one is able to retain depends on his/her processing efficiency. If one spends less cognitive resources to process the sentences, they should be able to remember more sentence final words. A question can be raised concerning these different assumptions: are they mutually exclusive?

Cantor and Engle (1993) set out to investigate whether working memory capacity relates to a measure presumed to reflect activation limits, namely, the fan effect task. Such task was also meant to be a retrieval task in which participants had both to activate and to retrieve previously learned information from LTM. In order to perform the fan effect task, participants had to learn a set of statements, each statement took the form of "the SUBJECT is in the PLACE" (e.g. the fireman is in the store). Next, participants carried out a speeded verification task in which they verified whether a target statement was a member of the set they had previously learnt or not. The fan effect is manifest because it takes participants more time to verify a statement that has been previously learnt if the subject of that statement is

linked to a range of other statements. In other words, a participant who learnt the set of statements,

the fireman is in the zoo,

the fireman is in the store,

the fireman is in the school,

the artist is in the house,

will take less time to verify that the artist (one statement) is in the house than the fireman (three statements) is in the store. In other words, verification time increases as the fan size increases (fan size is the number of times a subject occurs in the previously learned set with a different place). Verification time was the most important measure to indicate the magnitude of the fan effect. Cantor and Engle predicted that an increase in verification time brought about an increase in fan size would provide a measure of activation limits, which would be related to working memory capacity (as indexed by a version of the Operation-Word span test, Engle et al. 1990, as cited in Cantor & Engle, 1993). Results indicate that high- and low- working memory capacity individuals differed in their fan effect. Low-span participants showed a greater increase in verification time as fan size increased. According to Cantor and Engle, this result suggests that it took longer for low-span participants to retrieve the statements because they have less activation available than did high-span participants. Consequently, low-spans presented much larger fan effects while high-spans presented relatively small fan effects. This result was taken to support the assumption that working memory capacity and LTM activation limits reflect the same underlying construct.

Later, Cantor and Engle's (1993) view (high and low span readers simply differ in the overall level of activation available to the working memory system) ran into difficulties: it was not good enough to explain the nature of the limitation in working memory capacity that gives rise to individual differences. Cantor and Engle's views were elaborated by Conway and

Engle (1994). The latter started to assume that individual differences in working memory capacity arise only when a task is being performed under controlled limited capacity attention, then they set out to investigate such assumption. In fact, Conway and Engle's study (1994) was the first in a series of studies. Since then, Engle and his associates have conducted a set of new experiments, and came to the conclusion that an explanation for individual differences in working memory should also include the ability to control attention (Engle, Kane, & Tuholski, 1999). Some of these latest studies will be cited below.

In fact, the fan task allowed Cantor and Engle (1993) to argue that high and low-span readers differed in performance on a retrieval task. However, Cantor and Engle's fan task was not sensitive enough to distinguish between automatic retrieval from inactive LTM and controlled search from active memory because both the retrieval and the search were involved in the fan task (Engle & Oransky, 1999). More specifically, the verification phase of the fan task comprised two stages: first, participants related the subject of the target to a place and retrieved all the places associated with the subject; second, they searched the already activated (and retrieved) set of information in order to decide whether the target statement belonged to the set or not. Later, Conway and Engle (1994) gave further attention to the distinction between retrieval from inactive LTM and controlled search.

Conway and Engle (1994) set out to investigate whether working memory capacity influences two different types of retrieval. They start their paper by explaining the difference between primary and secondary memory. Briefly, the former was defined as the active portion of LTM, and the latter as the inactive portion of LTM. They compared reaction time performance in primary memory and secondary memory conditions in a memory search task. The experiment comprised a learning stage and a verification stage. During the learning stage, participants had to memorise sets of various sizes (4 sets of 2, 4, 6, 8 letters, and 6 sets of 2, 4, 6, 8, 10, 12 words). The sets contained either unique items (each item belonged to only one

memory set), or overlapping items (each item was a member of two different sets). It was expected that the overlapping condition would lead to a level of interference or response competition during the verification stage. Once participants had memorised these sets, they learned to associate the items in the set with a digit cue that corresponded to the size of the set. During the verification stage, a digit cue and a probe item (letter / word) were presented on a computer screen. Participants read the digit and the probe and then responded by pressing a key to indicate whether the item belonged to the cued set or not. The digit cue was shown either simultaneously with, or 1s. before the onset of the probe item. In the active/primary memory condition, the digit set cues were shown 1s. before the probe item. As a result, participants knew which memory set was being tested before the probe item appeared. In this condition, participants could retrieve the set information and have the set activated in primary memory when the probe item was shown. In order to recognise the item, participants only made a search in active/primary memory. In the inactive/secondary memory condition, the digit cue corresponding to the set size and the probe item were shown simultaneously. As a result, participants did not know which memory set was being tested until they saw the probe item. Under this condition, the appropriate memory set was assumed to be inactive. Therefore, first, the participant had to access and retrieve the appropriate set from inactive/secondary memory; second, they had to make a search to find out whether the probe item matched the digit or not. In short, the difference between secondary memory and primary memory retrieval is the following: the former is a two-stage process comprising the retrieval from inactive state plus the search from active state while the latter is a one-stage process comprising only the search.

Participants were classified as high or low-spans on the basis of their performance on an operation-word span task (La Pointe & Engle, 1990, as cited in Conway & Engle, 1994). Results indicated that low-span subjects were as fast as high span at carrying out the process

necessary for retrieval from inactive/secondary memory. On the basis of this result, Conway and Engle argue that working memory capacity does not play a role in retrieval of well-learned set information from secondary memory. They go on to explain that retrieval from secondary memory is the result of an automatic process, not a controlled, effortful process.

By contrast, working memory played a role in retrieval from primary/active memory but only when there existed a condition of interference or response competition among the items being retrieved. In other words, high and low-span participants differed in their ability to retrieve information from active memory only when there was overlap in set membership. Under this condition, low-span participants were slower to identify whether an item was a member of a cued set or not. Although there seemed to be some slight effect of overlap in set membership for high-span participants, such effect was much stronger for low-span participants.

Under the overlapping condition, each item belonged to two different sets, so the activation from the probe item spread to two sets, the appropriate and the inappropriate set. As a result, there were two competing responses. That is, when sets overlapped, activation spread to irrelevant information, then conflict arose because participants had to choose between the appropriate and the inappropriate set. When there was a conflict between competing responses, high-span readers were better able to use working memory resources to suppress information irrelevant to the task. In other words, suppression consumes working memory resources and high and low-span participants differ in terms of the resources available to them. Participants with greater resources of attention – high spans – have greater capacity for suppressing information that is irrelevant. Conway and Engle also pointed out that because low-span participants were not able to suppress the irrelevant information, they were often faced with conflicting information. This problem possibly led them to make a controlled,

serial search which is quite effortful and resource consuming. As a result, they were slower to identify whether an item was a member of a cued set or not.

High and low-span readers did not differ in retrieval time (from primary memory) when they performed under the no interference condition. This result was taken to indicate that under the latter condition, both high and low-span participants were able to perform the verification task by relying on automatic spread activation. That is, working memory resources were not required for performing the task.

There is a contradiction between the conclusions of the study by Whitney, Ritchie, and Clark (1991, cited above) and the conclusion of the research by Gernsbacher and Faust (1991, as cited in Engle, 1996). Whitney et al. have found that, when processing ambiguous information, high working-memory subjects managed to maintain irrelevant and unnecessary information for a longer period of time than did low working-memory subjects. In contrast, Gernsbacher and Faust have found that subjects who have high comprehension ability managed to suppress irrelevant and unnecessary information faster than did low-comprehension subjects. Because measures of working memory capacity and measures of reading comprehension are highly correlated (Daneman & Carpenter, 1980), it is quite safe to assume that high-comprehension subjects behave similarly to high working-memory subjects.

There are several procedural differences between the two studies: between Whitney et al. (cited above) and Gernsbacher and Faust (1991, as cited in Engle, 1996). As a result, the contradiction might arise from the type of experimental task participants were required to perform. It is noteworthy that Engle and his associates have found a way out of this controversy. According to their framework, a high-capacity subject, or a subject who has a great deal of working memory resources available, is able to keep ambiguous, and irrelevant information available if the task encouraged such a strategy but to suppress the irrelevant information if the task encouraged that strategy. In short, according to Engle, the conclusion

of either study is acceptable, considering that results depend on the specific demands of the experimental task.

#### 2.1.6 Working Memory as the Capacity for Controlled Attention

According to Engle, Kane, and Tuholski (1999), working memory comprises the contents of short-term memory plus some limited-capacity controlled attention. This view is consistent with the one of Baddeley and Logie (1999); however, for the latter, the concept of short-term memory has been incorporated by the slave systems. For Engle et al., the contents of the short-term memory consist of long-term memory traces activated above threshold level. Short-term memory traces are quickly lost through decay or interference. The processes for keeping these traces activated require limited-capacity attention, and such processes are also part of the working memory system. More specifically, according to Engle et al., working memory comprises a short-term store in which long-term memory traces are kept activated, the processes for achieving and keeping these traces activated and controlled attention.

The basic assumption underlying Engle, Kane, and Tuholski's (1999) framework is: they equate 'working memory capacity' with the capacity to control attention. They do not consider the capacity of the entire working memory system, instead, they take into account the specific capability of the (limited-capacity) mechanism responsible for controlling attention. As they put it, " 'working memory capacity' is not really about storage or memory per se, but about the *capacity for controlled, sustained attention in the face of interference and distraction*" (p.104). The capacity for controlled attention in Engle's et al. framework would correspond to capacity of the central executive in Baddeley and Logie's (1999) model, and the capacity of the Supervisory Attentional System in Norman and Shallice's (1986) model (as cited in Shallice & Burgess, 1993).

Engle, Kane and Tuholski (1999) propose that controlled attention is necessary for performing a range of executive functions: (a) maintaining goals activated in working memory, (b) solving conflicts among actions in order to prevent errors, (c) maintaining task information in the face of interference, (d) suppressing information irrelevant to the task, (e) effortful monitoring of errors, (f) effortful searching of memory. They also point out that individual differences in working memory capacity are likely to be manifest during the performance of tasks that tap executive functions because such tasks require controlled attention (see also Rosen & Engle, 1998, p.419, for a similar description of tasks reflecting individual differences in working memory capacity). Below, I describe a series of experiments which lend empirical support to these assumptions.

There are certain parallels between Baddeley and Logie's (1999) views and Engle, Tuholski, Laughlin and Conway's (1999) views: first, the role of the central executive (Baddeley's framework) is said to correspond to the role of the limited-capacity mechanism responsible for controlling attention (Engle's et al. framework). Second, Baddeley and Logie together with Engle et. al have given up the assumption that the central executive stores information, they argue that storage and processing do not share the same pool of resources. Their alternative view is that these cognitive functions are performed by separate components of working memory, the processing/controlling function is supported by the central executive, while the storage is supported by the slave systems in Baddeley's framework, or short-term memory in Engle's et al. framework. The latter assumption challenges Just and Carpenter's (1992) position (storage and capacity share the same pool of resources). Third, Baddeley and Logie have started to postulate executive functions, and Engle, Kane and Tuholski (1999) have made an attempt to specify these functions (cited above).

Despite sharing these views, Baddeley and Logie (1999), on the one hand, and Engle, Tuholski, Laughlin and Conway's (1999), on the other hand, do not take the same approach to



investigate working memory. Baddeley and his associates have made an attempt to separate working memory into component parts, and, lately, they have been investigating the biological implementation of such components. In addition to experimental data, Baddeley's model has also relied on neuropsychological evidence from brain-damaged patients and has recently been supplemented by a range of neuroimaging techniques. Engle's et al. assumptions were based on studies of individual differences. They have conducted several experiments in which they select a task to tap a particular executive function (a task that demands controlled attention), and relate performance on this task to individual differences in working memory span. More recently, Engle's et al. approach has relied on sophisticated statistical calculations such as factorial analysis/ structural equation modelling (Engle, Tuholski, Laughlin & Conway, 1999).

Engle, Tuholski, Laughlin and Conway (1999) set out to investigate whether working memory correlated with general fluid intelligence (gF)<sup>1</sup>. They assumed that working memory comprises the contents of STM plus controlled attention, and conducted an analysis of partial correlations. When they removed the contribution of STM, the remaining link between working memory and gF (which should reflect controlled attention) was sizeable and highly significant. By contrast, when they removed the contribution of controlled attention, the link between STM and gF was not significant. In other words, only the controlled attention correlated with performance on complex fluid intelligence tasks while the short-term memory component did not. On the basis of this result, they claim that the element of working memory which is relevant to higher-level cognitive tasks is controlled attention.

In a series of two experiments, Kane, Bleckely, Conway and Engle (in press) investigate whether the construct controlled attention is a source of individual differences in

---

<sup>1</sup> Engle, Tuholski, Laughlin & Conway (1999) explain that "gF refers to the ability to solve novel problems and adapt to new situations and is thought to be nonverbal and relatively culture free" (p.313).

working memory. In this particular study, they selected a task to tap a particular executive function, namely, the ability to suppress an automatic response so that task goals could be maintained. As stated above, controlled attention is necessary to perform this type of executive-function task. Kane et al. explain what they mean by controlled attention, or executive control capability, “an ability to effectively maintain stimulus, goal or contextual information in an active, easily accessible state in the face of interference, and/or to effectively inhibit goal-irrelevant stimuli or responses” (p.27). Capacity to control attention was measured by performance in an anti saccade task (explained below), and working memory capacity was measured by the Operation - Word span task (La Point & Engle, 1990, as cited in Kane et al.).

In Experiment 1, high and low-span subjects were tested in a prosaccade task (a visual cue was shown in the same position as a target letter that subjects had to identify subsequently to the cue) and in an antisaccade task (a visual cue was shown opposite the target). For the antisaccade task, when the cue indicated a position that did not contain the target, subjects had to move their eyes away from the cue or even prevent their eyes from being caught by the cue, such task requires attentional control. On the other hand, for the prosaccade task, when the cue was shown in the same position as the target, the eyes tended to be automatically drawn to the cued position. In Experiment 1, subjects were presented with an initial prosaccade session, and a final antisaccade session, then the order was inverted.

Given that the prosaccade performance relied on automatic, effortless responses, high and low spans were able to perform equally well, that is, span differences were absent, at least when the prosaccade session was presented first. This finding corroborates the conclusion that individual differences in working memory capacity are manifest only in situations that require controlled attention (for a similar position, see Engle, Kane, & Tuholski, 1999). This position

---

is to some extent consistent with Just and Carpenter's (1992) views as they argue that individual differences in working memory arise in cognitively demanding situations.

When the prosaccade task was the first one performed by subjects, span differences were not found. However, when the prosaccade task was performed second, the antisaccade first, low spans identified the target more slowly than did high spans. This result was considered an indication that low spans had greater difficulty switching from the controlled task (antisaccade) to the more automatic task (prosaccade), as if low spans persevered in the antisaccade task goals (controlled eye movements). In short, low spans' prosaccade performance was disrupted by previous practice on antisaccade trials.

Given that the antisaccade task demanded controlled attention, high and low spans performed differently, that is, high spans identified the targets faster and more accurately than did low spans. In short, high spans were better able to resist to having their attention caught by the cue.

In Experiment 2, subjects performed the target identification task from Experiment 1 while they had their eye movements measured across a long, initial antisaccade session and a shorter, final prosaccade session. Span differences remained regardless of substantial practice over antisaccade trials. Put another way, in both experiments, high span subjects outperformed low spans when identifying visual targets indicated by the antisaccade cues. The antisaccade task presented difficulties for low span subjects who were less able to suppress the automatic eye movements which were at odds with task goals. In short, in a task involving attentional control (the suppression of automatic eye movements), high-span subjects did better than low-span subjects. Kane's et al. major finding is that high spans performed better than low spans in a task requiring controlled attention but not a significant memory load. This finding supports the assumption that individual differences in working

memory do not reflect differences in storage capacity, but differences in the capacity for controlled attention (for a similar position, see Engle, Tuholski, Laughlin & Conway, 1999).

Rosen and Engle (1997) set out to investigate whether individual differences in working memory capacity relate to differences in performances of retrieval tasks. The procedure used to investigate the relationship between working memory and retrieval was to give subjects a category cue (animal names) and ten minutes to recall as many exemplars of that category as possible. The general strategy was to ask high- and low-span subjects to perform retrieval tasks either under a concurrent load condition, or a pre-load condition or no load. The underlying assumption was that individual differences in working memory capacity appear only under the conditions that require control of attention. Specifically, these conditions involve three types of executive functions, namely, self-monitoring of output to prevent repetition and error; suppression of previously retrieved responses, generation of cues to access new names. Subjects were grouped as high or low working memory capacity according to the results of a version of the Operation-Word span test (Turner & Engle, 1989).

The first experiment set out to investigate whether participants who score high on a measure of working memory capacity were able to retrieve more animal names than those who score low on the same measure. In the first experiment, participants performed under no load. Results indicate that high-span participants were able to retrieve more animal names by comparison with the number of animal names retrieved by the low-span participants.

The second experiment set out to investigate how an attention demanding current load would act upon the retrieval of high and low span participants. The assumption underlying this experiment was that a concurrent load would have a negative impact upon a generation task for those participants who employ working memory to generate animal names. Results indicate that the attention-demanding concurrent load had no significant effect on performance of low-span participants. By contrast, the load had a detrimental effect on

performance of the high-span participants. The high-spans who retrieved under load performed significantly worse, that is, the number of animal names that they generated were reduced if compared to the no-load condition, but even so they were able to generate significantly more names than were the low-span participants. In short, a concurrent load had a detrimental effect upon performance of high span participants but no effect upon performance of low-span participants. This result was attributed to the fact that high-span participants might have used working memory resources to generate animal names while low-span participants did not.

It should be noted that the subjects in these experiments were instructed to avoid repeating names. That is, this task required the participants to monitor for previously generated names so as not to say those names again, and the monitoring of such names is itself a drain on attentional resources. Put another way, given the instruction to avoid repetition, both low and high-span participants most likely employed working memory capacity for monitoring. However, monitoring for repetitions might have been particularly demanding for the low-span participants.

The lack of load effects on retrieval for the low-span participants indicated that they failed to employ working memory capacity for generating animal names, that is, for them, generating new animal names was automatic. The most plausible reason why the low-span participants failed to use their working memory capacity for generating names was because monitoring for previously generated names might have been too demanding for them; as a result, the low-span participants had little working memory capacity left to generate animal names. By contrast, load had a detrimental effect upon performance of the high-span participants. This result indicated that they had sufficient working memory capacity for both monitoring and retrieving animal names.

The performance of low span participants was inferior to the high-spans in two ways: in addition to generating fewer names than the high-span participants, the low-spans experienced greater repetition than the high-spans. Because low-spans directed their resources to monitoring; they did not have resources left to suppress previously retrieved responses, thus becoming unable to generate cues in order to access new names. By contrast, only the high-span participants had enough capacity to monitor for repetitions, suppress competing responses, and generate cues to access animal names. To conclude, the ability to monitor, to suppress, and to generate cues, which are attention demanding, are related to differences in working memory capacity.

Experiment three set out to investigate how a memory pre-load would affect retrieval of high and low-span participants. First, Rosen and Engle (1997) had participants learn a list of 12 names until they were able to recall the list correctly. Half of the participants were assigned a list of highly frequently animal names such as bird, dog, etc (related condition). The other half were assigned a list of 12 highly frequent building parts such as window, door, etc. (unrelated condition). After learning the relevant list, participants were instructed to say as many animal names as they could recall in 10 minutes. However, they were told not to mention any of those names learned in the previous list and not to repeat any names.

In Experiment three, it was expected that: (1) recall would be hurt for the related condition; (2) and after the findings of Experiment two, the recall of high-span participants would be more hurt than the recall of the low-span participants; (3) the unrelated condition would function as a control group. As expected, recall was hurt for the high-spans subjects. By contrast, recall of low-span participants was not affected by either pre-load condition (as with the concurrent load condition - Experiment two). Once again, the lack of an effect of load on recall performance of low-span participants suggests that retrieval may have been automatic for them.

Unexpectedly, the reduction in the number of animal names retrieved by the high-spans was almost as great for the unrelated condition as for the related condition. Both were significantly inferior to the control condition from Experiment two. In short, telling participants not to recall items from the previously learned list hurt the recall performance of high-span subjects, regardless of whether or not the list consisted of items from the animal category. This finding suggests that retrieval block was not semantically based.

### 2.1.7 Working Memory Capacity and L2 Performance

L2 reading performance. Harrington and Sawyer (1992) set out to investigate the relationship between working memory capacity and L2 reading performance. Working memory capacity was measured by a modified version of the Reading Span test in L1 and L2, and L2 reading performance was measured by the Reading and Grammar sessions of the TOEFL (Test of English as a Foreign Language). In addition, the traditional word and digit span tests were conducted in L1 and L2. These tests were given to a group of Japanese advanced learners of English. Harrington and Sawyer's results indicated that the mean scores for the L1 word/digit span tests were significantly higher than the L2 scores. However, there was no difference between mean scores for the L1 and L2 reading span tests. They also reported that the correlation between the reading span tests across the two languages was relatively low. Most importantly, Harrington and Sawyer found a strong correlation between L2 reading span and L2 reading performance (TOEFL). By contrast, L2 word/digit span tests did not correlate significantly with L2 reading performance. This finding agrees with a number of correlational studies in L1 showing that working memory capacity, as measured by the Reading Span Test, is a good predictor of L1 reading performance while traditional span measures are not. Moreover, Harrington and Sawyer's results lend support to the

interpretation of the Daneman and Carpenter's span task as a valid measure of working memory capacity even when the experimental task is conducted in L2.

Another study corroborates to the conclusion that working memory capacity is related to L2 reading comprehension. Yoshida (2000) sets out to examine whether working memory capacity, as measured by the Reading Span test in L2, correlated with inference generation in L2. She tested a group of Japanese learners of English at university level. First, her subjects read two passages in English, second, verbal protocols were collected and scored for two types of inference: bridging inferences (which serve to establish textual coherence), and elaborative inferences (which are not required to establish textual coherence but serve to improve a textual representation). Her results indicated that high-span readers generated more inferences, in particular, elaborative inferences while low-span readers generated fewer inferences. In addition, for low-span readers, the two types of inferences were more evenly distributed. On the basis of these results, she argued that higher-span readers have adequate working memory resources to perform the global processes of text integration whereas low-span readers focus on local coherence, thus forming textual representations which are loosely integrated.

L2 performance. Berquist (1997) examined the relationship between working memory capacity and L2 proficiency. Working memory capacity was measured by an adapted version of the Reading Span Test in L1 and L2. A cloze task was also added to the reading span test in order to make sure that subjects were actively processing the sentences. Proficiency was measured by performance on the Reading and Listening sessions of the TOEIC (Test of English for International Communication), in addition, the traditional word span test was conducted in L1 and L2. These tests were given to a group of native speakers of French, advanced learners of English. Results indicated that the mean scores for the L1 word span test, and the L1 reading span test were significantly higher than were the L2 scores.



Harrington and Sawyer found similar differences between L1 and L2 word span scores, but no significant differences between L1 and L2 reading span scores. Berquist reported that the following correlations were significant: between the word span tests across the two languages, between the reading span tests across the two languages, between all memory spans and L2 proficiency (TOEIC). Unexpectedly, results revealed that L2 word span was more strongly correlated with L2 proficiency than was L2 reading span. This finding contradicts a number of studies showing that traditional span measures are not good predictors of complex cognitive skills. Moreover, the L2 cloze task, a subscore of the L2 reading span test, yielded the highest correlation with L2 proficiency. This cloze task was assigned in order to impose heavier processing demands. Given this result, he went on to argue that working memory, as indexed in L2, is related to L2 proficiency, and is best explained in terms of processing efficiency, rather than in terms of a fixed inherent capacity.

A recent study, which is not particularly concerned with reading comprehension, yielded interesting findings. Miyake and Friedman (1998) investigated the relationship among four variables, individual differences in working memory capacity, indexed in L1 and L2, syntactic comprehension, and the acquisition of appropriate linguistic cues in L2. They explained that native speakers of different languages rely on different linguistic cues, namely word order, morphological agreement, case marking, animacy. For instance, while native speakers of English rely on word order, native speakers of Japanese take advantage of case markings. Miyake and Friedman's subjects were Japanese advanced learners of English. Regardless of their level of proficiency, native speakers of Japanese may have difficulty in adjusting their cue preferences to understand English syntax.

Working memory was measured by a listening span test in L1 and L2, and two other tests were applied, a syntactic comprehension test, and an agent identification task in L2. This latter test assessed to what extent participant's cue preferences were native-like. This study

differs from the ones above because the authors went beyond correlational results. They used a statistical technique (path analysis) that allowed them to track causal relationships among the four variables. Their results indicate the following: working memory (indexed in L1) determines working memory (indexed in L2); working memory (indexed in L2) determines cue preferences in L2; working memory (indexed L2) together with cue preferences affect syntactic comprehension in L2; and working memory (indexed in L2) directly affects syntactic comprehension in L2. On the basis of these results, they argue that larger-capacity learners have less difficulty in acquiring L2 cues than do smaller-capacity learners, and less difficulty in coping with the cognitive demands of syntactic comprehension in L2, at least this seems to be true for Miyake and Friedman's proficient L2 learners.

There is another study, which is not particularly concerned with reading comprehension, but made an important contribution to the field. Fortkamp (2000) found a relationship between working memory capacity and L2 speech production. Working memory capacity was measured by the Speaking Span Test (Daneman, 1991, as cited in Fortkamp, 2000) in L2, and speech production was obtained by a picture description task and a narrative task. Fortkamp took into account four aspects of L2 speech production, namely fluency, accuracy, complexity, and weighted lexical density. In both tasks, she found a positive correlation between working memory capacity and fluency, accuracy, and complexity, and, against her predictions, a negative correlation between working memory and weighted lexical density. After computing a linear regression analysis, she confirmed that working memory capacity is in fact a good predictor of fluency, accuracy and complexity in L2 speech production. These results support her assumption that higher-capacity individuals are better able to generate L2 speech which is fast and continuous, free of lexico-grammatical errors, and complex in a picture description task and a narrative task. She also explains that these four aspects of speech production reflect the processes which occur during the grammatical

encoding of the message. Grammatical encoding is interpreted as a cognitive task that requires the control of attention. She concludes that individual differences in working memory capacity are related to L2 speech production at the level of grammatical encoding, thus being related to the ability to control attention.

#### 2.1.8 A Gap in the Research Relating Working Memory Capacity to L2 Reading Performance.

As cited above, there have been some attempts to relate individual differences in working memory capacity to L2 reading performance. However, some of these studies have limitations: Harrington and Sawyer (1992) took performance on the TOEFL (Test of English as a Foreign Language) Reading and Grammar sections as general measures of L2 reading skill. This kind of measure does not offer insights into how the specific reading processes (decoding, lexical access, parsing, inferencing, and integrating) relate to memory capacity. Harrington and Sawyer argue that there is a need for studies which investigate this relation more carefully.

Our conclusion is that although there are some studies concerned with individual differences in working memory, as measured in L2, there is still a great deal of room for research: Berquist (1997), Harrington and Sawyer (1992), and Yoshida (2000) explain individual differences in working memory capacity in terms of reader's processing efficiency. Miyake and Friedman explain individual differences in working memory capacity in terms of an overall supply of resources which constrains language comprehension. Although all these assumptions are reasonable, none of these authors have included ability to control attention as a possible explanation for individual differences in working memory capacity (indexed in L2). It is true that Fortkamp (2000) goes a step beyond these former studies, explaining that L2

speech production at the level of grammatical encoding involves the ability to control attention, and relating speech production to individual differences in working memory capacity. However, Fortkamp is particularly concerned with speech production, she does not focus on reading comprehension.

Working memory capacity as measured in L1 and in L2. Miyake and Friedman (1998) argue that WM capacity, as measured in L1, bears a close relation to WM capacity, as measured in L2 ( $r = .58$ ,  $p < .01$ ). Furthermore, they seem to assume that working memory, as indexed in L1 and L2, draws upon the same pool of resources, at least this might be true for their advanced participants. They cite other researchers such as M. Osaka, N. Osaka, and Groner (1993) who share this same view. Although these results are certainly promising, they are not conclusive. Berquist (1997) and Mota (1995) found a significant correlation between reading span measures across languages, but they do not go so far as to say that the two measures are closely related. Harrington and Sawyer (1992) found only a moderate correlation between the reading span measures across the two languages ( $r = .39$ ,  $p < .05$ ). Given these differences, the relationship between working memory as indexed in L1 and L2 deserves further investigation.

Still, interesting questions remain in the present context: to what extent the advantages a reader has in working memory capacity, as measured in L1, will also be transferred to L2, or to what extent memory capacity will vary according to reader's proficiency in L2. These questions were raised by Harrington and Sawyer in 1992, but time has gone by and they are still relevant. It would be interesting to observe L2 learners over a period of time in order to investigate to what extent working memory capacity (indexed L2) improves as a function of improvement in language proficiency. To my knowledge, no longitudinal study has ever been carried out.

### 2.1.9 Working Memory: General Discussion

The present review started by mentioning an example which has often been used to illustrate the function of the traditional short-term-memory (the storage of a telephone number between the time that a person looks up the number in a directory and the time that the person dials it). This example does not serve to illustrate the function of working memory as it is conceived by the most recent models. According to the research reported above, nowadays, working memory is not for storage per se, but, rather, it has a key role in the performance of complex cognitive tasks (Miyake & Shah, 1999; among others). Even phonological short-term memory (or phonological loop as Baddeley and Logie, 1999, conceive it), which used to be considered as a system specialised for the temporary maintenance of speech-based information, has been assigned a more elaborate role.

Two different approaches have been mentioned: on the one hand, Baddeley and his associates have tried to specify the component parts of working memory. Lately, they have been investigating the biological implementation of such components. It is noteworthy that although Baddeley's approach is apparently structural, he does not describe the components of working memory as separate boxes located at a specific place in the brain. In fact, his approach is not as structural as it may seem to be. Baddeley and Logie (1999) accept that one of the functions of the working memory system is maintenance of long-term knowledge. That is, according to their views, although working memory and long-term memory are separate constructs, the contents of working memory may also include LTM information activated above some threshold level kept through the slave systems.

Another approach investigates the role of working memory in cognitive tasks. More specifically, this is an approach to individual differences, that is, researchers attempt to find a relationship between individual differences in a working memory task and performance on

complex cognitive tasks (Engle, Tuholski, Laughlin & Conway, 1999; Kane, Bleckely, Conway & Engle, in press; among others). Other researchers who also subscribe to the approach to individual differences have focused on the relationship between individual differences in working memory capacity and reading comprehension performance (Just & Carpenter, 1992; Tomitch, 1995, 1996, 1998; 2000; among others).

The researchers who investigate working memory capacity from an individual differences perspective failed to reach a consensus about several issues: it has been a matter of debate whether the working memory system assumed to underlie the Reading Span task (Daneman & Carpenter, 1980) was specific to language processing or reflected a more general limited-capacity system. On the one hand, Daneman and Carpenter (1980) argued that the capacity of working memory relied on a person's processing efficiency at the specific task to which working memory was being related. On the other hand, this view was challenged by Turner and Engle (1989) and by Engle, Cantor and Carullo (1992). The latter group argued against the processing efficiency view and the task-specific hypothesis. Lately, Miyake and Shah (1999) have wisely suggested that a dichotomous view is an oversimplification. In fact, although working memory might be constrained by a general capacity, it is reasonable to assume: (a) the existence of domain specific buffers, (b) the fact that specific skills contribute to working memory performance.

More recently, Engle and his associates have given up the debate between processing efficiency and domain-free views. They have changed the focus of their investigation and went on to examine the nature of the limitation in capacity that brings about individual differences in working memory span.

Cantor and Engle (1993) argued that high and low-span readers differed in the overall level of activation available to the working memory system for performing cognitively demanding task. However, this assumption was not good enough to explain the nature of the

limitation in working memory capacity. Cantor and Engle's views were elaborated by Conway and Engle (1994). The latter started to assume that individual differences in working memory capacity arise only when a task is being performed under controlled limited capacity attention.

Lately, Engle and his associates have argued that it is the ability to "control attention" that mediates the correlation between working memory span and complex cognitive tasks. What Engle has done is to select a task which taps one executive function (i.e. monitoring and updating of the content of working memory; inhibition and suppression of prepotent responses; switching attention between tasks) then investigates how this task relates to individual differences in working memory span (see Kane, Bleckely, Conway & Engle, in press; Rosen & Engle, 1997; Rosen & Engle, 1998). Miyake and Shah (1999) point to the need of better specifying these executive functions and carefully selecting tasks that tap them. In addition, a new research question has been raised concerning the executive functioning: whether these executive functions are independent from each other or whether they reflect a common underlying system. Miyake, Friedman, Emerson, Witzki, and Howerter (2000) did not seem to have provided a definite answer to such question.

Another earlier assumption has been disputed. Just and Carpenter (1992) explained that working memory in their conception would correspond to the central executive in Baddeley's model, and the central executive would perform both the storage and the processing functions of working memory. However, Baddeley and Logie (1999) together with Engle, Tuholski, Laughlin and Conway (1999) have given up the assumption that the central executive stores information, they argue that storage and processing do not share the same pool of resources. Their alternative view is that these cognitive functions are performed by separate components of working memory. Still, an important research question is to what extent the maintenance function and the executive control function are separable (Miyake &

Shah, 1999). Isn't goal maintenance in working memory essential for the proper execution of some complex cognitive tasks?

There is also an apparent contradiction between the conclusions of the study by Whitney, Ritchie, and Clark (1991, cited above) and the conclusion of the research by Gernsbacher and Faust (1991, as cited in Engle, 1996). Whitney et al. have found that, when processing ambiguous information, high working-memory subjects managed to maintain irrelevant and unnecessary information for a longer period of time than did low working-memory subjects. In contrast, Gernsbacher and Faust have found that subjects who have high comprehension ability managed to suppress irrelevant and unnecessary information faster than did low-comprehension subjects. Engle and his associates have found a way out of this controversy: according to them, the conclusion of either study is acceptable, considering that results depend on the specific demands of the experimental task.

Following the individual difference perspective, a great deal of studies have investigated the relationship between working memory capacity and L1 reading performance (Daneman & Carpenter, 1980, 1983; Tomitch, 1995, 1996, 1998, 2000a; among others). On the other hand, studies relating working memory to L2 reading are scarce. Indeed, not only are these studies scarce, but some of them also have limitations, for instance, they have used general measures of reading skill (Harrington & Sawyer, 1992). This type of measure does not offer insights into how the specific reading processes relate to working memory capacity. In addition, the studies relating working memory capacity to L2 reading have explained limitations in working memory capacity in terms of processing efficiency, which may be quite reasonable, but it is also important to attempt to investigate beyond the processing efficiency explanation. Given this gap in L2 reading research, there is room for studies, (a) which examine the relationship between working memory capacity and the specific reading



processes such as the task of main idea construction, (b) which confirm working memory capacity as an explanatory construct in L2 reading comprehension.

## 2.2 On Main Idea Construction

### 2.2.1 Models of Reading and Assignment of Importance to Information

The present section explains how different models of reading predict recall, assignment of importance, and establishment of coherence. It presents a distinction between the model of text comprehension proposed by Kintsch and van Dijk (1978), van Dijk and Kintsch (1983), Kintsch (1998), on the one hand, and the model proposed by Trabasso and Suh (1993), Trabasso, Suh, Payton, and Jain (1995), on other hand.

According to Kintsch and van Dijk (1978), at a local or micro level, the ideas in a text are represented as propositions consisting of a predicate and arguments. Predicates “may be realized in the surface structure as verbs, adjectives, adverbs, and sentence connectives” (p.367). In Kintsch and van Dijk’s model, propositions are arranged into a hierarchy (this type of arrangement implies that some propositions are more important than others), and comprehension depends on reader’s ability to establish referential coherence among these propositions. Referential coherence is determined by argument overlap among the propositions within the text. That is, the propositions are processed in a series of cycles with propositions in a sentence usually processed together. At each new reading cycle, readers connect the incoming propositions to those already existing in a short-term memory buffer through argument overlap. If readers are able to make the connections, the text turns out to be referentially coherent and easily comprehended. However, if readers fail to make connections between an incoming proposition and those already in short-term memory, then a proposition

from a previous cycle will be reinstated. If there is no argument overlap with any previous proposition in the text, readers will make an inference. When readers need to make either a reinstatement or an inference, comprehension difficulties may arise in that particular cycle. Both reinstatement and inferences are assumed to be resource-consuming operations. At the end of the cycle, some of the propositions will be carried over in short-term memory so that readers can connect them to propositions in the next cycle. The carry-over enables readers to construct coherence. A proposition that is carried the longest in the short-term-memory buffer and has the largest number of connections to other propositions is more likely to be recalled later. Selecting what information is kept in memory depends on a combination of how important the proposition is to text hierarchy and recency of information.

In addition to this micro-propositional level, a macro level has also been assumed by Kintsch and van Dijk (1978). Briefly, their model consists of a unit (a proposition); a larger structure constructed out of these propositions; the hierarchical relationship between these propositions; and a larger macrostructure at a global level. For the time being, only the micro-level has been described, but the macro-level of the model will be further discussed further below.

The second model described in this study has been proposed by Trabasso and his colleagues (Magliano, Trabasso & Graesser, 1999; Trabasso, Suh, Payton, Jain, 1995; Trabasso & Magliano, 1996; Trabasso & Suh, 1993). As they put it, one important way to achieve coherence in narrative texts is through establishing causal relations between sentences, e.g. a goal is usually related to an outcome: goal – “Betty really wanted to give her mother a birthday present”; outcome – “Betty gave the sweater to her mother” (Trabasso & Suh, 1993, p.7). More specifically, comprehension involves connecting incoming events, actions, and outcomes to the causal antecedents of these events, and actions, then these connections will contribute to the formation of causal chains at a global level. According to

this model, two variables determine the importance of a text unit: the first variable, the number of causal relationships that a text unit has with other units in the text, the more causal relationships a particular unit has with other units the more important it will be considered and the better it will be recalled. The second variable, whether the unit belongs to the causal chain or not. If a unit of text belongs to a continuous chain of causal events that connects the opening event to the final outcome, it will be considered more important and will be better recalled than if does not belong to this chain.

To test their assumptions, Trabasso and Magliano (1996) collected verbal protocols, and proposed a taxonomy for the mental operations that seem to occur in working memory while readers try to understand the information that is coming in – these operations were identified in the think-aloud protocols. The taxonomy is functional, and the functions of the mental operations are: to activate relevant world knowledge in working memory; to maintain information in working memory; to retrieve information either from prior parts of the text or from long-term memory representation of the text. It seems that activating world knowledge requires fewer working memory resources than reinstating prior information from the long-term memory representation. This may happen because world knowledge tends to be passively activated during the normal course of reading. These memory operations enable readers to make causal inferences. Trabasso and Magliano identified a particular type of backward inference which is concerned with the reasons why something occurs. This type of inference has been classified as explanation and has a major role in allowing readers to generate textual coherence. Indeed, the working memory operations maintain the information readers use to explain and to integrate the incoming event or action into the causal chain. Coherence is reached if higher order goal information is kept available in working memory by means of retrieval or maintenance, higher order goal information is used to explain the subsequent events, actions and outcomes of a plan in narrative texts.

The models described above are different in a number of ways. Although it is not the aim of the present study to compare, test, or judge which is the best model, I will mention some of their differences: (a) Kintsch and van Dijk (1978) assume that coherence is referentially based and is reached through argument overlap; lately, Kintsch (1998) has argued coherence can no longer be considered simply in terms of argument repetition. The activation of relevant knowledge can generate coherence, and the application of macrorules (described below) also serve to generate coherence and construct inferences. The other researchers, Trabasso and Suh (1993), assume that causal relations between sentences are the major source of coherence. (b) Because these models rely on different sources of coherence, the variables which predict recall and assignment of importance are also different: for Kintsch and van Dijk, recall and importance judgements are determined by how long information remains in the short-term buffer across different cycles and importance in text hierarchy, whereas for Trabasso and Suh, recall and importance are predicted by whether or not a text unit belongs to a causal chain and by the number of causal connections the unit has. (c) Text analysis is based on units of different sizes, Kintsch and van Dijk take propositions as the unit of text analysis while Trabasso and Suh's analysis is based on clause length units. This difference may be necessary because individual propositions may be too small to determine causal relations while clause length units may be too large to establish the several levels of the hierarchical relationships which is characteristic of the referential model (Mills, Diehl, Birkmire & Mou, 1993).

Experimental data have provided support for both models, and each of them has given a major contribution to research on text comprehension. For instance, Trabasso's model is quite suitable to explain how readers construct coherence in narrative texts, or in procedural texts in which there are many relationships in the form of the steps and procedures (Mills et al., 1993). In addition, earlier research (Fletcher, 1986) is consistent with the position of

Trabasso and his colleagues. Fletcher argued that in narrative texts, it is worth keeping character's plans and goals in short term memory, because this type of information might lead them to make causal inferences, which have a crucial role in comprehension. Despite the fact that both models are respected and, in our view, might even be complementary, the present study tends to draw upon Kintsch and van Dijk (1978), van Dijk and Kintsch (1983), Kintsch (1998). The reasons for that are the following: Trabasso and his group have been working with comprehension of narrative texts, and the present investigation is concerned with comprehension of expository texts. Second, one aspect of Kintsch and van Dijk's model is of particular relevance to the concept of main idea, that is, the construction of macrostructures (cited below).

Things have changed since Kintsch and van Dijk's (1978) model. Although the basic framework of the model remains the same (the propositional representation, the distinction between the micro-and macrostructure, the cyclical processing), the model has evolved.

It is noteworthy that, in their earlier model, Kintsch and van Dijk (1978) did not mention the term working memory, they mentioned the term short-term memory buffer. This was a limited-capacity buffer, which had a key role in the model: their assumption was that only those propositions that coexisted in the limited-capacity memory could be connected to each other. "The buffer was the bridge in the model between processing cycles that permitted the formation of a coherent mental representation of the text, which had to be processed sentence by sentence" (Kintsch, 1998, p.234). In a latest update of the model, Kintsch (1998) has modified this earlier position in some important aspects. One of his arguments is that comprehension may take place without a short-term memory buffer. Still, the buffer may be used in comprehension as an aid to working memory, for instance, it allows readers to form a more coherent text-base (the micro-propositional level). Kintsch (1998) argues that working

memory is the alternative mechanism for the construction of coherence through enabling readers to link text elements from different processing cycles. As he puts it:

...working memory is like a spotlight that moves across a text, sentence by sentence, constructing and integrating a mental representation in the process. The representation that results from this cyclical process is a coherent structure and not a sequence of disjoint structures, each corresponding to a sentence. (p.102)

According to Kintsch's (1998) latter perspective, working memory is an activated portion of long-term memory. In fact, he puts forth a theory of "long-term working memory", this theory hypothesizes that "individual differences in comprehension may be the result of skill and knowledge differences" (p.238). In the present study, it is granted that one of the roles of working memory is retrieval of long-term knowledge relevant to the task at hand, in addition, it is assumed that the scope of working memory is beyond that of being an activated portion of LTM (see also Baddeley & Logie, 1999).

Another innovation of Kintsch's (1998) present model is that there has been a shift from a schema-based control model to a bottom-up model. Traditionally, the process of understanding was considered to be under the rigid control of a schema that guided it. In other words, a schema was viewed as a control structure that regulated the comprehension process in a top-down manner (Schank & Abelson, 1977, as cited in Kintsch, 1998). More recently, Kintsch has argued that the outcome of comprehension does not stem from forcing comprehension into a pre-existing schema. According to his present model, comprehension is viewed as "...a loosely structured, bottom-up process that is highly sensitive to context and that flexibly adjusts to shifts in the environment" (p. 94). According to the latter view, comprehension tends to be quite chaotic in its initial stages, and becomes orderly only when it

reaches the level of consciousness. Comprehension is modelled by a construction process that is weakly controlled and initially takes place largely in bottom-up manner and then is followed by a constraint satisfaction process, that is, comprehension takes place when and if the elements that take part into the process reach a stable state in which the majority of elements are meaningfully related to one another and other elements that fail to fit the pattern of the majority are suppressed so that a stable configuration will be reached. Still, this is not to say that knowledge does not have a role in comprehension (this point will be discussed below).

### 2.2.2 Defining the Term Main Ideas

Cunningham and Moore (1986), Matos (1999), Tomitch (2000b), Williams (1988), Winograd and Bridge (1986) have argued that there seems to be little consensus among theorists as to the definition of the term ‘main ideas’. Williams has raised the following point: researchers, teachers, and readers may fail to consider the differences that exist among text types. In fact, what is important tends to be different in each genre<sup>2</sup>. For instance, in narrative texts, the important information is concerned with what happened in the story, and why. In argumentative texts, the important information tends to be the author’s thesis and the argument in support of this thesis. Given that, the definition of term main idea should be specific to each genre (Williams, 1988). In addition, although the principles of main idea

---

<sup>2</sup> It is beyond the scope of this study to provide a thorough definition of genre. We follow Swales (1990) and consider that a definition of genre comprises a communicative purpose and a conventional schematic structure. As Swales put it, “a genre comprises a class of communicative events, the members of which share some set of communicative purposes. These purposes are recognised by experts members of the parent discourse community, and thereby constitute the rationale for a genre. This rationale shapes the schematic structure of the discourse and influences and constrains choice of content and style”(p.58)

construction may be quite general, the construction of main idea in each genre may require some particular knowledge and strategies (Kintsch, 1998).

Cunningham and Moore (1986) explain that the term main idea is a general label, an umbrella term, and encompasses several terms such as key-word, summary, title, thesis, and theme. According to these authors, all these terms can be taken as the main idea for a text because they identify the important information from a particular perspective. If researchers or teachers want to evaluate whether a given response can be accepted as the main idea for a text, first, it is necessary to specify to which category the response belongs, that is, whether it is a key-word, summary, etc. then evaluate whether the response is an acceptable member of its category.

Cunningham and Moore (1986) have also argued that categories of main idea responses such as title and thesis are ideas that the author considers important from his/her perspective. However, the reader may have his/her own point of view and may be reading with a particular purpose in mind that differs from the author's perspective, that is, the main ideas can be controlled by the reader's intentions and by the task the reader has been assigned. A similar point has been raised by van Dijk and Kintsch (1983). The latter makes a distinction between contextually and textually important information. Textually important information takes into account the author's point of view. A well-written text is signalled and organised so as to communicate to the reader what the author considers important. Contextually important information is regarded as important by the reader for several reasons such as personal interest, and background knowledge. It is noteworthy that textual and contextual importance may coincide or differ; in addition, the reader may use textual or contextual criteria flexibly so as to suit his/her needs. Throughout this study, main idea refers to those ideas the author of the text signals as important (textual importance).



In addition to this lack of consensus on what the term main idea means, researchers in the field also face other difficulties (Winograd & Bridge, 1986). That is, they should choose what type of text they will investigate, how to establish a criteria to identify the main ideas in this particular text type, how to evaluate comprehension of those ideas that they have identified as main ideas, and what would be the experimental task suitable to evaluate the comprehension of main ideas.

According to Winograd and Bridge (1986), what type of text to use and how to identify the main idea are interrelated questions. When researchers choose texts which consist of only one paragraph, the topic sentence is often chosen as the main idea. When they choose longer texts, narratives or expositions, they often use two criterion to identify the main ideas: (a) fluent readers rate text information according to how they perceived importance (Johnson, 1970, as cited in Winograd & Bridge), (b) researchers conduct a formal analysis of the text structure (Meyer, Brandt & Bluth, 1980). In the present study, we will stick to the latter criteria.

It seems that experienced readers are better able to remember the main ideas in a text (Winograd & Bridge, 1986), or “superordinate” ideas to use van Dijk and Kintsch’s (1983) term. The question that has constantly been addressed is how these readers identify the main ideas. Tomitch (2000b) explains that experienced readers are often able to construct the main ideas of a text and to reach an agreement on what information is important; however, it is difficult for them to explain how they identify these ideas. Put another way, they seem to have procedural knowledge, that is, they know how to identify main ideas, but it is difficult for them to verbalize how they do it.

Winograd and Bridge (1986) point out that there are two possible ways to identify main ideas: first, experienced readers have acquired prior knowledge about several topics and several types of text structure; as a result, they become better able to distinguish between

important and “subordinate” information (in van Dijk and Kintsch’s, 1983, words). Second, authors provide signals in order to mark and emphasize the information that they want to present as important. The two possibilities are compatible: as readers become more experienced, they improve their knowledge of the word and of text content and structure; consequently, they become better able to identify the signals and the cues provided by the authors and also better able to use textual structure in order to organize the information they receive so as to construct a coherent textual representation.

In written texts, different types of signals are used to mark those ideas that the author considers important at a local level. There are graphical, syntactical, lexical and structural signals (Kintsch, 1998; van Dijk & Kintsch, 1983): graphical signals include type size, italics, etc.; syntactical signals consist of the passive voice, word order and other devices which might contribute to foreground and topicalize information; lexical signals include words such as ‘important’, ‘relevant’, ‘to conclude’, ‘the main...’, and repetition of key words; structural signals comprise titles, initial topic sentences, and summary statements. Although such signals are often used to indicate importance at a local level, they might achieve relevance at a global level through cumulative effect. In addition to these local signals, Kintsch (1998) also argues that the rhetorical organisation of the text at a global level may also lead readers to identify the main ideas. Experienced readers formulate hypothesis about the rhetorical organisation of the text (superstructure), such hypotheses will help them identify the rhetorical organisation and make predictions about how the information is organised. For instance, the reader may recognise that an expository texts presents a particular structure such as that of problem-solution and thus anticipate that the author will mention possible solutions to a problem. In addition, the reader might be able to integrate parts of the text together to form a coherent text representation; as a result, the reader may be able to recall the text as the gist of the important information organized comparably to the organization of the text. To conclude,

in order to identify main ideas readers use local signals, prior knowledge about the rhetorical structures of the text, and prior knowledge about the content of the text (see also Chamblis, 1995).

If the author does not use signals to cue the main ideas, the reader makes inferences about these main ideas and the relationship between them. It is important to make a distinction between those texts which present the main idea explicitly, and those ones which do not contain an explicit main idea statement. If the main idea is not explicit, readers cannot identify or select the main idea from those statements available in the text. As a result, they make an effort to construct it, assess it for adequacy, and attempt to update it if incoming information does not match their initial hypothesis (Afflerbach, 1990b; Budd, Whitney & Turley, 1995).

Winograd and Bridge (1986) point out another difficulty faced by researchers: the comprehension task assigned to participants. The task to be fulfilled and instructions received by participants might have an effect on the results of an experiment. For instance, Riley and Lee (1996) conducted an experiment in which half of the participants were asked to read a passage and to write a summary of it and another half were asked to read the passage and to recall it. Their results indicate that there are significant qualitative differences between the performance of two tasks: the summary protocols contained significantly more main ideas than the recall protocols. In addition, the summary protocols contained a higher percentage of main ideas than details while the recall protocols contained a higher percentage of details than main ideas. In short, Riley and Lee concluded that subjects writing summaries tended to produce more of the important information and to write a more coherent reconstruction of the passage than the readers instructed to recall the text. By contrast, the recall task may encourage the reader to treat information as equally important rather than encourage a more

qualitative interaction with the text where emphasis is placed on integrating the information and focusing on the main ideas.

To conclude, Winograd and Bridge (1986) argue that both researchers and teachers need to take into account a great deal of factors to define the term main idea and to establish some criteria to evaluate the comprehension of main ideas (see Matos, 1999, for a comprehensive review). Among such factors they cited: different types of local signals, the rhetorical organisation of the text, and the task to be fulfilled by the reader. It is also important to specify whether the term main idea is related to contextual or textual importance.

Winograd and Bridge's (1986) position is also consistent with the views of other researchers, for instance, Schellings and Van Hout-Wolters (1995). The latter mention three approaches to define the term main ideas, namely a linguistic approach which is based on the assumption that the text structure will signal what its main ideas are; a cognitive psychological approach which takes into account reader's variables such as personal goals, interests, and prior knowledge (in the present study, it is argued that working memory capacity is one of the variables related to the reader); and an educational approach which regards the main ideas in a instructional text as related to instructional variables such as task demands, test questions asked by the teacher, and instructional objectives. According to Schellings and Van Hout-Wolters, the linguistic approach has been mostly employed in research where students are instructed to identify or infer the main idea from a text (see also Brown & Day, 1983).

As stated above, the expression main ideas can take several forms. In the present investigation we understand as main ideas as the macrostructure of the text (Kintsch & van Dijk 1978; van Dijk & Kintsch, 1983; Kintsch, 1998). This macrostructure is described as a summary/gist of the contents of the text constructed through the application of macrorules. To put it another way, texts have a microstructure (local structure) and a macrostructure (global

structure) (Kintsch, 1998). As stated above, the microstructure of a text comprises its constituent propositions and their relationships. The macrostructure condenses the propositions of the microstructure into a hierarchical structure. That is, readers extract the macrostructure from the available text microstructure, they are able to perform this operation by applying macrorules. These rules serve to condense the micropropositions of a text base into a set of macropropositions that represent the gist of the text. They are applied according to readers' goals, and the rhetorical structure of text.

The macrorules are the following (van Dijk & Kintsch, 1983; Kintsch, 1998): (a) readers apply a selection rule to delete redundant, irrelevant propositions, or propositions that are not a necessary condition for interpreting other propositions; (b) readers apply a generalisation rule to replace a sequence of propositions by an umbrella proposition, which encompasses the whole sequence. For instance, propositions that contain a list of items such as knives, forks, spoons may be replaced by a proposition that contains the term silverware; (c) readers apply a construction rule to replace a sequence of propositions by a new inferred proposition derived from the sequence. To sum up, the macrorules are used for reducing a text into its macrostructure, applying them readers select the ideas that are important in the hierarchy and also condense them. Macrorules can be applied recursively to micropropositions as well to macropropositions. It follows that the resultant macrostructure is hierarchical, and composed of more than one level. What matters for reading comprehension, the main idea of a text, is formally represented by the macrostructure.

According to Kintsch (1998), readers tend to construct the macrostructure or abstract the main idea from the text automatically as an integral part of comprehension. As stated above, macrostructure construction does not occur blindly. That is, macrostructure construction to some extent relies on reader's schematic knowledge about some highly conventionalized types of text, "rhetorical superstructures" (Kintsch 1998, p. 68), see also

Carrell's (1985) formal schemata. On the other hand, we shall not consider that macrostructure construction results from forcing comprehension into a pre-existing, rigid schema. In fact, in his latest update of the model, Kintsch conceives comprehension as a process which is "sensitive to context" and adjusts itself to changes in the environment (p.94). In addition, reader's goals also control the application of macrorules, if reader's goals are vague, if the text does not present a conventionalized rhetorical structure, or if the reader fails to recognize the structure, readers might even be able to construct a macrostructure, but this macrostructure will not be predicted by text structure. van Dijk and Kintsch (1983), explain their proposal:

Each reader, with particular goals and knowledge background, interacts with the text in a new way producing a different macrostructure. The set of possible macrostructures will have much in common, since, after all, all macrostructures are derived from the same text, but to the extent that knowledge differences exist among readers and that their reading goals are not the same, different reading episodes will result in different macrostructures. In the extreme case, when a text is being read for a very unusual and specific purpose, the macrostructure may be far removed from the one intended by the author. (p.53)

The present study examines how the macrostructure which is constructed by each reader compares to the rhetorical organization of the experimental texts. That is, the study compares how the macrostructure which is constructed by each participant compares to the main idea the author of the text has intended as signalled by the organization of the text.

It is reasonable to assume that if the text is well-organized, well-signalled, and the reader possesses enough prior knowledge about the content and the structure of the text, the

macrostructure construction is an inherent component of comprehension. However, when text comprehension is too difficult for the reader, the construction of the macrostructure is deautomated (Kintsch, 1998). This assumption is consistent with Bereiter, Burtis and Scardamalia's (1988) views. The latter pointed out that the difficulty of the text can have great impact on the kind of process that is involved in macrostructure construction.

Afflerbach (1990b) proposes that in case of deautomation, readers need to resort to comprehension strategies to construct the main idea (Afflerbach uses the term main idea instead of macrostructure). As the construction becomes deautomated, readers may also be able to report their strategies. In short, Afflerbach and Kintsch agree that the macrostructure or main idea construction may be an automatic process, but for Afflerbach, if the comprehension task is too difficult, the construction is mediated by non-automatic strategies (defined below).

The findings of Brown and Day (1983) agreed with the macrorules proposed by van Dijk and Kintsch (1983). Brown and Day (1983) collected verbal reports from expert readers, college rhetoric teachers, while they attempted to summarize expository texts. They analyzed the protocols and identified some strategies these expert readers used to write a summary of the texts. The analysis indicated the following: expert readers used a deletion strategy to delete unnecessary or trivial information as well as a superordination strategy to encompass a list of subordinate information. The latter strategy is roughly similar to van Dijk and Kintsch's generalization rule. Importantly, readers also used an invention strategy, which was considered the most difficult one. Brown and Day formulated the invention strategy in the following terms: if a topic sentence did not appear in the text, readers would construct one. However, Brown and Day were criticized: they simply identified the strategies, but did not go so far as to explain explicitly how the main idea is constructed (Afflerbach, 1990b). It is noteworthy that in Brown and Day's experiment, expert readers provided their verbal reports

while writing a summary of the texts. In van Dijk and Kintsch's (1983), Kintsch's (1998) model, the macrorules are general rules which underlie the comprehension of texts, not just specific rules used for doing a summary writing task. Another important point is that Brown and Day designed experimental texts especially to be summarized. In other words, their texts were constructed so that summarization rules were likely to be applied. Brown and Day did not use *naturally occurring texts*, that is, their texts that were especially designed for the experiments.

In the present study, we assume that as the main idea is not obviously stated, the main idea construction stops being an automatic process thus becoming a process executed under cognitive control (Afflerbach, 1990b). In this situation, the construction becomes a working-memory demanding process. The present study sets out to investigate the following points: (a) how the main idea is formed during comprehension when readers are faced with difficult texts L1/L2 (the main ideas are undersignalled); (b) how the ability to form the main idea of a difficult text L1/L2 relates to individual differences in working memory capacity, (c) whether the strategies readers use to construct the main ideas are related to working memory capacity. Our aim is to assess, not only the product of comprehension (whether readers have the ability to construct the main idea or not), but also some of the variables related to the construction process, that is, to describe the strategies readers use to construct the main ideas, and how such strategies relate to their working memory capacity.

### 2.2.3 Defining the Term Strategy

According to Urquhart and Weir (1998), there seems to be an element of subjectivity in the way some researchers have been classifying strategies. However, this subjectivity might be reduced if researchers make an attempt to agree on a definition of strategies. In the past,



Olshavsky (1977) defined strategy as “a purposeful means of comprehending the author’s message” (p.656). More recently, Pritchard (1990) has argued that definitions such as the one proposed by Olshavsky were problematic because they missed the important element of choice. Given this problem, he went on propose his own definition, “a strategy is defined as a deliberate action that readers take voluntarily to develop an understanding of what they read” (p.275). It is noteworthy that Pritchard mentioned the words deliberate and voluntary thus emphasizing that this choice is a conscious one.

Pritchard’s (1990) position is consistent with Cohen’s (1998) views. The latter also added the words choice and conscious to his definition. As Cohen explained it, language learning and language use strategies are those processes which learners select consciously and may result in action taken to improve L2 learning or use. Although Cohen is not defining reading strategies (his definition is concerned with language learning and language use strategies), he makes it clear that “the element of consciousness is what distinguishes strategies from those processes that are not strategic” (p.4). He went on to emphasize that strategic moves are the ones that the learner is at least partially aware of, even if learner’s full attention is not focused on them.

Another way of putting it is that strategies have not reached the level of automaticity of processes such as syntactic parsing, and lexical accessing. The latter processes may become so automatic in L1 or in advanced L2 reading that they will operate largely subconsciously and can no longer be reported by readers (Urquhart & Weir, 1998). Ericsson and Simon (1980) also subscribe to this position. According to them: “Processes that have been so often repeated as to have become automated are less often and less fully reported” (p.242). On the other hand, since strategies are not automatic processes, they remain at the conscious level and readers are often able to report them (Afflerbach, 1990b).

In the present study, we follow Cohen and Pritchard also sticking to the side of conscious choice. It is expected that given a difficult text, main idea construction will not be automatic. As a result, readers will be able to report their construction strategies (Afflerbach, 1990b, also argued along the same lines, but he did not test whether working memory capacity is one of the factors that might influence strategy choice).

In reading research, the word strategy has been traditionally associated with a response to a problem (Olshavsky, 1977) or comprehension failure (Sarig, 1989). Nevertheless, defining what the word *problem* means might be problematic as well. Urquhart and Weir (1998) have made an attempt to be more specific: initially, they explained that strategies can be viewed as attempts to solve problems at a local level such as failure to comprehend a word, failure to find a piece of information one is looking for. In addition, they have also pointed to the importance of global strategies which enable readers to integrate the text as a whole and achieve higher standards of coherence. Block (1986) has also made a similar distinction between local linguistic strategies and general strategies. The label local linguistic strategy is self-explanatory, the label general strategy is concerned with comprehension-gathering at a more global level such as integration of information, recognition of text structure, and comprehension monitoring.

As stated above, one of the aims of the present study is to describe the strategies used by high and low- working-memory readers while trying to construct the main idea of texts. First, readers were divided as high or low-span on the basis of the reading span test. Second, to elicit readers' strategy, the pause-protocol technique was used (Tomitch, 1995). To classify the type of strategy used by readers, I drew upon the coding scheme designed by Block (1986).

Earlier strategy research would divide readers into good or poor readers a priori, and then the strategies revealed by verbal reports of these good and poor readers would be

classified and then equated with some aspect of good or poor reading behavior (Hosenfeld, 1977). Sarig (1989) has reacted against this earlier approach. According to her, a particular strategy or set of strategies cannot allow us to predict success or failure in reading comprehension. Along with this argument, Cohen (1998) also pointed out that a given strategy cannot be associated with success or lack of success. Indeed, many variables might come into play. The effectiveness of a given strategy or a set of strategies may depend on several characteristics of the learner, their reading goals, the context, the comprehension task or the interaction of these factors. When we propose a division between high and low-working-memory readers, we are not trying to say that high-span readers are likely to use the good strategies while low-span tend to use the ineffective ones. Our assumption is that low-span readers may not have enough working memory capacity to use working-memory-demanding strategies such as text integration, especially if the text is difficult to read. Although the construction of main idea is considered essential to text comprehension, Brown and Day (1983) have argued that many readers lack the strategies to construct them. We would like to find out whether lack of working memory resources may prevent readers from constructing the main idea and from using strategies that will enable main idea construction.

## CHAPTER 3

### 3 METHOD

In order to investigate the research questions and hypotheses introduced in Chapter One, an experiment was conducted at UFSC (Universidade Federal de Santa Catarina). The first part of the experiment assessed participants' working memory capacity (L1 and L2) by means of a modified version of the reading span test, and the second part, participants' ability to extract the main idea of two texts (L1 and L2). The two reading span scores as well as the two reading ability scores came from the same subject.

The present chapter describes the method used for conducting the experiment and for analysing data. It describes the participants, the design, the procedures for data collection, and the procedures for data analysis.

#### 3.1 Participants

The 18 participants were native speakers of Brazilian Portuguese, and speakers of English as a foreign language. All of them were enrolled in the graduate course at UFSC, studying either applied linguistics or literature in English. Sixteen of them were applying for a master's degree and two of them for a doctor's degree.

One of the reasons for choosing this particular group of readers was the following: graduate students must read effectively, that is, they must be able to extract the main ideas from their academic texts in order to learn about a particular subject.

The second reason for choosing this particular group of subjects was their level of proficiency<sup>3</sup> in English. That is, a reasonable level of proficiency is a pre-requisite for joining a graduate course in English: 1) these graduate students have already undergone a written and oral entrance examination in English; 2) they are required to speak English in class and to write their assignments in English; 3) most of these students are already teachers of English as a foreign language, or are going to make English into a profession. In short, participants' level of proficiency was expected to range from upper-intermediate to advanced. It is important to choose participants who are already proficient in L2 so that the results of the experiment will be attributed to individual differences in working memory capacity and not to differences in language proficiency.

The third reason for choosing these participants was that they all belonged to the same group, which ensured a certain degree of uniformity in language experience. However, this choice was not a way of indexing participant's proficiency in L2 or their reading ability. In fact, participant's level of proficiency was not strictly controlled. All participants took part in the experiment on a voluntary basis.

Each participant in the study contributed two reading span scores (L1 and L2), and two reading ability scores (L1 and L2).

### 3.2 Instruments for Data Collection

The experiment consisted of two working memory tasks (L1 and L2), and two reading ability tasks (L1 and L2). The working memory tasks were presented visually on a laptop screen (18 cm x 25 cm), and the Power-Point program was used for the presentation of sentences of the reading span tests (L1 and L2). In addition, two response booklets were used

---

<sup>3</sup> In this study, language proficiency is defined as "a person's skill in using a language for a specific purpose" (Richards, Platt

for keeping participants' answers. To perform the reading ability tasks, participants read a text in English and another in Portuguese and were asked to think aloud about their reading. Participants' comments were recorded by a cassette-tape-recorder. The texts used for the reading ability measures were printed.

### 3.3 Working Memory Measures

The reading span test. While participants in most of the studies relating working memory to reading comprehension are native speakers of English, the ones in the present study were not. Because of this difference, the working memory span test underwent some changes in order to avoid floor effects due to task difficulty. The sentences used in the span test in English were borrowed from Harrington and Sawyer (1992), there were 42 sentences, instead of the usual 60 (Daneman & Carpenter, 1980; among others). The sentences were active, ranging from 11 to 13 words in length, each ending in a short noun, one syllable in length. These sentences were 3 to 4 words shorter and syntactically simpler than those employed by Daneman and Carpenter. Previous research has shown the importance of controlling the variables involved in the sentences of the reading span test (Rothe-Neves, 2000). As for the span test in Portuguese, the 42 sentences were taken from popular magazines such as *Veja* (April 19, 2001; June 13, 2001), *Isto É* (May 30, 2001; June 6, 2001), *Superinteressante* (May, June, 2001), as well as from the newspaper *Folha de São Paulo* (June 3, 2001). These sentences were controlled for length so as to be as long as the sentences in English, and the final words were also nouns, one to two syllables in length. The sentences in Portuguese were not controlled for syntactic complexity because subjects were reading in their native language, in addition, they are the type of sentences readers often come across in

familiar publications such as *Veja*, and *Folha de São Paulo*. Finally, a pilot study was conducted in order to find out whether subjects would be able to perform the two tests equally well.

A grammatical judgement task was added to the span test to make sure that subjects were really processing the sentences for meaning. The judgement task was used by Turner and Engle (1989) and followed by Harrington and Sawyer (1992) and by Budd, Whitney and Turley (1995). There were grammatical and ungrammatical sentences. The former (50%) made sense syntactically and semantically. The latter (50%) were created by reversing the last 4 to 6 words immediately prior to the final word.

The materials for the test also included two response booklets for each subject, one for the span test in English, the other for the test in Portuguese. Each response booklet comprised 24 pages, with 2 pages for each set. The first page was designed so that subjects would point out whether each sentence in the set was grammatical or not. The second page was blank, but for the prompt "RECALL WORDS", so subjects had to write down the words recalled in the order they had been presented. In addition to the booklets, subjects also received a page of written instructions (Appendix C).

Procedures. Unlike most span tests in which subjects are required to read the sentences aloud (Daneman & Carpenter, 1980), in the present test, the 42 sentences were presented visually on a computer screen one at a time and subjects had to read them silently, then judge whether they were grammatically possible or not. Individual sentences were displayed at a rate of 9 seconds in the middle of the screen. Following Budd et al. (1995), sentences were presented in sets of increasing length. In other words, sentences were divided into 12 sets, the number of sentences per set started from 2 extending to 5 (3 sets of 2 sentences, 3 sets of 3 sentences, 3 sets of 4 sentences, 3 sets of 5 sentences). Having read the last sentence in each

set, subjects read the prompt “RECALL WORDS”. Subjects were given 6 seconds to recall each word.

Subjects read the sentences on the screen, then marked in the booklet whether the sentences were grammatical or not. Having rated each sentence in a set, subjects would turn the page in the booklets, and would try to write down the last word of each sentence in the set. Subjects would receive credit only if they recalled the final word in the order of presentation and made the right decision about the grammaticality of its corresponding sentence (Budd et al., 1995). Half mark was given, when subjects were right in two out of three sets. A subject was assigned as being at the span level at which s/he was correct on two out of three sets (Daneman & Carpenter, 1980). In other studies, e.g. Harrington and Sawyer (1992), the dependent measure for the reading span test was the number of words recalled.

Participants were classified as high or low-spans according to their scores on the reading span tests, on a scale ranging from 0.5 to 5.0. Participants were divided into two groups: the ones who scored up to 2.0, including the participants who scored 2.0 were classified as low-spans, the ones who scored above 2.0 were classified as high-spans. The labels low and high-span are relative to the present sample.

The experimental test was preceded by a training session consisting of 6 sets (3 sets of 2, 3 sets of 3 sentences). The training sentences were in L1 because participants might have felt more comfortable learning the procedures in their native language before being tested. In the experiment, each participant was tested in L1 and L2. The test in L1 took place before the test in L2. Participants received both oral and written instructions, and the tests were conducted in individual sessions in the presence of the researcher.



### 3.4 Reading Ability Measures

Materials. In the present study, two expository texts, one in English and another in Portuguese were used. Both texts were taken from magazines of popular science, namely *Superinteressante Especial: O Melhor de Superintrigante* (2001, August), and *Popular Science* (2001, Summer) (see Appendix D, for the original and the experimental versions of the texts). On the one hand, the texts could not be so difficult as to entirely obliterate comprehension (Coté & Goldman, 1999). Given that, texts from such magazines were chosen because they are not extremely difficult. That is, one does not need to be an expert in a particular subject to read texts of popular science. In fact, these texts do not require that readers understand complicated concepts. On the other hand, the experimental texts could not be too easy to read, nor could the topic of the texts be too familiar. As previous research has shown, if the experimental texts are too easy, participants will not interrupt their reading to verbalize their thoughts (Afflerbach & Johnston, 1986; Block, 1986). Along with Afflerbach and Johnston, Coté and Goldman (1999) also explain that if the texts are too easy, the reading process will be automatic and inaccessible to verbalisation. In conclusion, the experimental task was meant to simulate a reading-to-learn situation, that is, participants were assigned expository texts which they read in order to learn and acquire new knowledge (Coté & Goldman).

The main feature of the experimental text was that the main ideas were undersignalled, then titles and subheadings were removed (Afflerbach, 1990b; Afflerbach & Johnston, 1986). In addition, some of the key words, summary words, and some words signalling textual structure (e.g. linking words) were removed; moreover, topic sentences were modified so as not to signal the topic of the text overtly. These texts were taxing to comprehend and gave a good opportunity for uncovering differences in reader's strategy use. It is noteworthy that

under other conditions, different strategies may be selected. Despite the fact that the main ideas were undersignalled, the global coherence of the texts was preserved.

A pilot study with 4 participants and interviews with two judges were conducted in order to make sure that texts were undersignalled. The experimental version of the texts was developed during the pilot study. The first experimental version of the text in L1 had to be revised because it was extremely difficult. Although the text in L1 was taken from a magazine of popular science, and it was written in the readers' native language, there was a general consensus among judges that the first experimental version (L1 text) was too difficult to read: the judges argued that participants in the experiment, namely students of literature and applied linguistics, would not have much knowledge about the topic of the text (the life span of a star). Thus, participants would be faced with two difficulties: lack of knowledge about the topic of the text, in addition to the lack of signals.

The two texts were "Existência Tumultuada: Como Nascem, Vivem e Morrem As Estrelas" (Superinteressante Especial: O Melhor de Superintrigante, 2001, August), and "Drug Delivery: Getting Under The Skin" (Popular Science, 2001, Summer). The original version of the former text (L1) consisted of 474 words while the experimental version was reduced to 303 words. The original version of the latter (L2) consisted of 431 words while the experimental version was reduced to 317.

Both texts (L1 as well as L2) presented a clear structure. As for the L1 text, it is organized so as to describe a process (Aebersold & Field, 1997): the author describes the process of birth, maturity, and death of a star. As for the L2 text, its structure resembles the one Hoey (1994) has classified as situation-problem-solution-evaluation. However, the structure of this particular text is not exactly the same as the one described by Hoey. It follows that the present text is divided into six parts: situation - we still take pills and injections, but researchers are developing new methods to sneak drugs past the body's

defences; problem – although some drugs are already delivered through the skin, the already existing skin patches are not effective enough for such larger molecules as insulin; current solution - to break the skin barrier by means of using more effective patches; ideal solution - the ultimate goal is to push drugs directly into the cell; evaluation - pushing drugs directly into the cell is still improbable. It was important to choose texts which had a clear pattern of organisation. The reason for this choice was the following: text structure was used to guide the researcher and the judges to design the scales for scoring the verbal protocols, thus enabling the researcher and judges to decide whether participants were able to extract the main ideas or not.

Since both texts were taken from the same type of source, namely magazines of popular science, they had some features in common. First, a structural feature of the original texts was that the general main idea was given in the beginning paragraph followed by some detail about the topic (Aebersold & Field, 1997). The first paragraph of “Existência Tumultuada: Como Nascem, Vivem e Morrem As Estrelas” started with the thesis that a star goes through three phases - this part of the paragraph was omitted in the experimental text. The first paragraph of “Drug Delivery: Getting Under The Skin” started explaining that pills and needles may become a thing of the past because researchers are developing new methods to deliver drugs through the skin - part of this paragraph was also omitted, namely the part mentioning the development of modern technology to break the skin barrier. Second, also typical of the texts of popular science was the use of citations from expert-researchers, in this case, experts in the fields of astronomy (text in L1) and chemical / electrical engineering (text in L2). Such citations serve to lend credibility to the information being presented. Third, in both texts, the paragraphs tended to be quite short which is also a text feature typical of newspaper writing (Aebersold & Field). The latter feature may be considered an indication

that these texts were not addressed to a particular community of experts, instead, they were addressed to general public as a newspaper article is.

In addition to the experimental texts, an extra text was used in order to train subjects and make them acquainted with the procedures of the pause-protocol. It was a one-paragraph text in Portuguese and was taken from *Superinteressante* (2001, July), “Sol pra contrariar: Esfriamento Global”. This text was also modified so as to be undersignalled (see Appendix D, for the original and modified version). It explained how to solve the problem of global warming, and was organised in terms of situation-problem-solution-evaluation (Hoey, 1994): situation – the global warming has been caused by gasses which prevent the heat from leaving the earth; problem - too much smoke has made our planet darker; as a result, the planet has absorbed a great deal of heat which brings about the dangerous effects of global warming; solution - to make the planet lighter; evaluation - if it is possible to make the planet lighter, we will be able to avoid global warming.

The experimental tests were developed during the pilot study, that is, the interviews and the think aloud protocols of the four participants in the pilot study, as well as judges' evaluation signalled how readable the experimental texts were. Based on Kintsch and van Dijk's (1978) consideration, tests of readability were not conducted. According to them, “conventional accounts of readability have certain shortcomings” (p. 372). They explain that readability is not only a property of the text, but it is also related to reader's factors. That is, factors related to readability may depend on reader's working memory capacity. Indeed, a piece of research reported by Kintsch and Vipond (1978, as cited in Kintsch & van Dijk, 1978) indicates that the readability of some texts changes a great deal as a function of reader's working memory capacity. In addition, readability also seems to depend on the nature of selection strategy used by the reader. In Kintsch & Van Dijk's own words:

A reader with a poor selection strategy and a small buffer, reading unfamiliar material, might have all kinds of problems with a text that would be highly readable for a good reader. *Thus, readability cannot be considered a property of texts alone, but one of the text reader-interaction* (p. 372, emphasis added).

### 3.5 Assessment of Reader's Ability to Extract the Main Idea of the Texts

This section displays the scales used to assess reader's ability to extract the main idea of the texts (L1 and L2). To design these scales, a criterion was used namely, textual structure. The scales were designed a priori. Magliano et al. (1999) as well as Trabasso and Suh (1993) have worked with inference generation during thinking-aloud tasks. They argue that it is important to identify causal relationships between text elements a priori in order to predict which causal inferences the participants will make. In line with their argument, the main ideas were identified a priori so as to design the scales, then it was possible for the investigator to predict which main ideas a skilled reader would encounter.

As stated above, the L1 text described the life-span of a star, which comprised four periods: birth, youth, maturity, death of a star. The L2 text consisted of six parts: situation, problem, current-solutions, ideal-solution, evaluation. Verbal protocols were rated on a scale from 0 to 4, and whenever the participant mentioned one of the parts of the text, s/he received 1 score (L1), and 0.66 (L2). Subjects who were able to reproduce the full structure found in the experimental text received four scores. The assumption underlying this scoring procedure was that subjects had to perceive each part of the text and integrate them in order to fully extract the main idea of the text. Next, scales will be presented for the L1 text (from table 3.1 to table 3.6). Table 3.1 is concerned with the general main idea of the L1 text, and tables 3.2 to 3.6 are concerned with the main idea for each paragraph. In addition, we present scales for

the L2 text (from table 3.7 to table 3.14). Table 3.7 is concerned with the general main idea of the L2 text, and tables 3.8 to 3.14 are concerned with the main idea for each paragraph. The experimenter and the two judges had an agreement on the scoring of the protocols.

3.5.1 Scales for Assessing Reader's Ability to Extract the Main Idea of the L1 Text

(Existência Tumultuada: Como Nascem, Vivem e Morrem as Estrelas?).

Table 3.1

General Main Idea

Use of Structure		Stages
4	The three stages of development and the death of a star.	<b>First stage</b> , the birth of a star by means of a combination of gasses such as hydrogen. <b>Second stage</b> , the youth: there is some atomic fusion, as a result, hydrogen is transformed into helium, releasing light and heat. <b>Third stage</b> , the maturity: almost all the hydrogen has become helium. As a result, the fusion of gas molecules decreases, and there is a great deal of contraction, which releases heat and light. Finally, the opposite takes place, the star expands. And the <b>death</b> of a star: the way the star is going to die depends on its mass. The larger the mass, the more violent is the final contraction.
3	The three stages of development.	First stage: the <b>birth</b> of a star; second stage, the <b>youth</b> ; and third stage, the <b>maturity</b> .
2	-The first and the second stages; -Or the first and the third stages; -Or the first stage and the death of star; -Or the second and the third stages; -Or the second stage and the death of a star; -Or the third stage and the death of a star.	The <b>birth</b> of a star and the <b>youth</b> ; Or the <b>birth</b> of a star and the <b>maturity</b> ; Or the <b>birth</b> and the <b>death</b> of star. Or the <b>youth</b> and the <b>maturity</b> ; Or the <b>youth</b> and the <b>death</b> ; Or the <b>maturity</b> and the <b>death</b> of a star.
1	-The first stage. -Or The second stage. -Or the third stage. -Or the death of a star.	The <b>birth</b> of a star; Or the <b>youth</b> ; Or the <b>maturity</b> ; Or the <b>death</b> of a star.

Table 3.2

First paragraph/ The birth of a star

<b>Use of Structure</b>	<b>Stages</b>
3	The birth of a star by means of the combination of gasses (hydrogen), which are brought together due to the gravitational force.
2	The birth of a star by means of a combination of gasses such as hydrogen.
1	The birth of a star.

Table 3.3

Second paragraph / The youth

<b>Use of Structure</b>	<b>Stages</b>
3	During the youth of a star: there is some atomic fusion, as a result, hydrogen is transformed into helium, releasing light and heat.
2	During the youth of a star, there is some atomic fusion.
1	The youth of a star.

Table 3.4

Third paragraph/ The middle-aged years

<b>Use of Structure</b>	<b>Stages</b>
3	During this intermediate period, the star has reached a stage of equilibrium, there is little contraction.
2	During this intermediate period, the star reaches a stage of equilibrium.
1	The star reaches a middle-aged period.

Table 3.5

Fourth paragraph / The maturity

<b>Use of Structure</b>	<b>Stages</b>
3	Almost all the hydrogen has become helium. As a result, the fusion of gas molecules decreases, and there is a great deal of contraction. Finally, the opposite takes place: the star expands.
2	Maturity is a period of great changes, and eventually the star undergoes some expansion.
1	Maturity is a period of great changes.



Table 3.6

Fifth paragraph / The death

<b>Use of Structure</b>	<b>Stages</b>
3	The death of a star: the way the star is going to die depends on its mass. The larger the mass, the more violent is the final contraction.
2	The larger the mass of a star, the more violent is its final contraction.
1	The death of a star.

3.5.2 Scales for Assessing Reader's Ability to Extract the Main Idea of the L2 Text (Drug Delivery: Getting Under the Skin).

Table 3.7

General Main Idea

<b>Use of Structure</b>		<b>Stages</b>
4	-Situation	We still take pills and injections, but researchers may develop new ways to sneak drugs past the body's defence.
	-Problem	Some drugs are already delivered through the skin, but the skin patches aren't effective for such larger molecules as insulin.
	-Current Solutions	To break the skin barrier by means of using: 1) a tiny patch of 400 hollow Microscopic needles; or 2) a similar patch with an electronic circuit; or 3) an implantable polymer chip.
	-Evaluation	The tiny patch of needles is effective because the insulin turned out to be at work.
	-Ideal Solution	The ultimate goal is to push drugs directly into the cell.
	-Evaluation	This method is still years away.
3	-Situation	We still take pills and injections, but researchers may develop new ways to sneak drugs past the body's defence.
	-Problem	Some drugs are already delivered through the skin, but the skin patches aren't effective for such larger molecules as insulin.
	-1 Solution	To break the skin barrier.
2	-Problem	Some drugs are already delivered through the skin, but the skin patches aren't effective for such larger molecules as insulin.
	-Current Solution	To break the skin barrier.
1	-Problem	Some drugs are already delivered through the skin, but the skin patches aren't effective for such larger molecules as insulin.
	Or	Or
	Solution	To break the skin barrier by means of using: 1) a tiny patch of 400 hollow microscopic needles; or 2) a similar patch with an electronic circuit; or 3) an mplantable polymer chip.

Table 3.8

First Paragraph / Situation

Use of Structure	Stages
3	Although most of us still take medicines as pills or injections, researchers have been developing new ways to sneak drugs past the body's defences.
2	Researchers have been developing new ways to sneak drugs past the body's defences.
1	Pills and needles may be a thing of the past.

Table 3.9

Second Paragraph / Problem

Use of Structure	Stages
3	Although some drugs are already delivered through the skin, skin patches aren't very effective for such larger molecules such as insulin.
2	Skin patches aren't effective for such larger molecules such as insulin.
1	Some drugs cannot be delivered through the skin.

Table 3.10

Third Paragraph / First Solution

Use of Structure	Stages
3	A patch of tiny needles has been developed to break the skin barrier.
2	Researchers have developed a device to break the skin barrier.
1	A patch of tiny needles has been developed.

Table 3.11

Fourth Paragraph / Evaluation

Use of Structure	Stages
3	The patch of tiny needles has proved itself to work and it is painless.
2	The patch of tiny needles has proved itself to work.
1	The patch of tiny needles is painless.

Table 3.12

Fifth Paragraph / Second Solution

<b>Use of Structure</b>	<b>Stages</b>
3	Researchers have developed another patch of needles which has an electronic circuit and allows the wearer to self-administer the drug through the skin.
2	Researchers have developed another patch of needles which has an electronic circuit.
1	Researchers have developed another patch of needles.

Table 3.13

Sixth Paragraph

<b>Use of Structure</b>	<b>Stages</b>
3	MIT researchers have developed an implantable polymer chip that dispenses drugs inside the body.
2	MIT researchers have developed an implantable chip.
1	MIT researchers have developed a chip.

Table 3.14

Seventh Paragraph

<b>Use of Structure</b>	<b>Stages</b>
3	The ultimate goal is to push drugs directly inside the cells; however, this method is years away.
2	The ultimate goal is to push drugs inside the cells.
1	Scientists have not been able to push drugs inside the cells yet.

3.6 Procedures

Pause Protocol. This type of procedure was borrowed from the Problem-Solving theory then adapted to serve the purpose of eliciting qualitative data in reading research (Cavalcanti, 1987). More specifically, this procedure has often been used to investigate readers' cognitive strategies (Block, 1986, 1992, among other). Following Tomitch (1995), in the present study we have used a pause protocol procedure. That is, participants were required

to monitor their silent reading and interrupt it to make comments. Put another way, participants were instructed to read the texts silently, at their own pace and to interrupt their reading whenever they perceived a pause\* (no matter how short it was) or problem.

PAUSE\* - moment when the reading activity is interrupted and you find yourself, for instance, thinking about a problem encountered, or about something that might have caught your attention (Tomitch, 1995, p.194).

When participants interrupted their reading because they had perceived a problem, they were asked to indicate the pause in the text, that is, read aloud the word, expression or sentence that caused the pause; comment on the reason for the pause, that is, if the pause was caused by something that caught their attention, or by a problem that they had found. If the pause required solving a problem before they started reading again, participants were instructed to make an effort and think aloud while devising a solution. Firstly, participants were trained so as to become acquainted with the pause protocol technique (Cavalcanti, 1987). Secondly, the actual experiment took place, and they read two texts: the first in Portuguese and the second in English.

Participants were told beforehand that the purpose of their reading was to formulate the main idea of each paragraph and the main idea of the whole text. A visual prompt (a small square) was placed at the end of each paragraph as a reminder, so when participants reached the end of the paragraph they would stop and comment on what they had just read, that is, about the content of the paragraph. In addition, they would try to formulate the main idea for each paragraph, and as soon as they got to the end of the text, they would try to formulate the main idea for the whole text. After they finished reading, that is, before giving the main idea for the entire text, subjects were allowed to look over the text so as to obtain a more coherent

version than the fragmentary one that they might have formulated due to the interruption during the pause-task (Block, 1986). Each participant was tape-recorded during individual sessions in the presence of the researcher who attended the sessions to make sure that the technique was being applied correctly. The resulting protocols were transcribed verbatim (see Appendix A). There were 18 participants multiplied by two texts, that is, 36 protocols in all.

In order to apply this technique successfully, the researcher had to comply with some requirements (Cavalcanti, 1987): a silent environment (as much as possible) so that reading would remain as a private activity; the researcher used as little electronic equipment as possible so as to make the experimental task “similar to real-life”; and also used authentic and complete texts, not chunks. Cavalcanti explains that participants may verbalise in L1 as well as in L2. In the present study, since all participants shared the same L1, they were instructed to make their comments in L1 so as to feel at greater ease.

The reading ability measures and the working memory measures were collected at the same session. One half of the participants did the reading ability tests first and the working memory tests second while the other half followed the opposite order.

### 3.7 Pilot Study

#### 3.7.1 Working Memory Measures

Participants. In order to make sure that the working memory tests were working properly, a pre-pilot study was conducted in May 2001, the test was given to one subject, who has a PhD in physics. The actual pilot study was conducted at Universidade Federal de Santa Catarina (UFSC) in June 2001. Participants were native speakers of Brazilian Portuguese and had been studying English at university level for three years, they were currently enrolled in

the fifth semester of the undergraduate course, majoring in English. This part of the pilot study was conducted with a group of twelve students in a single session. One of the subjects was discarded because he failed to understand the instructions for the reading span test. Subjects were grouped according to how long they had been studying English at university. This method of grouping based on semester level is the traditional way of grouping students in the undergraduate course and ensures a certain degree of uniformity in language experience at each level. However, this is not a way of indexing subjects' proficiency in L2.

Major findings. A positive correlation was found between L1 and L2 working memory spans. In addition, the mean scores for the reading span tests in English and Portuguese were roughly the same, there was no statistically significant difference between them.

Following Budd, Whitney, and Turley (1995) the span test was presented visually and individual sentences were displayed at a rate of 7 seconds. However, in the present pilot study the sentences were presented on a computer screen while Budd et al. have used the overhead projector. The major finding was concerned with the time of presentation of individual sentences. In fact, an interesting point was raised by participants. A majority of participants in the pilot study claimed that the presentation was too fast. This seemed a fair comment because participants in Budd et al.'s study were tested in L1 while participants in the present study were tested in both L1 and L2. Based on participants comments, it was decided that in the real experiment the sentences would be displayed at a rate of 9 seconds instead of 7 seconds.

### 3.7.2 Reading Ability Measures

Participants. A pre-pilot study was conducted at UFSC in August 2001, the test was given to one subject, who was applying for a PhD in linguistics. In the actual pilot study, there were two judges and four participants, all of them were native speakers of Brazilian

Portuguese, and taught English as a foreign language. As for the judges, the two of them had an MA in applied linguistics. As for the participants, three of them had already got an MA in applied linguistics, and were applying for a PhD. These three participants and the two judges had the same academic background of the participants in the real experiment. Only one among the four participants was an undergraduate student, and she was currently enrolled in the sixth semester at UFSC, that is, she had been studying English at university level for three years.

The verbal protocols and interviews were collected in individual sessions.

Major findings. The two judges agreed that the first version of the experimental text in L1 was too difficult to read. Their main argument was that the text was badly signalled to such an extent that participants would not even be able to perceive that the text had a definite structure. This problem would prevent participants from activating their knowledge of text structure (or formal schemata, Carrell, 1985). Since the participants in the experiment would not have much knowledge about the topic of the L1 text (the life span of a star), they would be faced with three sources of difficulties: lack of knowledge about the topic of the text, lack of signals, and difficulty to perceive text structure. Given that the two judges had agreed, we decided to reformulate the experimental text in L1 before piloting the study. Our solution was to signal the text in L1 slightly more so that readers would at least have a way into text structure. Thus, the text in L1 was modified, then resubmitted to judges' appraisal.

In general, the results of the pilot study indicated that participants could extract the main ideas of the text in L1 as well as they could in L2. That is, there was no statistically significant differences between the mean scores for ability to construct main ideas across languages. Another interesting result was that subjects questioned vocabulary more often while they were reading in L2, which is quite understandable because they were not reading in their native language. Despite this questioning, vocabulary did not seem to impair



comprehension, that is, subjects were able to overcome their problems by using the context, in the end, they turned out as able to extract the general main idea of the text in L2. Also important, once participants had received an orientation to the technique of thinking aloud, they were able to fulfil the task with relative ease.

### 3.8 Description of Reader's Strategies

In addition to focusing on the product of reading comprehension, that is, whether readers were able to extract the main idea of each paragraph and the overall main idea of the text, the present study also focuses on the process of reading. That is, this study also aims to describe the strategies used by readers while trying to extract the main idea of texts. To elicit readers' strategy, the pause-protocol technique was used. To classify the type of strategy used by readers, we drew upon a coding scheme designed by Block (1986). However, Block's scheme has been adapted in order to suit the purposes of this study. The adaptations are mentioned below.

According to Block's coding schema (1986), strategies were classified as a function of readers' mode of response and strategy type. In the present study, only the strategy type was considered. In addition, strategies were grouped into two levels, namely general comprehension and local linguistic strategies. Both types of strategies are equally important for readers to accomplish high levels of comprehension, and they interact. However, the second part of this study will focus on the relationship between general comprehension strategies and working memory capacity. Description of these categories follow.

The first type of strategy comprises general strategies for comprehension-gathering and comprehension-monitoring.

1. Anticipate content: readers predicted the content that appeared in subsequent portions of the text. e.g. “No começo do parágrafo, ele está falando do hidrogênio que vai se transformar e ai já causa desconforto, né? Porque a gente quer saber o que que é essa transformação e como eh que funciona sem ler o resto né. Já” (S18).

2. Recognize text structure: readers made a distinction between main points and supporting details, identified and mentioned parts of the textual structure, and assessed the purpose of information. e.g. “Algumas drogas como a nicotina e hormônios podem ser injetados através, né? - penetrados através da - da pele. No caso de insulina não, porque é muito grande, mas esse pesquisador traz (uma) - uma solução. Que é um dispositivo que você pode transportar drogas através - da pele” (S3). The text (L2) is organised in terms of situation-problem-solution-evaluation, and this participant was able to mention two of the parts of the text, the problem (some drugs such insulin cannot go through one’s skin) and the solution (a skin patch).

3. Integrate information: readers related incoming information to the previously seen content. e.g. “Então, a relação do primeiro texto com o segundo texto, o prime-primeiro parágrafo do segundo, é que o primeiro fala-se da estrela, (da segunda) – o segundo parágrafo se fala que é uma fusão, mas é uma fusão de quê? Uma fusão das partículas de gás. Então, o segundo para-parágrafo, basicamente, fala-se da estrela jovem, só que está mal elaborado. Que eu acho que deveria ser colocado: ‘ Há uma fusão de partículas de gás soltas no universo, que forma a estrela jovem chamada Ple-Plêiades, na Via Láctea ‘ ” (S3).

4. Question information in the text: readers questioned the text ( e.g. truthfulness, and relevance of the content). e.g. “ Aqui ele se – ele diz que esse novo aparelho estaria na verdade utilizando quatrocentas microagulhas, né? Apesar de serem pequenas, na minha opinião ainda são agulhas, então, é um, apenas um – uma – um melhoramento de um – um método mais antigo, né? ele tem que ser por agulhas” (S1).

5. Interpret the text: readers proposed a hypothesis, or drew a conclusion. e.g. "É, a ideia geral do texto, basicamente, é falar da vida útil de uma estrela, né? Desde o nascimento até a, digamos, assim, a morte dela. Quais as transformações químicas e tem – denominações – deno – denominações que ela sofre através de sua existência. É, acho que é isso. Desse texto, acho que é isso" (S13).

6. Use general knowledge and associations: readers used their already existing knowledge and experience to expand, evaluate and clarify the content. e.g. "Nesse parágrafo é interessante que enquanto a gente está lendo, assim, tem bem aquela sensação de – de começar a lembrar do que a gente aprendeu na escola ou, então, o que a gente está lendo, na verdade, aí começa a lembrar já da supernova, das estrelas azuis, da cor – da variação das cores das estrelas de acordo com a idade e tal, né?" (S18).

7. Comment on behavior and process: readers made a comment on the strategies they used to understand the text, and even expressed a sense of accomplishment or frustration. e.g. "O parágrafo se refere às partículas de hidrogênio que formam – que – que se concentram devido a forças gravitacionais. Quando eu vou tentar fazer o resumo do – do parágrafo, eu procuro identificar algumas palavras-chaves" (S5).

8. Monitor comprehension: readers made an assessment of their degree of understanding. e.g. "Primeiro pará-parágrafo eu tenho que ler duas ou três vezes pra realmente conseguir entender o que que está querendo dizer. E fala sobre...Não consigo entender direito: 'An endless stream'. Bom, novos tipos de – melhores tipos de droga fazem com que ... tomamos muitas pílulas e injeções, mas que no futuro tanto pílulas, quanto injeções, elas vão ser antiquadas" (S6).

9. Correct behavior: readers realized that an assumption, or paraphrase was incorrect, and made an attempt to review their earlier position. e.g. "Quando o hélio se acaba...não, na verdade, quando o hidrogênio se converteu em hélio, ele...a estrela vai aumentar umas

cinquenta vezes de tamanho e isso é o que vai acontecer com o sol daqui a quatro quase cinco bilhões de anos” (S6).

10. React to text: readers responded to the text emotionally. e.g. “É o tipo de texto que eu não costumo ler, então, fica confuso” (S6).

The second type of strategy consists of readers’ attempts to deal with specific linguistic issues at a local level.

11. Paraphrase – correct: readers re-stated in different words something they had already read without changing the original sense. This strategy was often used to enhance readers’ understanding, to consolidate ideas, and to signal a reaction. e.g. “Esse primeiro parágrafo está bem claro, que fala sobre as partículas de gás. O astrônomo Robert B., da Universidade de São Paulo, ele fala sobre essas partículas que, devido as forças gravitacionais, elas – elas vão se concentrando. Ah, ok! Então, a estrela é formada por uma gigantesca – gi – gigantesca nuvem de gás, que é formada pelas partículas de ga-gás, que elas vão se soltando no universo. Essa é a idéia principal, é a formação da estrela, segundo o astrônomo Roberto da – Roberto B., da Universidade de São Paulo, da USP. Então, esse primeiro parágrafo fala, basicamente, da formação da estrela, né? Na minha concepção esse primeiro parágrafo está bem – está bem elaborado” (S3). Participant’s paraphrase was consistent with the original sense of the first paragraph (L1): that is, the birth of a star by means of the combination of gasses (hydrogen), which are brought together due to the gravitational force.

12. Paraphrase - incorrect: e.g. “Bom, novos tipos de – melhores tipos de drogas fazem com que...tomamos muitos pílulas e injeções” (S6). The experimental text (L2) does not say that because we have newer and better drugs, we are going to increase our intake of drugs. Indeed, what the text says is that pills and injections may become a thing of the past. It is

noteworthy that Block (1996) includes the strategy paraphrase in her framework, but does not make any distinction between correct, incorrect, and partially correct paraphrases.

13. Paraphrase - partially correct: e.g. “Então esse texto trata do uso de remédios, tal como pílulas ou através de injeção para monitorar o nível de glicose e de insulina. Enquanto uns, como Mark Praunitz, alega que as moléculas de insulina são muito grandes e, portanto, o melhor que deve ser feito é através de injeção? Outros, como pesquisadores da Alza Corp, alegam que o melhor é injetar dentro da pele ‘titanium-foil blades’, pedaços de titânio” (S8). The participant seems to understand that according to the text (L2), it is possible to use some medication to control blood glucose levels. However, the paraphrase is incomplete: it is not enough to say that ‘titanium-foil blades’ will be used to slice the skin. The participant fails to mention the reason why the skin needs to be sliced. In fact, s/he does not say that the ‘titanium-foil blades’ will serve the purpose of shuttling drugs through the skin.

14. Reread: readers went back and read a portion of the text again either aloud or silently. This strategy seemed to indicate lack of understanding; but it may also give readers time to think about the content. e.g. “ Mais uma pausa na segunda frase do quinto parágrafo: ‘a massa da estrela for até duas vezes a do Sol, sua contração transformará o corpo celeste em um pequeno astro moribundo’,... ‘Em um pequeno astro moribundo, cuja gravidade já não consegue segurar os gases na periferia’. Aí, já tem que ler, acho que, umas cinco vezes, porque tem que tentar entender de novo” (S18).

15. Question meaning of clause or sentence: readers pointed out that they failed to understand a portion of the text. e.g. “No sexto parágrafo, fala de Robert Langer, ele colocou um chip que dispensa as drogas dentro do corpo. Mas não – não desenvolve o assunto, ele solta uma idéia, mas essa idéia não é desenvolvida. Então, esse texto é muito vago da- que para ver entre um parágrafo e outro que não tem – não tem algo que ligue, né? Não tem ganchos – não há ganchos aqui” (S3).

16. Question meaning of a word: readers pointed out that they failed to understand the meaning of a particular word. e.g. “Algumas palavras me soam estranhas como “zapping” e mesmo outras palavras, apesar de serem pa-palavras semelhantes com o português, são palavras que normalmente não estão no meu vocabulário cotidiano e – e dificultam como, por exemplo, ‘electrode’, ‘molecules’ ”(S12).

17. Solve vocabulary problem: readers made use of the context, or of a synonym to overcome their problems with vocabulary. e.g. “ ‘Jolt’, eu não conheço essa palavra. ‘Jolt of ec- electricity’. Tem que ser alguma coisa como carga de eletricidade ou um tipo de instrumento. É ele deve ser um instrumento, porque eles estão falando que não conhecem ainda a voltagem exata para se fazer isso, pra abrir as membranas. Ou uma rajada de eletricidade, algo assim” (S14).

18. Translation: this strategy was not included in Block’s framework. Readers translated part of the text in L2, making an attempt to reach a better understanding of the text. e.g. “E a célula pode ser teimosamente fechada” (S3). This is a possible translation for a piece of the original text: “the cell is stubbornly shut”.

### 3.9 Data Analysis

The first part of study aims to investigate the following assumption: there is a relationship between reader’s ability to construct the general main idea of a text when the text is undersignalled and their working memory capacity. This assumption was unfolded into six specific hypotheses.

Hypothesis (a). Working memory (as measured by the L1 reading span test) will correlate positively with the reader’s ability to construct the main idea in L1.

Hypothesis (b). Working memory (as measured by the reading span test L2) will correlate positively with the reader's ability to construct the main idea in L2.

Hypothesis (c). Working memory (as measured by the L1 reading span test) will correlate positively with the reader's ability to construct the main idea in L2.

Hypothesis (d). Working memory (as measured by the L2 reading span test) will correlate positively with the reader's ability to construct the main idea in L1.

Hypothesis (e). Working memory capacity in L1 will correlate with working memory capacity in L2.

Hypothesis (f). Reader's ability to construct the general main idea of the text in L1 will correlate positively with their ability in L2.

The first part of the study will investigate the relationship between two variables, namely reading ability and working memory capacity. The scales displayed above will be used to assess reader's ability to extract the main idea of the texts (L1 and L2), and working memory capacity will be assessed by the reading span test (L1 and L2). The approach adopted to investigate the relationship between these variables follows mainstream research on working memory capacity. That is, the Pearson Product Moment Coefficient of Correlation ( $r$ ) is the statistical technique used to measure the strength and significance of the correlation between the two variables. In addition, due to the number of participants in this study, and the nature of the data, another statistical test, Spearman's Correlation Coefficient for Ranked Data will be performed to confirm the results of the Pearson Coefficient of Correlation (see Appendix K for the results of Spearman's rho).

The second part of this study presents a descriptive analysis and it aims to answer the following research question:

Research question. How do readers conceive task of the main idea construction in (L1 and L2) texts when the texts are undersignalled?

To investigate how readers conceive the task, we will present and analyse data which consist of excerpts from the think-aloud protocols. The excerpts are chosen as representative of the specific strategy used by participants while accomplishing the main idea construction task. The strategies will be coded and classified according to Block's (1986) scheme, cited above. The purpose of the analysis is twofold: first, it describes the strategies readers use to construct the main idea; second, it also describes how readers assign importance to information.

The third part of the study is descriptive and exploratory in nature. In other words, it is not concerned with formulating and testing a hypothesis, instead, we have chosen to explore three research questions. This part of the study departs from mainstream research on working memory because it sets out to investigate qualitative differences in working memory capacity. That is, it investigates whether individual differences working memory capacity relates to the strategies used by reader's to construct the main idea of texts (L1 and L2) when the main idea is undersignalled. In short, we investigate whether there is a difference in the pattern of strategy use of high and low-span readers, and, whether there is a difference in strategy use in L1 and L2.

Research question (a). Is it possible to form groups of readers who have a similar profile of strategy use to construct the main idea of an expository text (L1 and L2) when the main idea is undersignalled?

Research question (b). Is it possible to form groups of strategies which have typically been chosen by a particular group of participants?

If the answers to questions (a) and (b) are affirmative, question (c) will pursue the investigation.



Research Question (c). Is working memory capacity related to the specific strategies readers use to construct the main idea when the text (L1 and L2) is undersignalled?

To answer these questions, data will be displayed on frequency tables (subjects vs. strategies); in addition, two statistical techniques will be used, namely, the Simple Correspondence Factor Analysis (Escofier & Pagès, 1992), and the Cluster Analysis (Escofier & Pagès, 1992), the results of these statistical analyses will be displayed in several graphs (below).

## CHAPTER 4

### 4 RESULTS AND DISCUSSION

This chapter reports the results of the statistical analysis and the descriptive analysis made to address the hypotheses and the research questions of the present study. The chapter is organised into three sections.

The first section investigates a general assumption: there is a relationship between reader's ability to construct the general main idea of a text when the text is undersignalled and their working memory capacity. This assumption was unfolded into six specific hypotheses. To test these hypotheses, a correlational analysis was performed. This section presents the results of the correlational analysis and the descriptive statistical analysis performed for the working memory measures (L1 and L2) and the reading ability measures (L1 and L2).

In the second section, a research question was formulated in order to investigate how readers conceive the task of main idea construction (L1 and L2) when the main idea is undersignalled. To answer this question, the section presents a descriptive analysis: first, the section describes the strategies used by readers to construct the main idea; second, how they assign importance to information.

The third section sets out to investigate whether individual differences in working memory capacity relates to readers' profile of strategy use. Three research questions were formulated to investigate this relationship. Question (a) investigated whether it is possible to form groups of readers who have a similar profile of strategy use to construct the main idea of an expository text (L1 and L2) when the main idea is undersignalled; question (b) investigated whether it is possible to form groups of strategies which have typically been chosen by a particular group of participants. If the answers to questions (a) and (b) are affirmative,

question (c) will pursue the investigation, examining whether working memory capacity is related to the specific strategies readers use to construct the main idea when the text (L1 and L2) is undersignalled. To answer these questions, data will be displayed on frequency tables (subjects vs. strategies); in addition, the results of the two statistical techniques, namely the Simple Correspondence Factor Analysis (Escofier & Pagès, 1992), and the Cluster Analysis (Escofier & Pagès, 1992) will be displayed in several graphs (below).

#### 4.1 Working Memory Measures and Reading Ability Measures: A Statistical Analysis

##### 4.1.1 Descriptive Statistical Analysis

This section reports the descriptive statistics for the working memory spans, as measured by the reading span test, and the measures of reading ability. To perform the descriptive statistics, a computer program was used, namely, the Statistical Package for Social Sciences - SPSS (1999).

Table 4.1 displays the descriptive statistics – the Mean (M), the standard deviation (SD) – for the reading span tests in L1 and L2, and the reading span scores of each participant.

Table 4.1  
Descriptive statistics for the Reading Span Test in L1 and L2

	L1	L2
<u>M</u>	2.5833	2.4444
<u>SD</u>	1.1015	1.2706
S	Span	Span
S1	2.5	2.5
S2	3.5	3.5
S3	1.5	1.5
S4	3.5	1.5
S5	3.5	3.5
S6	0.5	0.5

S7	1.5	1.5
S8	2.5	3.5
S9	2	3.5
S10	3.5	4.5
S11	3.5	1.5
S12	3.5	1.5
S13	5	5
S14	2	1.5
S15	1.5	1.5
S16	2.5	3.5
S17	2.5	2
S18	1.5	1.5

N=18

A matched-sample t test (two-tailed) at  $\alpha = .05$  was conducted to check whether there was a statistically significant difference between the means of the reading span tests across languages. The t test shows that there is no significant difference between the two means,  $t(17) = .025$ ,  $p = .568$ . This result replicates the one of the pilot study.

Table 4.2 displays the descriptive statistics for reader's ability to construct the general main idea of the text in L1 and L2 when the text is undersignalled - the Mean (M), the standard deviation (SD), and the reading ability scores of each participant.

Table 4.2  
Descriptive statistics for the measures of reading ability in L1 and L2

	L1	L2
<u>M</u>	2.17	2.33
<u>SD</u>	.92	.66

S	M IDEA	M IDEA
S1	3	3,5
S2	2	3,5
S3	2	2
S4	3	2
S5	4	2
S6	2	2
S7	2	2
S8	1	2
S9	1	1
S10	3	3
S11	2	3
S12	3	2
S13	3	3
S14	2	2

S15	2	2
S16	0	3
S17	2	2
S18	2	2
<b>N = 18</b>		

Another matched-sample t test (two tailed) at the .05 level of significance was conducted to check whether there is a significant difference between the means for the measures of reading ability (L1 and L2). The t test indicates that there is no statistically significant difference between the means,  $t_{.025}(17) = .513$ .

#### 4.1.2 Correlational Analysis

This section presents the results of statistical correlational analyses, the Pearson Product Moment Coefficient of Correlation (one-tailed), on the reading span test and reading comprehension measures (see scatter diagrams below). To perform the correlational analysis, a computer program was used, the SPSS (1999).

The section retakes six hypotheses which were based on the general assumption stated above. That is, readers would be able to construct the main idea of a text provided that one condition was met, they had sufficient working memory resources.

Hypothesis (a) predicted that working memory (as measured by the L1 reading span test) would correlate positively with the reader's ability to construct the main idea in L1. Results from the Pearson Product Moment Coefficient indicate that there is a statistically significant correlation between L1 reading span and ability to construct the general main idea of the text in L1,  $r(18) = .448$ ,  $p = .031$  (see figure 4.1. below).

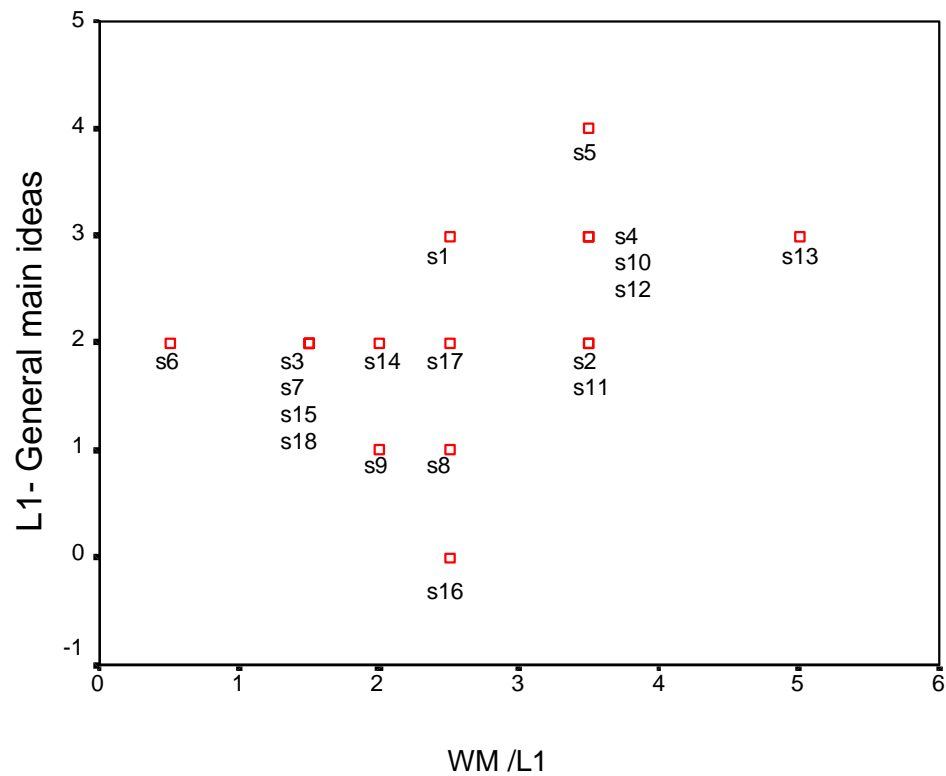


Figure 4.1: Scatterplot: L1 General Main Ideas X L1 Working Memory

With respect to the strength of the present correlation between reading span (L1) and reading comprehension in L1: this correlation was weaker than the correlations reported in previous studies. For instance, Daneman and Carpenter (1980) found that the reading span test correlated with a specific component of reading comprehension, namely, the ability to compute pronominal references. Their correlation was impressive,  $r(18) = .90, p < .01$ . The difference in the strength of these correlations can be attributed to various factors because there are several procedural differences between the two studies. To cite a few of them: the measures used by Daneman and Carpenter differ from the ones used here. First, while the present study focuses on a global measure of reading ability, Daneman and Carpenter focused on a local sentence-to-sentence integration ability. Second, although the present reading span test and Daneman and Carpenter's test are similar in that both tests tap reader's storage and processing capacity, they are not exactly the same. In fact, there is a difference between these reading span measures: in their study, subjects were instructed to read the sentences aloud at

their own pace, while in this study, subjects read the sentences silently as each sentence was displayed on a computer screen at a rate of 9 seconds. Most importantly, despite these differences, it is still worth comparing results across studies because both studies have used valid measures of reading ability and working memory span, thus ensuring that the results in both studies are reliable. To conclude, the present correlation between working memory capacity (L1) and L1 reading ability may be weaker than the ones reported in previous studies, but it is significant. Given that, it is reasonable to argue that the present correlation corroborates previous findings in the literature.

Hypothesis (b) was based on the assumption that working memory (as measured by the reading span test L2) would correlate positively with the reader's ability to construct the main idea in L2. Results from the Pearson Product Moment Coefficient show that the correlation between L2 reading span and ability to construct the general main idea of the text in L2 did not reach significance,  $r(18) = .372$ ,  $p = .064$  (see figure 4.2, below). In fact, such correlation is weaker than the correlation found by Harrington and Sawyer (1992) between L2 reading span and the TOEFL Reading section,  $r(30) = 0.54$ ,  $p < .001$ . The difference in the strength of these correlations may possibly be attributed to a factor: the measure of reading ability used by Harrington and Sawyer differs from the one used here. In Harrington and Sawyer's study, reading ability has been operationalized as performance on the TOEFL Grammar and Reading sections and a cloze test, and these are general measures of reading ability. In the present study, we have made an attempt to investigate how working memory relates to a specific reading process, namely, ability to construct the main idea.

Taking the result from the Spearman's Correlation Coefficient for Ranked Data, the correlation between L2 reading span and ability to construct the general main idea of the text in L2 reaches significance  $\rho(18) = .400$ ,  $p = .050$  (see Appendix K for the results of

Spearman's rho). Given that, it is reasonable to assume that hypothesis (b) is a borderline case.

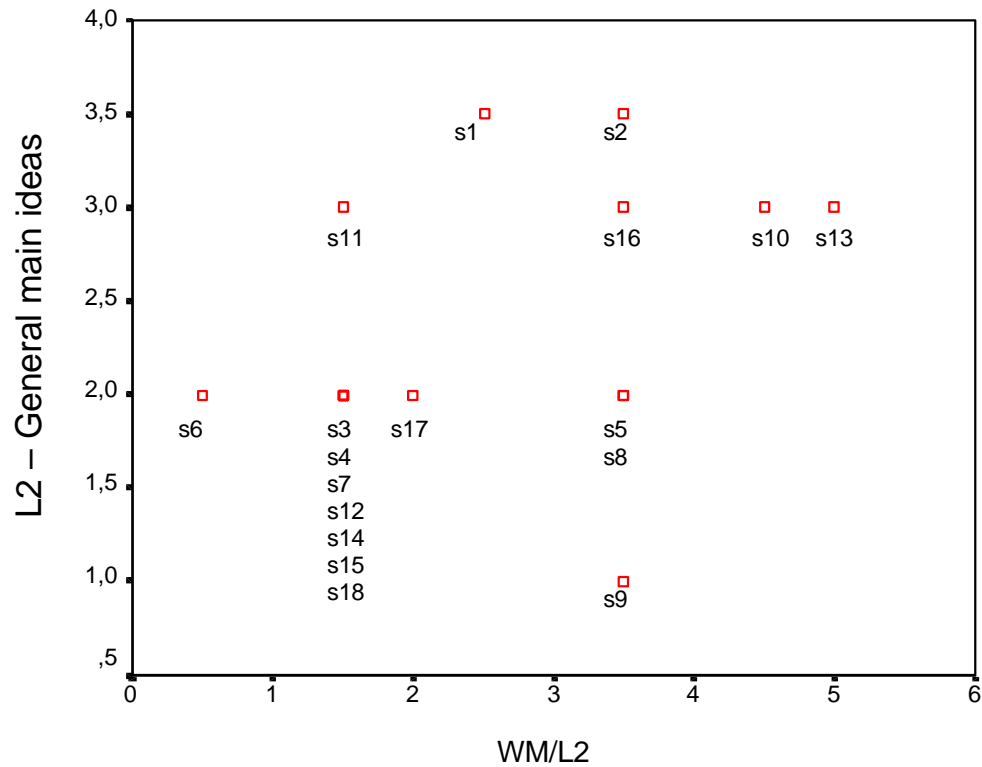


Figure 4.2: Scatterplot: L2 General Main Ideas X L2 Working Memory

The prediction made in Hypothesis (c) was that working memory (as measured by the L1 reading span test) would correlate positively with the reader's ability to construct the main idea in L2. Results show that there is a significant correlation between L1 reading span and ability to construct the general main idea of the text in L2,  $r(18) = .482$ ,  $p = .021$  (see figure 4.3, below).



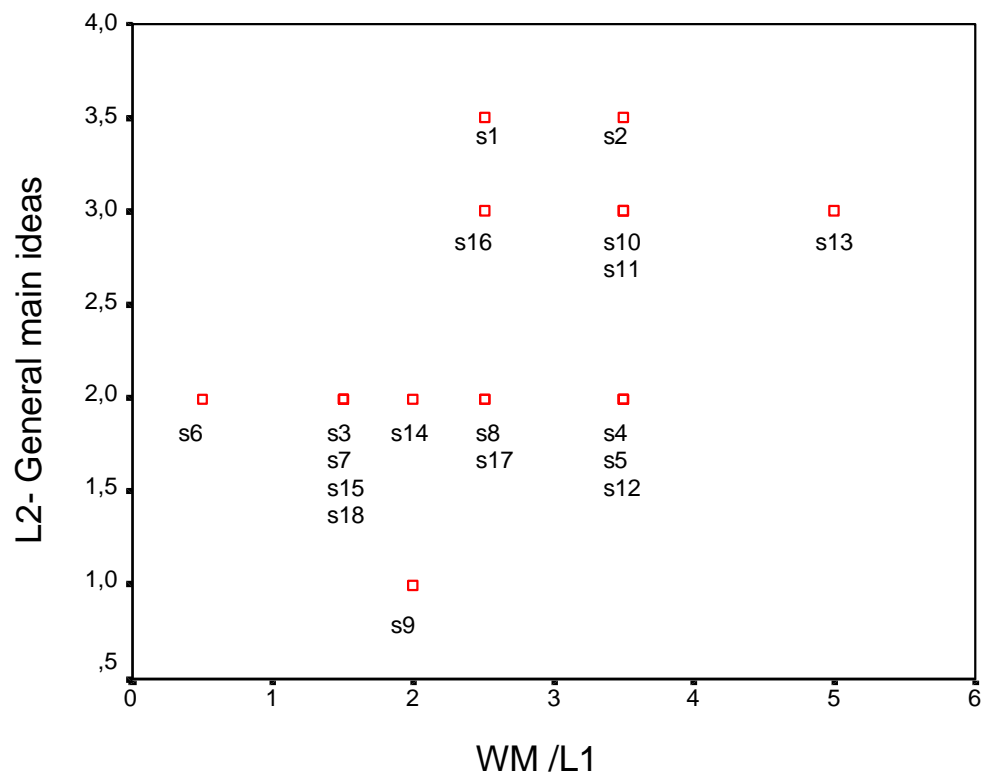


Figure 4.3: Scatterplot: L2 General Main Idea X L1 Working Memory

Hypothesis (d), which is converse to hypothesis (c), predicted that working memory (as measured by the L2 reading span test) would correlate positively with the reader's ability to construct the main idea in L1. No statistically significant correlation was found between L2 reading span and ability to construct the general main idea of a text in L1,  $r(18) = .033$ ,  $p = .448$  (see figure 4.4. below).

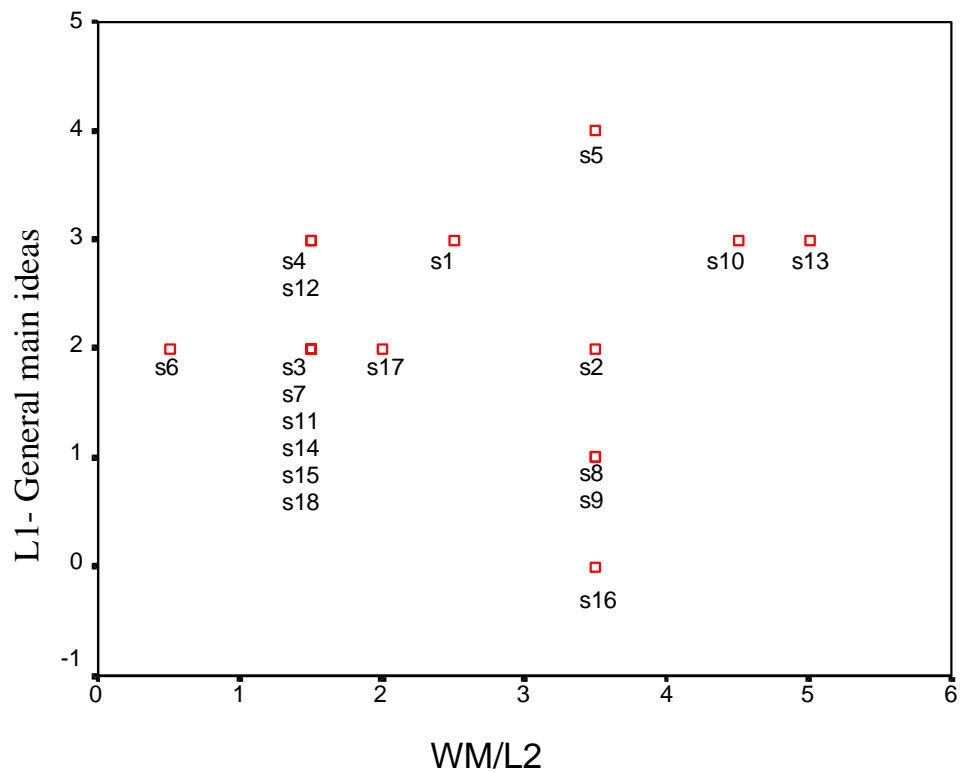


Figure 4.4: Scatterplot: L1 General Main Idea X L2 Working Memory

Table 4.3 reports the correlation coefficients calculated between the working memory capacity, as measured by the reading span test (RST), and reader's general ability to construct the main ideas.

Table 4.3

Pearson Product Moment Correlations between the Reading Span Test (RST) and general ability to construct the main ideas in L1 and L2.

	Reading Ability L1	Reading Ability L2
RST L1	.448*	
RST L2		.372*
RST L1		.482*
RST L2	.033*	

\*  $p < .05$   
N=18

To sum up, although the coefficient of correlations between working memory (L1) and reading ability (L1); working memory (L1) and reading ability (L2) were moderate, they reached significance, thus lending support to hypotheses (a), (c). Taken together, these results lend support to the general assumption which underlies the present investigation, that is, it was possible for readers to construct the general main idea of a text when the main idea was undersignalled as long as they had enough working memory resources. In other words, high-span readers were able to construct the main idea significantly more often than were low-span readers.

The results just presented above deserve further comments. On the one hand, results lend support to hypotheses (a) and (c) and seem to indicate the following: the variable working memory, as measured by the L1 reading span test, has a key role in the relationship between working memory capacity and reading comprehension in L1 as well as in L2. On the other hand, hypothesis (d), which is converse to hypothesis (c), was not confirmed, that is, the correlation between working memory capacity (L2) and the ability to construct the general main idea of the text in L1 did not reach significance. In short, the variable working memory, as measured by the L2 reading span test, does not seem to be important for the relationship between working memory capacity and reading comprehension in L1. Still, the variable working memory, as measured in L2, seem to have a role in the relationship between working memory and reading comprehension in L2 (hypothesis b): taking the result of the Spearman's Correlation Coefficient for Ranked Data, the correlation between L2 reading span and ability to construct the general main idea of the text in L2 reaches significance  $\rho(18) = .400$ ,  $p = .050$  (Appendix K).

Hypothesis (e) predicted that working memory capacity in L1 would correlate with working memory capacity in L2. Working memory was measured by the reading span test in

both languages. Results show that there is a fairly strong correlation between L1 and L2 reading span,  $r(18) = .644$ ,  $p = .002$  (see figure 4.5).

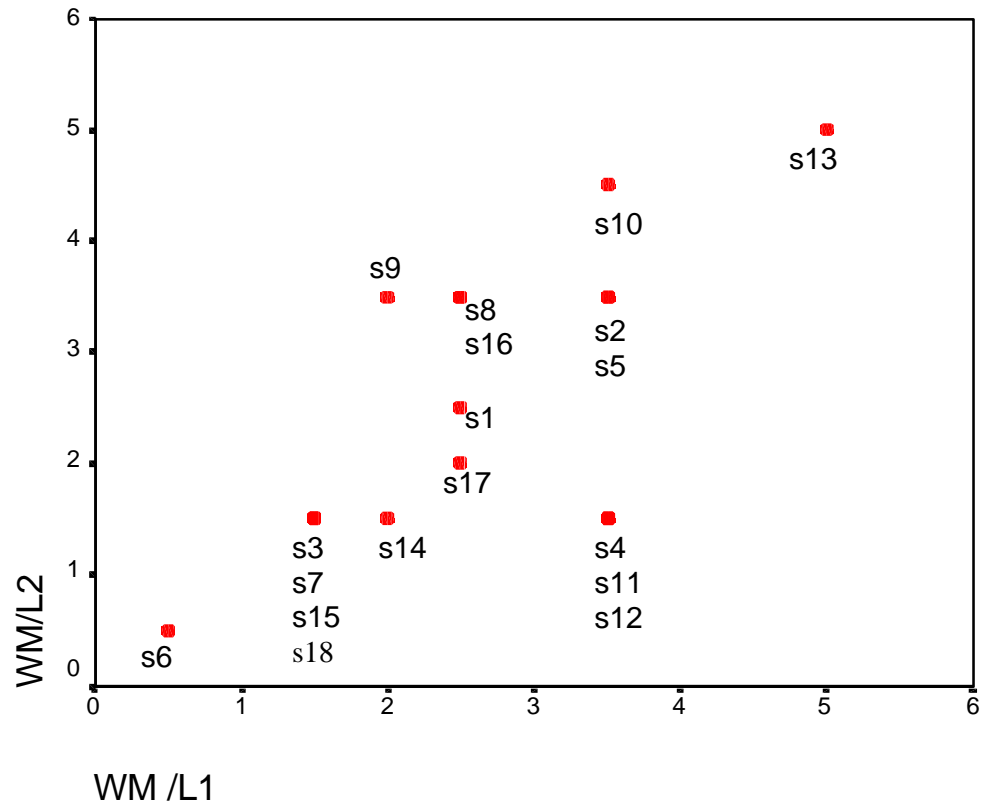


Figure 4.5: Scatterplot: L2 Working Memory X L1 Working Memory

The present correlation between L1 and L2 working memory to some extent replicates previous research findings: according to Harrington and Sawyer (1992), the correlation between working memory measures across languages, L1 Japanese and L2 English, was “in the moderate-to-strong range” (p.32),  $r(30) = .39$ ,  $p < .05$ . Mota (1995) found the strongest correlation,  $r(16) = .78$ ,  $p < .01$ , between working memory measures across languages, L1 Portuguese and L2 English.

The basic assumption underlying hypothesis (f) was that reader’s ability to construct the general main idea of the text in L1 would correlate positively with their ability in L2. The correlation between the reader’s ability to construct the general main idea of the text in L1

and L2 did not reach significance,  $r(18) = .144$ ,  $p = .285$  (see figure 4.6, below). This result is unexpected.

Two types of correlations have been found in this study, (1) between measures of working memory capacity across languages (see result above); (2) between measures of working memory capacity and of reading ability (see table 4.3 above). A third type of correlation has not reached significance, that is, the correlation between measures of reading ability across languages. The latter result is unexpected. In other words, because of the fairly strong correlation between working memory capacity and reading ability (Daneman & Carpenter, 1980; Tomitch, 1995, among others), it was expected that the correlation between measures of reading ability across languages would have a considerable overlap with the correlation between measures of working memory capacity across languages. While the correlation between measures of working memory capacity across languages was found, the correlation between measures of reading ability across languages was not. A possible explanation for this unexpected result has not been found.

Hulstijn and Bossers (1992) found that L2 reading comprehension and L1 reading comprehension scores were moderately correlated ( $r=0.59$ ,  $p < .01$ ), whereas L2 reading comprehension and L2 knowledge (i.e. grammar and vocabulary) were strongly correlated ( $r=0.83$ ,  $p < .01$ ). These correlations offered a first insight into the influence of L2-specific (i.e. grammar, vocabulary) and non-L2-specific factors (i.e. L1 reading comprehension skills) involved in L2 reading. To investigate further the relationship between L2-specific factors, non-L2-specific factors, and L2 reading ability, they conducted a stepwise regression analysis and came to the conclusion that the contribution of L2-specific knowledge for L2 reading comprehension far outweighed that of non-L2 specific factors. Given this result, it seems that poor reading in a foreign language is due to inadequate knowledge of the target language. On the other hand, to a smaller extent, non-L2-specific factors also contributed to L2 reading

comprehension, that is, such factors are also responsible for differences among L2 readers. In addition, Hulstijn and Bossers also tested another hypothesis: there would be a stronger relationship between L1 and L2 reading comprehension for the most skilled L2 readers of their sample. They calculated the Pearson Correlations between L1 and L2 reading comprehension for two groups: a group of the least and a group of most skilled readers of their sample. The correlation was almost non-existent for the least skilled readers ( $r=0.08$ ,  $p<.01$ ) and moderate for the most skilled readers ( $r=0.40$ ,  $p<.01$ ). According to their interpretation, these results indicate a trend, that is, the contribution of L2-non-specific factors such as L1 reading ability was more important for the most skilled readers.

In the present investigation, given that readers' level of proficiency in L2 is far beyond threshold level, that is, they do not have any problems with L2-specific knowledge (grammar, vocabulary, etc.), it seemed reasonable to assume that there would be a strong relationship between L1 and L2 reading comprehension. However, this expectation was not met.

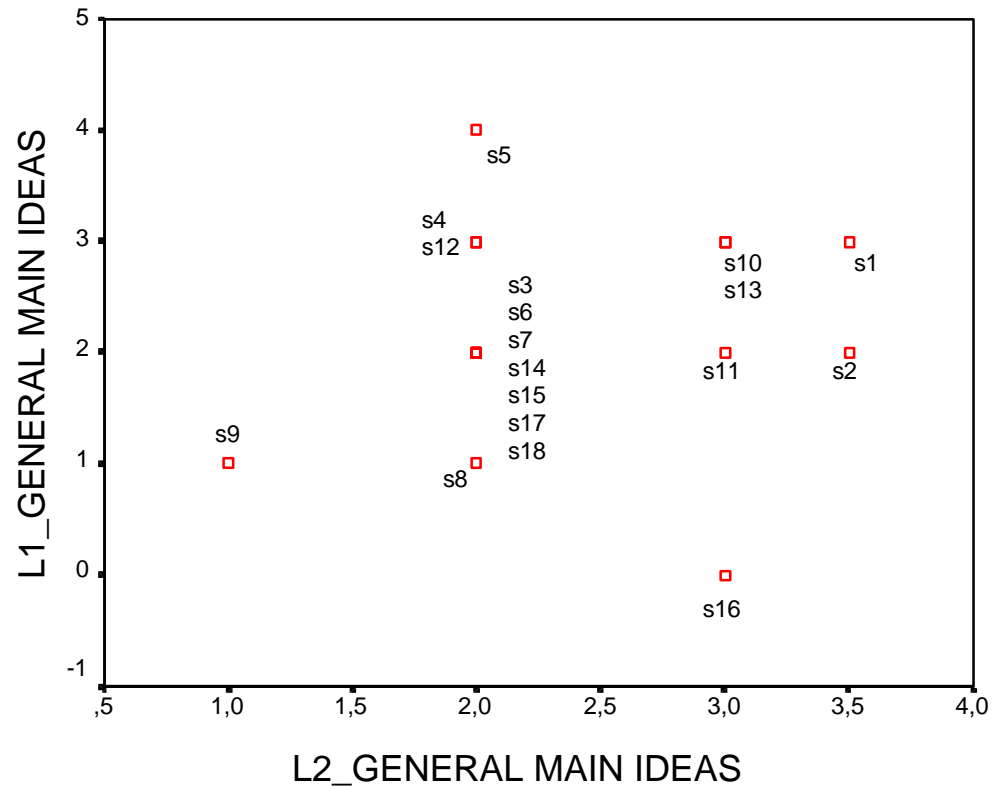


Figure 4.6: Scatterplot: L1 General Main Ideas X L2 General Main Ideas

Because of the number of participants in this study, and the nature of the data, another statistical test, Spearman's Correlation Coefficient for Ranked Data has been performed to confirm the results of the Pearson Coefficient of Correlation. As expected, the results of Spearman's Correlation provide further support for the results just reported above (see Appendix K for the results of Spearman's rho.).

## 4.2 Descriptive Analysis

### 4.2.1 Main Idea Construction Task - before, during and after Reading:

The present section aims to answer the following research question: how do readers conceive the task of main idea construction in (L1 and L2) texts when the texts are undersignalled?

Main ideas can be constructed before, during or after reading (Johnston & Afflerbach, 1985). In order to answer the question above, this section describes the strategies used for constructing main ideas before, during and after reading, as well as the strategies used for assigning importance to information. The section presents and analyses data which consist of excerpts from the think-aloud protocols. The excerpts were chosen as representative of the specific strategy used by participants while accomplishing the main idea construction task. As these are excerpts of a protocol, they may lack the contextual richness of the complete protocol, but are a more manageable form to present data (see Appendix A, for the entire protocol). Protocols were transcribed verbatim.

More specifically, the aims of this section are the following: to find out what are the strategies adult L1/L2 readers (proficient in L2) use for extracting the main idea of an undersignalled text in L1 and L2, what are the textual cues they pay attention to in order to assign importance to information; what actions they take when they fail to understand at the local level; as well as their resources for overcoming local problems, their resources to achieve a reasonable standard of coherence, what they do to integrate the text at a global level.



Constructing the main idea before reading. One type of general comprehension strategy indicates that readers are making an attempt to construct the main idea before reading, namely, anticipate content, which is a forward oriented strategy. Readers put forward a hypothesis about the main idea and try to verify or refine it while reading. In the excerpt below, the reader predicts that the paragraph is going to explain the type of transformation undergone by the hydrogen, “no começo do párrafo, ele está falando do hidrogênio que – que vai se transformar...”. This initial prediction guides the interpretation for the entire paragraph. In other words, the initial prediction enables the reader to set a clear goal, that is, s/he wants to find out how this transformation occurs, “...porque a gente quer saber o que que é essa transformação e – e – e como é que funciona...”.

... No começo do párrafo, ele está falando do hidrogênio [que]-0 que vai se transformar e aí também [já]-[já]- já causa um desconforto, né? Porque a gente quer saber o que que é essa transformação [e]- [e]- e como é que funciona, assim sem ler o resto, né? já. Ainda continua a leitura: “Com isso, diminui a fusão entre as moléculas de gás e começa um período de contração”, aí já [é]-0 [é]- causa mais desconforto ainda. [Pra]-0 pra resumir esse párrafo, eu acho que, (inint) até0 muito mais tempo [que o]- que os outros, porque tem [mais]- 0 maior número de informações, [porque o]-0 [porque é mais]-0 porque é mais complexo um pouco, né? Tá, esse quarto párrafo0 fala que quando [o]- o hidrogênio de uma estrela se esgota ele [vai]- vai começar a se transformar, ele já havia se convertido em hélio, aí depois o que vai acontecer? As partículas vão começar0 a se contrair0 e o astro vai começar a se expandir... (S18).

When readers have a great deal of knowledge about the content of the text, this strategy, anticipate content, is efficient and generates a reasonable main idea spending fewer working memory resources (Johnston & Afflerbach, 1985). This is an important strategy because it enables readers to develop a “proactive perspective” (Afflerbach, 1990a, p.131), with which the meaning of a text can be predicted. Furthermore, this strategy can even be used to help readers monitor comprehension (Afflerbach, 1990a). However, in the present study, participants had low knowledge about the topic of the texts. As a result, the strategy often failed and the initial hypothesis was either replaced or revised. It is noteworthy that the revising of a prior hypothesis may place additional demands on working memory because readers have both to maintain the initial hypothesis in working memory and to contrast the incoming information with the initial hypothesis in order to revise it. In the excerpt below, the fragment “não, espera aí” indicates that the reader is making an effort to monitor comprehension, and the initial hypothesis (when the hydrogen is used up, the star undergoes some transformation) is revised. Eventually, the reader is able to add some further information to his/her initial hypothesis, adding that the entire process of transformation undergone by a star depends on its mass. It is noteworthy that complementing an incomplete draft, or adding further information to a initial hypothesis is not as resource consuming as correcting a mistaken initial hypothesis.

... Aqui é quando o hidrogênio se esgota. Na maior parte0 o hidrogênio se esgota. Aqui quando falta o hidrogênio...0

ou seja, quando falta hidrogênio0 a situação se torna mais crítica. O que acontece?

Quando falta... 0 (inint) quando falta o hidrogênio [na estrela]-0 na estrela, por exemplo, o sol. “Sua contração transformará o corpo” terrestre...0 se a massa... Não, espera aí. Dependendo da massa... 0 ”Se a massa da estrela for...” 0 sua contração vai se

transformar no corpo terrestre. “Se a massa for de duas a três vezes a do sol, a contração será muito mais forte”. “Quando a massa é maior, a condensação” é mais violenta e sua densidade [é tão]- [fica]- torna-se (hes) (sussurros) por consequência os gases dessa camada periférica [se <tor- >]- se transforma em uma supernova. (sussurros) (S8).

Constructing the main idea during reading. In the excerpt below, while the participant is reading, s/he often stops input in order to summarise the information that has been read so far, that is, the participant stops to provide brief summary-words e.g. “descrição da estrela”, “ocorrem transformações”, “quais são essas conseqüências”. These summary-words might indicate that the participant is trying to condense the information into single units which will take less space in working memory (Johnston & Afflerbach, 1985). In short, the participant condenses smaller chunks of the text into summary-words, thus making further progress towards the main idea construction.

van Dijk and Kintsch (1983), Kintsch (1998) described some basic rules for extracting the gist of a text, namely, generalisation and integration rules. The application of such rules involves encapsulating lengthier chunks of information into single units. In the excerpt above, an integrative strategy similar to Kintsch’s rules has been used, that is, there was the replacement of a chunk of information by a single summary word which encompassed all the information in the chunk.

The encapsulation of information into single units may be considered one of the mechanisms used to minimise the demands on the storage of information. Just and Carpenter (1992) argue that storing a great deal of sentences may consume reader’s limited working memory resources. Given that, readers tend to develop countervailing mechanisms to minimise storage demands and keep the overall demands on working memory more

manageable. In short, it will save reader's storage resources to selectively maintain representations of only the important information in an activated form.

“O brilho e o tamanho da estrela variam pouco, ocorrendo apenas uma ligeira contração.” [descreve]-0 [descrição da estrela]-0 descrição...0

O que acontece com a estrela em relação ao brilho e ao seu tamanho. Ocorre mínima contração. O brilho e o tamanho da estrela <va-> varia pouco0 e isso faz com que ocorra uma ligeira contração. “É o caso do Sol, é outro exemplo. (sussurros) [Quando esse hidrogênio]-0 – [quando há escassez de hidrogênio]-0 – quando essa (“substância”) se esgota na estrela, ocorrem transformações. Que transformações são essas? Então esse parágrafo está falando sobre0 o que ocorre com a estrela0 quando0 uma boa parte do hidrogênio se esgota. [Quais são essas consequências0 – <des->]-0 [quais são as consequências] – quais são as transformações disso. O hidrogênio é (“transformado”) em hélio, diminui a fusão. “A quantidade de calor gerados é tão grande”. O astro se expande, o raio aumenta e o calor se dilui. E “a estrela vira uma gigante vermelha”, ou seja, quais são as transformações da estrela quando o hidrogênio se esgota. Tudo bem (S8) (emphasis added).

Constructing the main idea after reading. Readers tend to perform some operations to construct the main idea after reading a paragraph or an entire text. These operations have been classified as listing, topic-and-comment, draft-and-revise (Johnston & Afflerbach, 1985; Afflerbach, 1990b). The present section describes the strategies used by readers in order to perform such operations.

After reading a paragraph, readers may find themselves unable to formulate the main idea. Under these circumstances, readers may skim through the text selecting and “listing”

important words or phrases (Johnston & Afflerbach, 1985, p. 213). It is noteworthy that listing information might not lead readers to integrate the text or to extract the main idea. In the excerpt below, the reader keeps on reading parts of the text but eventually fails to extract the main idea of the third paragraph, that is, the reader does not mention that the star has reached an intermediate period, which is a stage of equilibrium.

Ah, tá! O terceiro parágrafo, fala-se (hes) [da] – da existência<sup>0</sup> que o <ca-> (hes) cerca de noventa por cento da sua existência ... <sup>0</sup> (hes) mas depois ele não continua: “Durante cerca de 90% da sua existência” o quê? Aí [o] – o caso do Sol, ok! O Sol<sup>0</sup> é um exemplo de estrela, mas [não] – não tem relação com “[noventa] – noventa por cento de sua existência.” Eu achei que [ficou meio] - <sup>0</sup> faltou alguma coisa nessa parte do texto. Problema de estrutura. Bom, o Sol, [aí] – aí depois ele explica melhor: “se encontra na fase intermediária da sua existência, sofrendo mínima <condensa-> condensação.” Que se relaciona com ligeira contração, mas [não] – não ... o <te-> essa parte do texto não é muito claro. É terceiro parágrafo fala [sobre] – (hes) sobre<sup>0</sup> a existência da estrela, o tempo de existência. Mas ela não ... essa parte não é uma parte muito clara. (S3)

Having read through a paragraph, readers may find that they are only halfway towards the main idea. This might occur due to difficulties with the topic of the text (Johnston & Afflerbach, 1985). This halfway point might indicate that readers are able to formulate a topic such as “A ideia geral do texto é: está falando sobre as partículas de gás, geralmente hidrogênio. Elas vão se – elas vão se formar - vão se transformar numa estrela”, but they are unable to qualify this topic with a conclusive comment. Under these circumstances, the reader might skim, then list parts of the texts. This may be an attempt to load working memory with

“pre-digested” information. However, the loading will not be useful unless the reader manages to integrate such information. It is noteworthy that the loading postpones a final judgement about the main idea. In the excerpt below, a final judgement has been reserved till more text is read. The fragments “depois ele começa”, “daí ele explica”, “aí o que acontece” indicate that the reader is listing parts of the text in a sequence of comments till being confident enough to state the main idea. Such fragments may be an indication that the reader is making an effort to break the construction task into a more manageable subtask, that is, a less resource-consuming subtask. Johnston and Afflerbach (1985) have labelled this operation as “topic-comment”. It is noteworthy that this operation is quite responsive, that is, the reader is able to recognise that only a topic has been constructed, but it still requires further qualification (Johnston & Afflerbach, 1985).

A idéia geral do texto é: está falando sobre as partículas de gás, geralmente hidrogênio [ela vão se] – elas [vão se formar]- vão se transformar numa estrela. Depois ele começa a falar [da] – das reações que acontecem <den-> dentro dessa estrela e0 fala [do] – da duração [do] – da luz ou não, do tamanho das estrelas e0 de que tipo [de] – [de] – de estrela, dependendo [do] – do tamanho ou da idade (hes) acho que idade ele não fala. (hes) Pode-se formar, daí ele explica que0 quando o hidrogênio que é o gás [que a maioria [das] – das estrelas]- de qual a maioria das estrelas é composto0 começa a ficar rarefeito, aí, o que acontece [são]- são várias0 reações0 [que podem]-0 e que podem0 transformar esse astro em três tipos: um astro que ele chama de moribundo, um pulsar0 ou uma supernova. Acabou (S18).

Johnston and Afflerbach (1985) have identified another halfway point, which was not a definite topic, but rather a rough draft of the main idea. It seems that the reader is

dissatisfied with the main idea and goes on to revise the draft until the main idea statement feels more accurate. To perform the operation of draft-and-revise, the reader in the excerpt below uses the strategy interpret the text, indicating that s/he was able to draw a final conclusion based on an earlier draft.

In the next excerpt, the reader starts with a general statement, that is, initially, the reader states that the author is talking about drugs, such as nicotine, then about molecules of insulin: “...Ele fala que é... Ele fala de algumas drogas, depois – depois ele fala sobre moléculas de insulina”. Reading further, the reader goes on to elaborate on his prior main idea statement and eventually realises that drugs will be taken through the skin, thus pills and injections will no longer be used. The fragment, “Ok! Agora eu entendi.”, seems to indicate that the reader has refined his/her earlier assumption.

[Esse segundo] - esse segundo parágrafo0 (hes) fala que <algu-> algumas drogas como0 a nicotina...0 Não está bem elaborado. [Ele] - ele não se <rela-> <re-> se relaciona com o primeiro. Ele fala que é... 0 (hes) Ele fala de algumas drogas, [depois] – depois ele fala sobre moléculas de insulina. Que você pode0 (hes) esfregar insulina na sua pele o todo dia0 e ela não entrará, mas ela não se relaciona0 muito. Que nicotina e hormônios podem ser entregues através da pele? Podem <se-> podem entrar através da pele, mas a insulina não. Ok! Agora eu entendi. (hes) Então, o segundo parágrafo se [ao]- ao primeiro0 é que pelo...<f-> se0 (hes) essas0 (hes) pílulas0 e agulhas serão coisas do passado, muitas coisas poderão ser (hes) <intra-> intravenosas. Então, (hes) você pode, através da pele, (hes) injetar [o]-0 o remédio, né? No caso da nicotina e hormônios, mas como as moléculas de insulina são muito grande, [elas não entrarão] – elas não penetrarão na pele. [Essa] – essa é a idéia [da]-0 do parágrafo dois. (S3)

#### 4.2.2 Assignment of Importance

In addition to strategy choice, there is another important aspect of the main idea construction task, namely, the assignment of importance to information (Johnston & Afflerbach, 1985). There are three general sources of information that readers use to assign importance: knowledge-based cues, text-based cues (Kintsch, 1998; van Dijk & Kintsch, 1983), and the readers' beliefs about the writer (Johnston & Afflerbach, 1985). In the construction task, assigning importance, organising, and integrating information are intertwined. To sum up, besides behaving strategically, readers use in a flexible way different sources of information in order to determine levels of importance. Next, excerpts from protocols will be examined in order to find out how readers assign importance.

Knowledge – based cues as a key factor in assignment of importance. Previous research has shown that familiarity with text relevant information plays a major role in the assignment of importance during the task of main idea construction (Johnston & Afflerbach, 1985). In the present study, the topic of both texts were meant to be unfamiliar to readers. During the pilot study, an attempt was made to control the variable familiarity. Although both texts were meant to be equally unfamiliar, the L2 text turned out to be more familiar than the L1 text. Still, the L2 text was not so familiar as to enable readers to construct the main idea automatically.

Due to lack of familiarity with the topic of the L1 text, when readers found something familiar such as a word or a phrase, the familiar item was considered important. As in the excerpt below, the reader focuses on the word “fusão” so as to extract the main idea of the paragraph. It is noteworthy that the reader below is able to comment on his behaviour. “...No segundo parágrafo, eu me direcionei logo à fusão...(S5)”.



...Quando eu volto vou0 tentar fazer o resumo [do] - do parágrafo, eu procuro0 (hes) identificar algumas palavras-chaves.

No segundo parágrafo, eu me direcionei logo à fusão0 e à quantidade de calor pra poder0 perceber [o] - conteúdo do parágrafo. Que, no caso, é exatamente esse né? Que [a] – a fusão das partículas, ela gera uma grande quantidade de calor e luz (S5).

Johnston and Afflerbach (1985) go on to explain that specific words might be used as “focal points” or some foundation from which the main idea statements might be constructed (p.215), i.e. “gravitacionais”, “hidrogênio”, “partículas de gás” in the excerpt below are being used as focal points.

Eu termino o parágrafo e normalmente eu volto pra ler quando tem algumas palavras (hes) que não são comuns no meu vocabulário cotidiano, como por exemplo, <gave-> gravitacionais, (hes) hidrogênio, partículas de gás. (hes) Está falando a respeito de um0 (hes) astrônomo que comenta como as estrelas são formadas. Então, que elas seriam formadas a partir [de]-0 partículas de gás, né? [que <ju->]- que estão soltas no universo e que vão se juntando aos poucos (hes) através da força gravitacional (S12).

In conclusion, words or phrases have an important role, serving as the basis for the main idea construction task in unfamiliar texts when prior knowledge is lacking. This observation supports Gernsbacher’s (1997) views. According to her, the initial process of comprehension involves laying a foundation. That is, comprehenders tend to use initial segments (e.g. words, sentences, pictures) to lay foundations for their mental representations of larger units (e.g. sentences, paragraphs, story episodes). In the present study, in addition to being unfamiliar, the L1 text was undersignalled in order to prevent readers from taking

advantage of topic sentences. As a result, familiar words had a key role in helping readers lay a foundation for the comprehension of a text which is both unfamiliar and undersignalled.

It is beyond the scope of the present study to investigate the influence of readers' goals on the main idea construction task. However, it cannot be denied that the assignment of importance is always related to some specific goal, to reader's conception of the task (Kintsch & van Dijk, 1978), and their standards of coherence. In addition, readers tend to adjust their goals as comprehension problems arise (Johnston & Afflerbach, 1985), and they might allocate their working memory resources in order to fulfil these goals.

When readers came across unfamiliar words, they often described importance assignment processes as they made decisions to allocate resources (Johnston & Afflerbach, 1985). For instance, the participant in the next excerpt encountered the phrase "zapping charged", s/he claimed to be unfamiliar with the phrase, but decided that this phrase was not important enough for him/her to spend working memory resources to figure out its meaning. Although the participant did not spend resources figuring out the unfamiliar phrase at a local level, the participant went on reading and in the end was able to formulate a general main idea statement for the paragraph, which might be an indication that the participant was reading in a more global way.

Voltei para a expressão "zapping charged", eu não estou conseguindo, pelo contexto, definir o que é. Vou tentar ler de novo. (hes) Essa frase0 essa <pri-> "<A>-according to researchers" até "pushing them into the skin" 0 é uma coisa que não está clara para mim. Eu vou continuar lendo para ver se0 faz sentido. Agora eu vou voltar ao início do parágrafo pra ler0 todo, pra ver se0 eu consigo entender. O parágrafo é sobre o funcionamento desse0 adesivo que o cara inventou, mas0 pelo <vo-> vocabulário, as estruturas eu não estou conseguindo entender como é o funcionamento, realmente,

[da]-0 coisinha, lá. Eu sei que de alguma forma0 (hes) a pele vai sendo, microscopicamente, (hes) perfurada e que é possível0 autoaplicar insulina através desse mecanismo, mas0 qualquer outro detalhe não está muito claro para mim (S5).

Some unfamiliar terms were assigned importance. In the excerpt below, it is possible to infer that the word “jolt” was assigned importance because the participant allocated a considerable amount of processing resources, using a local strategy to try to figure out the meaning of this specific word from the context. In short, the reader has attributed comprehension failure to the word “jolt”, then this word was assigned importance.

“Jolt”, eu não conheço essa palavra. “Jolt of <ec>-electricity”. Tem que ser alguma coisa0 como carga de eletricidade ou um tipo de0 instrumento. É ele deve ser um instrumento, porque eles estão falando que não conhecem ainda0 a voltagem exata0 pra se fazer isso, pra0 abrir as membranas. Ou uma rajada de eletricidade, algo assim. Bom, vou voltar a ler o último parágrafo, que ele é maior, pra entender melhor o que eles estão querendo dizer. Bom, então eles falam que os pesquisadores, eles0 sabem que essa carga de eletricidade poderia abrir [uma] – a <me-> membrana da célula, mas eles não sabem precisamente, a voltagem...(S14)

Text-based cues as a key factor in assignment of importance. In addition to using what they know about a topic to assign importance, readers also used cues from the text or from their knowledge of text structure (Johnston & Afflerbach, 1985).

Readers may assign importance by noting the author’s repeated use of the same concept (Johnston & Afflerbach, 1985). The overlapping concepts can be used as a key for constructing a main idea statement for the entire paragraph (in general reader’s demonstrated

actions predicted by models of text comprehension: Kintsch & van Dijk, 1978; van Dijk & Kintsch, 1983). In the excerpt below, the reader perceives that “as partículas de gás - hidrogênios”, “as partículas de gás soltas no universo”, “as partículas de gás, o hidrogênio, se concentram devido as forças gravitacionais” “uma gigantesteca nuvem de gás” are the concepts which are being reinstated, and will eventually contribute to construct the main idea statement. That is, the reinstatement enables the reader to conclude that the paragraph refers to the formation of a star, “como a estrela se forma”. In the excerpt below the reader had to use the strategy integrate information so as to put together the overlapping concepts.

De acordo. (hes) As partículas [de gás] – hidrogênios. De acordo com pesquisa feita na Universidade de São Paulo, partículas de gás, ou seja, [o] – o hidrogênio, [elas] – 0 [elas] – 0 as partículas de gás soltas no universo, de modo geral, a medida [que os] – [o] – as partículas de gás, o hidrogênio, se concentram0 devido as forças gravitacionais, eles formam0 o que chamamos de estrela “uma gigantesca nuvem de gás”. [Como a estrela se forma]-0 como a estrela se forma (S8).

Words or concepts did not have to be identical because readers may construct meaning from overlap of related concepts rather from repetition of the same concept. This operation has been called ‘listing’ by Johnston and Afflerbach (1985): when readers list concepts either they are just listing concepts which they fail to integrate, or they are able to establish a context of important concepts or words so as to trigger the process of main idea construction. In the excerpt below, the reader lists: “a morte da estrela”, “o hidrogênio se esgota”, “ela passa por transformações drásticas”, “as consequências desse esgotamento”. The reader is successful and manages to extract the main idea.

Pausa, retornar ao início do parágrafo. O parágrafo fala da morte da estrela. Quando o hidrogênio se esgota e ela passa por transformações muito drásticas. O último parágrafo fala das consequências dessa – <trans-> [dessas]– (hes) desse esgotamento (“drástico”) do hidrogênio, das transformações que, de acordo com o tamanho [da] – da estrela, ela pode se transformar num astro que não consegue segurar os gases da periferia, mas pode acabar [num] – num buraco negro, se a densidade for muito alta...(S5).

Readers were also taking advantage of text structure so as to better understand a specific paragraph. This strategy can be used regardless of readers’ knowledge of specific content domain and; consequently, it can be used in situations in which the reader lacks relevant content knowledge (Johnston & Afflerbach, 1985). In the excerpt below, the reader perceives that in the third paragraph (L2 text), the author mentions a solution to a problem that has been previously stated. This is an indication that the reader was able to recognise at least part of the structure of the experimental text (situation-problem-solution-evaluation).

Então, [e] - e no parágrafo três (hes) esse <Prau-> Prausnitz, ele desenvolveu umas agulhas microscópicas (hes) [que] – [que <po ->] que possa (hes) injetar? (hes) remédios através da pele. Então, isso seria, basicamente, uma solução pro problema de moléculas de insulina. Apesar desse texto não <ester-> ser bem escrito, porque é uma coisa não está ligando a outra. Dá pra entender [o que] – o que eles querem transmitir. Que no futuro [não vai] - não vai haver mais pílulas e agulhas (hes). Algumas drogas como a nicotina e os hormônios podem ser (hes) [injetados através, né?] – penetrados através [da] – da pele. No caso da insulina não, porque é muito grande, mas (hes) esse pesquisador traz [uma] – uma solução. Que é um dispositivo

que você pode transportar drogas através [da] – da pele. Esse o parágrafo três. (S3)  
(emphasis added).

According to Johnston and Afflerbach (1985), not only do readers use text structure, but they also use the paragraph structure to better understand a specific paragraph. However, readers in this study did not often use the paragraph structure. This might have happened because the experimental texts were undersignalled, and some of the topic sentences and words which signalled the local structure within the paragraphs were removed. It is noteworthy that although the texts had been undersignalled and readers did not take advantage of paragraph structure, some readers were still able to use knowledge of text structure to integrate parts of the text (see excerpt just above).

Readers often used the relationship between paragraphs to try to make sense out of a segment of the text (Johnston & Afflerbach, 1985). This is suggested in the next excerpt in which the reader was attempting to construct the main idea of a paragraph by using the strategy integrate to join two adjacent paragraphs. This strategy is essential for establishing coherence and for deep understanding. In the excerpt below, the strategy is resource-consuming because it is backwards oriented. That is, the reader had to reinstate previous information in working memory in order to integrate information previously read with information being currently read. As suggested in the next excerpt, while the reader was reading the second paragraph, he reinstated the first one.

[Esse segundo]- esse segundo parágrafo0 (hes) fala que <algu-> algumas drogas como0 a nicotina... 0 Não está bem elaborado. [Ele]- ele não se <rela-> <re-> se relaciona com o primeiro. Ele fala que é... 0 (hes) Ele fala de0 algumas drogas, [depois]- depois ele fala sobre moléculas de insulina. Que você pode0 esfregar

insulina na sua pele o todo dia0 e ela não entrará, mas ela não se relaciona0 muito. Que nicotina e hormônios podem ser entregues através da pele? Podem <se-> podem entrar através da pele, mas a insulina não. Ok! Agora eu entendi. (hes) Então, o segundo parágrafo se [ao] ao primeiro0 é que pelo...<f> se0 (hes) essas0 (hes) pílulas0 e agulhas serão coisas do passado, muitas coisas poderão ser (hes) <intra-> intravenosas. Então, (hes) você pode através da pele, (hes) injetar [o]-0 remédio, né? No caso da nicotina e hormônios, mas como as moléculas de insulina são muito grandes, [elas não entrarão]- elas não penetrarão na pele. [Essa]- essa é a idéia [da]-0 do parágrafo dois. (S3) (emphasis added)

The writer as a factor in the assignment of importance. When readers assign importance, they also take the writer into account. Reader's assignment of importance may be influenced by their reactions to the author's particular style of writing (Johnston & Afflerbach, 1985). In addition, readers make inferences about the author's intent, and react for or against the author's views. However, in the present experiment, while reading in L1, participants did not often react to the author's views. There are two possible explanations for this trend, firstly, participants were assigned texts of popular science, and science tends to be considered as objective and not related to the author's personal views; hence, the author might have been regarded as a mere reporter of scientific facts. Secondly, because participants were low knowledge about the topic of the text, they often reacted to texts in terms of recognising their own lack of familiarity with the content, instead of reacting to author's position. This seems to be true for the L1 text. In fact, participants claimed that they were not in the habit of reading texts such as the one in L1, "...Eu preciso voltar, ler em voz alta, porque o assunto não é – do meu – da – da minha esfera de - de leituras habituais...(S 11)"; "...'Partículas de gás' é o tipo de texto que eu não costumo ler, então, fica confuso...(S6)".

While reading in L2, participants often reacted to text in terms of recognising structural problems, which is quite understandable because participants were assigned modified texts. Indeed, a prominent feature of the experimental texts was lack of signals. As participant three in the excerpt just above has put it, “Esse segundo – esse segundo parágrafo fala que algu-algumas drogas como a nicotina... Não está bem elaborado. Ele – ele não se rela-re- se relaciona com o primeiro...(S3)”. In short, this participant was able to perceive that there are some linking words missing between the two paragraphs. As s/he went on,

... Mas [não]-não desenvolve o assunto, ele (hes) [é um]- 0 ele0 solta uma idéia, mas [essa]– essa idéia não é desenvolvida. Então, esse texto é muito vago0 [da]- que dá pra ver entre um parágrafo e outro0 que [não tem]– não tem algo que ligue, né? [não tem]- não tem ganchos, não há ganchos aqui (S3) (emphasis added).

In addition, some readers were able to react to the L2 text by giving an appraisal of the new technology being described. As we can see in the next quotation, participant one questioned whether the technology that is said to be the latest development is really innovative, “...microagulhas, né? Apesar de serem pequenas, na minha opinião ainda são agulhas, então, é um, apenas um – uma – um melhoramento de um –um método mais antigo, né? ele tem que ser por agulhas (S1)”. There is a possible reason why participants were more critical of the information presented in the L2 text: the topic of the L2 text, which is related to health, might have been more common than the topic of the L1 text; as a result, participants could add their personal views to it. By contrast, readers might have been too unfamiliar with the topic of the L1 text to question information, and even to take a position for or against the author.



Conditional importance. Participants also assigned what has been called “conditional importance” to some parts of the text (Johnston & Afflerbach, 1985, p.221). Conditional importance is subject to adjustment as further information comes in, that is, further information may reinforce or weaken previous assignment of importance. In the excerpt below, initially, the participant ascribes importance to a description of stars in terms of their brightness and size. However, as the participant goes on reading, s/he reviews his/her earlier position. That is, the participant concludes that the change in brightness and size of a star is only a sign of a transformation, and the key point of the paragraph is the transformation undergone by the star as hydrogen becomes scarce and is transformed into helium.

“O brilho e o tamanho da estrela variam pouco, ocorrendo apenas uma ligeira contração.” [descreve]-0 [descrição da estrela]-0 descrição...0

O que acontece com a estrela em relação ao brilho e ao seu tamanho. Ocorre mínima contração. O brilho e o tamanho da estrela <va-> varia pouco0 e isso faz com que ocorra uma ligeira contração. “É o caso do Sol, é outro exemplo. (sussurros) [Quando esse hidrogênio]-0 – [quando há escassez de hidrogênio]-0 – quando essa (“substância”) se esgota na estrela, ocorrem transformações. Que transformações são essas? Então esse parágrafo está falando sobre0 o que ocorre com a estrela0 quando0 uma boa parte do hidrogênio se esgota. [Quais são essas consequências0 – <des->]-0 [quais são as consequências] – quais são as transformações disso. O hidrogênio é (“transformado”) em hélio, diminui a fusão. “A quantidade de calor gerados é tão grande”. O astro se expande, o raio aumenta e o calor se dilui. E “a estrela vira uma gigante vermelha”, ou seja, quais são as transformações da estrela quando o hidrogênio se esgota. Tudo bem. (S8)

### 4.2.3 Working Memory Management Process

The excerpts below corroborate previous research findings, indicating that experimental texts should be difficult enough to tax reader's working memory. However, the experimental texts cannot be unreasonably difficult (Coté & Goldman, 1999). That is, if the text is too difficult, readers will not have enough working memory resources available to cope with the demands of the main idea construction task. Neither can such texts be too easy. That is, under favourable circumstances, readers will have enough working memory resources to perform the components of the reading process automatically. As a result, they will fail to report their strategies for the main idea construction task (Johnston & Afflerbach, 1985). To conclude, the present results support previous claims: the experimental texts should be difficult enough to prevent automatic processing, leading readers to monitor for both content and strategy use. In addition, individual differences in working memory capacity are not manifest unless the comprehension task is difficult (Just & Carpenter, 1992). Despite being difficult, these texts should tax working memory only to a certain extent.

During the piloting of this study, an attempt was made to produce experimental texts which would not favour the reader, then the original texts had to be modified. However, there were circumstances in which a participant found a paragraph easy. Under favourable circumstances, many components of the reading comprehension process became automated. As a result, little information about the comprehension process was revealed in the think-aloud protocols. This finding has been predicted by most authors who wrote about verbalisation (Coté & Goldman, 1999; Johnston & Afflerbach, 1985, Afflerbach, 1990b). The excerpt below indicates that the participant (S1) might have found the paragraph easy: there was no report of comprehension strategies and the main idea construction process was

automated. The participant in the excerpt below is a mid-span reader, who scored 2.5 in both L1 and L2, in a scale ranging from 0.5 to 5.

O primeiro parágrafo fala, (hes) diz que no <fu-> no futuro (hes) os remédios que nós tomamos (hes) [serão]-0 (hes) serão tomados não mais através [de]-0 pílulas ou injeções (S1).

Going to the other extreme, readers faced processing difficulties as their working memory started to reach capacity limitations (see Johnston & Afflerbach, 1985 for a similar description). The extreme of this situation took place when a reader found a paragraph too difficult, and working memory was on the verge of overloading. As a result, the reader had to make a huge effort to construct the main idea. In the excerpt below, the reader kept on re-reading the text, and brought prior knowledge into play, but was unable to integrate the text so as to construct the main idea. It is noteworthy that the participant in the excerpt below (S18) is a low-span reader. In both L1 and L2 s/he has scored 1.5.

O quinto parágrafo. Aí, mais uma pausa (hes) depois da primeira frase. (hes) “Em um outro período, [quando falta hidrogênio]- quando a falta de hidrogênio torna-se crítica, apesar da rápida expansão, a fusão entre os gases diminui continuamente”, (toss) aí [vem]-0 remonta a idéia de fusão e a gente tenta <imagi-> voltar pra química, pra física, lembrar o que é fusão, o que que é estado de ebulição, o que que o processo e tudo. Aí, já tem que ler mais uma vez. Eu li duas vezes, o problema já0 foi resolvido. Mais uma pausa0 na segunda0 frase do0 quinto parágrafo: “Se a massa da estrela for até duas vezes a do sol, sua contração transformará o corpo celeste em um pequeno astro moribundo,” aí também a quantidade de informação, <pri-> principalmente,

depois do “se a estrela for até duas vezes ao – a do sol”, depois dessa informação sua <contro>-contração transformará o corpo celeste e em aqui acho que deve ter um erro [de <gr->]- de grafia, não sei. “Em um pequeno astro moribundo, cuja gravidade já não consegue segurar os gases na periferia”. Ai já tem que ler, acho que umas cinco vezes, porque tem que entender de novo...(S18)

In between these two extremes, comprehension difficulties arose, but readers were still able to construct the main idea. Such difficulties probably arose because the experimental texts were undersignalled, and taxed working memory. Due to these difficulties, readers’ strategies for main idea construction became de-automated, then available for them to report. Next, an excerpt from the protocol of participant 11 will be presented. Reading the paragraph below, one will have the opportunity to compare the performance of different participants (S11 - below) and (S1 - above) as they constructed the main idea of the same paragraph (first paragraph - L2 text). While participant 11 faced processing difficulties, participant 1 was able to extract the main idea of the paragraph automatically.

Eu fiz uma leitura do primeiro parágrafo, agora [eu] - eu retorno. Foi uma leitura muito rápida, estou retornando. Que ele quer comentar aqui que remédios, né? comprimidos e agulhas serão coisa do passado, né? que as [pessoas] – as pessoas normalmente tomam remédios... (hes) foi desatenção, agora, deixa eu voltar. Desliguei um momento. O que ele fala [que]- que agulhas e comprimidos será uma coisa do passado, né? que- que [de]- um número grande de drogas novas que entram no mercado, muitos de nós ainda, né? tomamos remédios, né? <o-> <o-> ou injeções. “[pills]- pills and needles may be a thing of the past”. Mas ele acredita que no futuro

essa coisas0 como agulhas e <com-> comprimidos será uma coisa [do]- do passado (S11).

In the excerpt above, participant 11 considered her/his first reading of the paragraph too fast, thus feeling the need to re-read it. The fact that the reader was able to recognise this need may indicate that s/he was aware of processing difficulties, or at least aware of his/her difficulty in fulfilling the task (main idea construction), “Eu fiz uma leitura do primeiro parágrafo, agora eu - eu retorno. Foi uma leitura muito rápida, estou retornando”. Later on, the reader reinstated this need, that is, s/he said, “...agora, deixa eu voltar”. This participant was even able to evaluate her/his policy to allocate working memory resources “...foi desatenção, agora, deixa eu voltar. Desliguei um momento...”. S/he went on making an initial draft-proposal for the main idea” Que ele quer comentar aqui que remédios, né? comprimidos e agulhas serão coisa do passado, né? que as pessoas – as pessoas normalmente tomam remédios”. Through using a local strategy, translating from English into Portuguese, the reader was able to revise her/his initial position and extract the main idea. S/he concluded that “um número grande de drogas novas que entram no mercado, muitos de nós ainda, né? tomamos remédios, né... Mas ele acredita que futuro essa coisa como agulhas e com-comprimidos será uma coisa do –do passado”.

To conclude, it seems reasonable to assume that when readers face difficult texts, they may be able to construct the main idea as long as they have adequate working memory resources. In addition, when readers are able to recognise their processing difficulties, they may use strategies to overcome them. In the excerpt above, the reader (S11) used some local strategies (re-read, and translation) in order to make the task more manageable. The use of these strategies might indicate that the reader is faced with processing bottlenecks. As cited above, participant 11 was quite successful. That is, s/he slowed down processing through

using local strategies, but was still able to integrate the text at a more global level. In the end, s/he turned out as able to fulfil the main idea construction task.

#### 4.3 Individual Differences in Working Memory Capacity and Readers' Profile of Strategy

##### Use

The general aim of the present section is to investigate qualitative differences in working memory capacity. In order to conduct this investigation, the section addresses three research questions. Question (a) investigated whether it is possible to form groups of readers who have a similar profile of strategy use to construct the main idea of an expository text when the main idea is undersignalled (L1 and L2). In this section we are not concerned with local strategies, that is, we will focus on general strategies for comprehension-gathering and comprehension monitoring (Block, 1986). Question (b) investigated whether it is possible to form groups of strategies which have typically been chosen by a particular group of participants. If the answers to question (a) and (b) are affirmative, question (c) will investigate further, examining whether working memory capacity is associated with the specific strategies readers use to construct the main idea of a text when the main idea is undersignalled. More specifically, my aim is to compare participant's profile of strategy use in order to investigate whether the groups of participants, high and low-span readers, present a different or a similar profile of strategy use to construct the main idea of the texts (L1 and L2). In order to investigate whether reader's profile of strategy use is associated with their working memory span, two statistical techniques, namely, the Simple Correspondence Factor Analysis and the Cluster Analysis were performed (Escofier & Pàges, 1992). To perform these techniques, the computer program SPAD (2001) for windows has been used. This

section is descriptive and exploratory in nature, and results are presented in the figures (below) and frequency tables (below).

Five steps were taken to answer the research questions in this section: first, data was displayed in a frequency table (subjects vs. strategies), subjects in rows and strategies in columns (see table 4.4 / Portuguese and table 4.5 / English). The numbers in each cell indicate how often a particular strategy has been used by a given subject.

In the table 4.4 / L1 (just below), the titles that appear in each column stand for the following strategies.

L1GS_ANT	- L1 General Strategy - Anticipate Content
L1GS_STR	- L1 General Strategy Recognize - Text Structure
L1GS_INT	- Integrate Information
L1GS_QUE	- Question Information in the Text
L1GS_INTER	- Interpret the Text
L1GS_KNO	- Use General Knowledge and Associations
L1GS_BEH	- Comment on Behaviour and Process
L1GS_MON	- Monitor Comprehension
L1GS_COR	- Correct Behaviour
L1GS_REA	- React to Text
L1GS_RTFO	- React to Text in Terms of Form

Table 4.4.

## Frequency Table: Subjects x General Strategies (Portuguese)

ID_ SPADN	LIGS_ ANT	LIGS_ STR	LIGS_ INT	LIGS_ QUE	LIGS_ INTER	LIGS_ KNO	LIGS_ BEH	LIGS_ MON	LIGS_ COR	LIGS_ REA	LIGS_ RTFO	Total
s1	0	0	1	0	1	0	1	2	0	0	0	5
s2	0	0	0	0	2	0	0	0	0	0	0	2
s3	0	0	2	1	3	0	1	0	1	0	0	8
s4	0	0	0	0	0	0	0	1	0	0	0	1
s5	0	0	0	0	1	0	2	2	0	0	0	5
s6	0	0	0	0	0	0	0	0	1	3	0	4
s7	0	0	0	0	2	3	0	1	0	1	0	7
s8	2	0	0	0	4	0	0	0	1	0	0	7
s9	0	0	0	0	2	0	3	0	0	0	0	5
s10	0	0	0	0	1	0	1	1	0	1	0	4
s11	0	0	1	0	4	0	5	6	0	1	1	18
s12	0	0	1	0	3	0	2	0	0	0	0	6
s13	0	0	0	0	3	0	0	0	0	1	2	6
s14	0	0	0	0	3	1	0	0	0	2	0	6
s15	0	0	1	1	5	0	2	1	0	2	0	12
s16	0	0	0	0	0	0	0	1	0	1	0	2
s17	0	0	1	0	2	0	0	4	0	2	0	9
s18	2	0	0	0	1	4	6	2	1	2	4	22
Total	4	0	7	2	37	8	23	21	4	16	7	129



In the table 4.5, the titles that appear in each column are the same as the ones described above, but the table describes the strategies used in L2.

Table 4.5.

Frequency Table: Subjects x General Strategies (English)

ID_ SPADN	L2GS_ ANT	L2GS_ STR	L2GS_ INT	L2GS_ QUE	L2S INT	L2GS_ KNO	L2GS_ BEH	L2GS_ MON	L2GS_ COR	L2GS_ REA	L2S RTF	Tota
S1	0	0	0	0	2	1	1	0	0	1	0	5
S2	0	0	1	0	2	0	0	0	0	1	0	4
S3	0	1	2	1	1	0	0	0	0	0	3	8
S4	0	0	0	0	0	0	0	0	0	0	0	0
S5	0	1	0	0	2	1	1	4	0	0	0	9
S6	0	0	0	0	0	2	1	2	0	1	0	6
S7	0	0	0	0	2	2	0	0	0	0	0	4
S8	0	0	1	2	4	0	0	1	1	0	0	9
S9	0	0	0	0	2	2	0	3	1	4	0	12
s10	0	2	1	0	3	0	0	0	0	0	0	6
s11	0	0	4	0	9	0	5	6	1	0	1	26
s12	0	0	0	0	1	0	0	4	0	0	0	5
s13	1	0	0	0	1	0	0	0	0	0	0	2
s14	0	0	0	0	3	0	0	2	0	0	0	5
s15	0	0	0	0	1	1	1	2	1	0	0	6
s16	0	0	0	0	2	1	0	1	0	1	0	5
s17	0	1	0	0	2	0	0	1	0	0	0	4
s18	0	0	0	0	2	1	4	0	1	2	0	10
Total	1	5	9	3	39	11	13	26	5	10	4	126

The second step was to calculate the relative frequency (see tables 4.6 / Portuguese and 4.7 / English, below). The relative frequency has been calculated in terms of percentage ratio. That is, it was necessary to transform the raw frequencies of strategies (above) into percentage. The percentage represents the ratio of verbalizations of strategies to the total number of verbalizations for each subject. As shown in table below, the percentage ratio is

calculated in relation to the total amount of strategies used by the reader. In the tables 4.6 and 4.7, the percentage in each cell indicates the relative frequency.

Table 4.6

Row Profiles Subjects x General Strategies (Portuguese)

ID_	LIGS_	LIG	LIGS_	LIGS_	LIGS_	LIGS_	LIGS_	LIGS_	LIGS_	LIGS_	LIGS_	Total
SPADN	ANT	_STR	INT	QUE	INTER	KNO	BEH	MON	COR	REA	RTF	
S1	0%	0%	20%	0%	20%	0%	20%	40%	0%	0%	0%	100%
S2	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	100%
S3	0%	0%	25%	13%	38%	0%	13%	0%	13%	0%	0%	100%
S4	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	100%
S5	0%	0%	0%	0%	20%	0%	40%	40%	0%	0%	0%	100%
S6	0%	0%	0%	0%	0%	0%	0%	0%	25%	75%	0%	100%
S7	0%	0%	0%	0%	29%	43%	0%	14%	0%	14%	0%	100%
S8	29%	0%	0%	0%	57%	0%	0%	0%	14%	0%	0%	100%
S9	0%	0%	0%	0%	40%	0%	60%	0%	0%	0%	0%	100%
S10	0%	0%	0%	0%	25%	0%	25%	25%	0%	25%	0%	100%
S11	0%	0%	6%	0%	22%	0%	28%	33%	0%	6%	6%	100%
S12	0%	0%	17%	0%	50%	0%	33%	0%	0%	0%	0%	100%
S13	0%	0%	0%	0%	50%	0%	0%	0%	0%	17%	33%	100%
S14	0%	0%	0%	0%	50%	17%	0%	0%	0%	33%	0%	100%
S15	0%	0%	8%	8%	42%	0%	17%	8%	0%	17%	0%	100%
S16	0%	0%	0%	0%	0%	0%	0%	50%	0%	50%	0%	100%
S17	0%	0%	11%	0%	22%	0%	0%	44%	0%	22%	0%	100%
S18	9%	0%	0%	0%	5%	18%	27%	9%	5%	9%	18%	100%
Total	3%	0%	5%	2%	29%	6%	18%	16%	3%	12%	5%	100%

Table 4.7

Row Profiles Subjects x General Strategies (English)

ID_ SPADN	L2G_ ANT	L2GS_ TR	L2GS_ INT	L2GS QUE	L2G INTE	L2GS_ KNO	L2GS_ BEH	L2GS_ MON	L2GS_ COR	L2GS_ REA	L2G RTF	Total
S1	0%	0%	0%	0%	40%	20%	20%	0%	0%	20%	0%	100%
S2	0%	0%	25%	0%	50%	0%	0%	0%	0%	25%	0%	100%
S3	0%	13%	25%	13%	13%	0%	0%	0%	0%	0%	38%	100%
S4												
S5	0%	11%	0%	0%	22%	11%	11%	44%	0%	0%	0%	100%
S6	0%	0%	0%	0%	0%	33%	17%	33%	0%	17%	0%	100%
S7	0%	0%	0%	0%	50%	50%	0%	0%	0%	0%	0%	100%
S8	0%	0%	11%	22%	44%	0%	0%	11%	11%	0%	0%	100%
S9	0%	0%	0%	0%	17%	17%	0%	25%	8%	33%	0%	100%
S10	0%	33%	17%	0%	50%	0%	0%	0%	0%	0%	0%	100%
S11	0%	0%	15%	0%	35%	0%	19%	23%	4%	0%	4%	100%
S12	0%	0%	0%	0%	20%	0%	0%	80%	0%	0%	0%	100%
S13	50%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	100%
S14	0%	0%	0%	0%	60%	0%	0%	40%	0%	0%	0%	100%
S15	0%	0%	0%	0%	17%	17%	17%	33%	17%	0%	0%	100%
S16	0%	0%	0%	0%	40%	20%	0%	20%	0%	20%	0%	100%
S17	0%	25%	0%	0%	50%	0%	0%	25%	0%	0%	0%	100%
S18	0%	0%	0%	0%	20%	10%	40%	0%	10%	20%	0%	100%
Total	1%	4%	7%	2%	31%	9%	10%	21%	4%	8%	3%	100%

Third, participants were classified as high or low-spans according to their scores on the reading span tests, on a scale ranging from 0.5 to 5.0. Participants were divided into two groups: the ones who scored up to 2.0, including the participants who scored 2.0 were classified as low spans, the ones who scored above 2.0 were classified as high spans. There were 7 low span readers and 11 high-span readers (L1); 10 low-span readers and 8 high-span readers (L2), see Appendix L for graphs. The labels low and high-span are relative to the present sample. Fourth, a statistical technique was used, namely, the Simple Correspondence

Factor Analysis (Escofier & Pàges, 1992). Fifth, another statistical technique was used, namely, the Cluster Analysis. This latter technique was used to complement the Simple Correspondence Factor Analysis (Escofier & Pàges, 1992). The results of the Simple Correspondence Factor Analysis and the Cluster Analysis will be presented in the subsection 4.3.1 (below).

Data at hand indicate that individual differences in readers' profile of strategy use were perceptible when readers used general comprehension strategies. By contrast, such differences were not noticeable when they used local strategies. Given that, the present section aims to investigate whether working memory capacity is associated with the general comprehension strategies readers use to construct the main idea of a text (L1 and L2).

#### 4.3.1 General Comprehension Strategies – Portuguese (L1)

The present section addressed questions (a), (b), (c). Question (a) investigates whether it is possible to form groups of readers who have a similar profile of strategy use to construct the main idea of an expository text when the main idea is undersignalled. Question (b) investigates whether it is possible to form groups of strategies which have typically been chosen by a particular group of participants. Only if questions (a) and (b) turned out to be affirmative, the investigation would pursue question (c), which investigates whether working memory is associated with reader's profile of strategy use. There is a reason for checking questions (a) and (b) before addressing question (c). That is, it was necessary to perform the statistical technique Cluster Analysis to answer question (c), but before performing such technique, it was necessary to perform another statistical technique, the Simple Correspondence Factor Analysis, which tackled questions (a) and (b). In short, the Simple Correspondence Factor Analysis was to some extent a prerequisite for the Cluster analysis.

The Simple Correspondence Factor Analysis. This technique enables us to investigate how readers associate themselves with reading strategies. Initially, this section describes three main characteristics of this analysis (figure 4.7 below). First, participants who are next to each other present a similar profile of strategy use for constructing the main idea in L1. That is, if a participant is next to each other, their close position indicates that they have used each strategy in a similar ratio, e.g. subjects 5, 11, and 17; subjects 14 and 13. On the other hand, participants who are far from each other present a different profile of strategy use, e.g. subject 4 and subject 8 (see figure 4.7 below).

Second, the origin of the figure indicates the average profile of strategy use of the group. Subjects who are far from the origin differ a great deal from the average profile of the group, e.g. subjects 3, 8, 4. By contrast, subjects who are close to the origin do not differ from the average profile of the group, that is, they are representative of the group, e.g. subject 10 is the most representative of the entire group (see figure 4.7 below).

Third, the proximity between two triangles, each triangle stands for a strategy, indicates that the strategy has been used in a similar ratio, e.g. anticipate content and correct behaviour; monitor comprehension and comment on behaviour. The greater the distance between two triangles – the greater the difference in the ratio the strategies have been used (e.g. question information and use of knowledge) (see figure 4.7). In the figure below, each strategy has been identified by a label and each participant by a number.

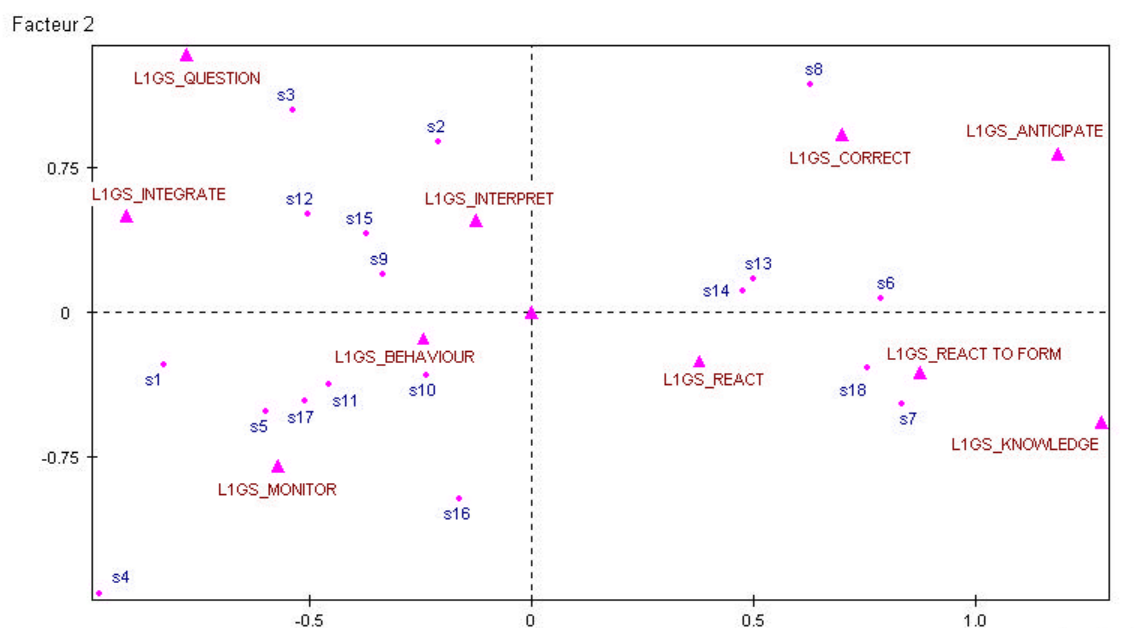


Figure 4.7. Projection of General Comprehension Strategies (L1) and participants.

Question (a) investigates whether it is possible to form groups of readers who have a similar profile of strategy use to construct the main idea of an expository text when the main idea is undersignalled (L1).

The answer to question (a) is affirmative. Observing figure 4.7, it is possible to detect four major groups of readers who have a similar profile of strategy use: (a) subjects 1, 5, 17, 11, and 10; (b) subjects 12, 15, 9 form a second group which seems closer to the first group; (c) subjects 14, 13 and 6 form a third group, but their profile is quite different from the first and second groups (d) subjects 18, and 7 are also related and seem closer to the third group (14, 13, 6), but far from the first (1, 5, 17, 11, 10) and the second (12, 15, 9) groups.

Question (b) investigated whether it is possible to form groups of strategies which have typically been chosen by a particular group of participants.

Observing figure 4.7 (above), it is reasonable to assume that the answer to question (b) is affirmative. In figure 4.7, we can identify groups of strategies which have often been used by a particular group of participants: (a) use of general knowledge and react to text in terms of

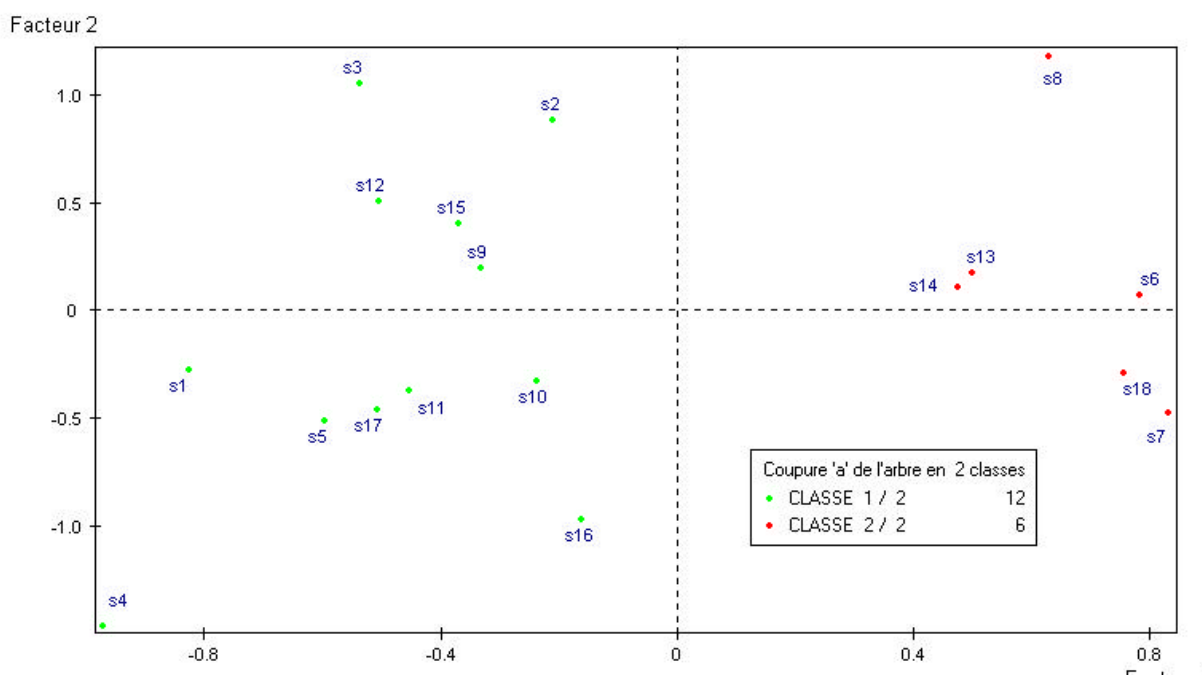
form are close to each other because they have been used by the subjects (18, 7); (b) such strategies are far from the other strategies, question information and integrate information, because these latter strategies have been used by a different group of subjects (3, 12, 15, 9); (c) monitor comprehension and comment on behaviour have also been used by another group of subjects (1, 5, 17, 11, 10).

In other words, according to figure 4.7, subjects 1, 5, 17, 11, 10 are close to each other because their profile of strategy use is similar, that is, they have often chosen the strategies monitor comprehension and comment on behaviour, but they have not used the strategies correct behaviour and anticipate content. In addition, subjects 2, 15, 9 have chosen the strategy interpret, but have not used the strategies react to text in terms of form and use of knowledge. These latter strategies have been used by subjects 18 and 7.

The Cluster Analysis. In order to form groups of participants who use specific strategies in a similar ratio, another statistical technique – the Cluster Analysis - has been used to complement the Simple Correspondence Factor Analysis (Escofier & Pàges, 1992). The Cluster Analysis enables us to divide participants into groups according to their profile of strategy use (see figure 4.8 below). The assumption underlying the Cluster Analysis was that the variability within subjects in the same group is low, but the variability between subjects in different groups is high (Escofier & Pàges, 1992). That is, subjects who belong to the same group have a similar profile of strategy use, on the other hand, groups differ in their profile of strategy use. In the present study, results indicate that it is possible to form two major groups of participants: group one consists of 12 participants and group two of 6 participants.

In the figure below, each point (either green or red) stands for each participant. Participants who have the same colour belong to the same group while participants who differ in colour belong to a different group. Participants in group one (green) can be associated with the strategy monitor comprehension. In addition, none of the participants belonging to group

one has used the strategy use of knowledge. On the other hand, participants belonging to group two (red) have used the strategy react to text.



**Figure 4.8.** Identifying Two Groups of Participants (Red X Green)

Question (c) investigates whether reader's profile of strategy (L1) use is associated with their working memory span.

Figure 4.9 (below) complements the figure 4.8 (just above). In these figures, it is possible to compare the profile of strategy use of subjects who differ in working memory capacity. Taken together, the results presented in these figures enable us to evaluate whether low and high-span readers present a different profile of strategy use.

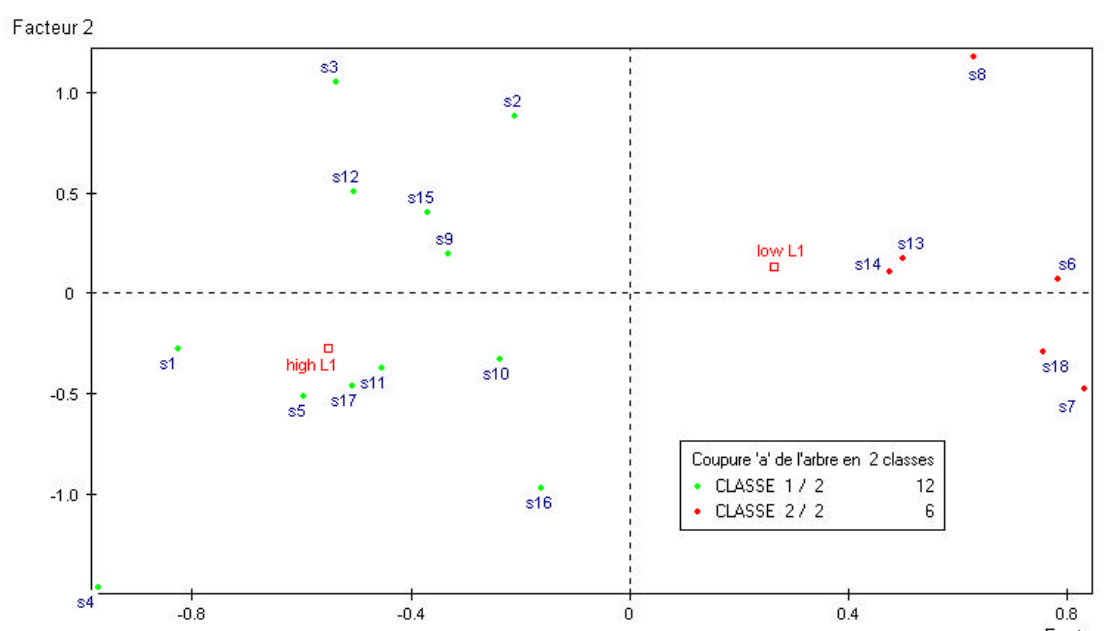
In figure 4.9, the point "low L1" is the most representative of low-span readers – it can be interpreted as the average participant in the low-span group, that is, the participant who presents the average profile of strategy use among participants with low working memory capacity. Likewise, the point "high L1" is the most representative of high-span readers, and



can be interpreted as the average participant in the high-span group. The one who presents the average profile of strategy use among participants with high working memory capacity.

To conclude, results in figures 4.8 and 4.9 indicate that the answer to question (c) is affirmative, that is, it is reasonable to assume that readers' pattern of strategy use is associated with their working memory capacity. While group one (green) is associated with the profile of strategy use of high-span readers, group two (red) is associated with the profile of strategy use of low-span readers.

While group one (high-span readers) have often chosen the strategies integrate information, monitor comprehension, comment on behaviour and process, group two (low-span readers) have often chosen the strategies anticipate content, use of knowledge and associations, correct behaviour, react to text emotionally, react to text in terms of form. Both low and high-span readers have chosen the strategy interpret the text though this strategy is slightly closer to the high span group. Participant 11 has the most representative profile of strategy use of group one (high-span) while participant 14 has the most representative profile of strategy use of group two (low-span).



**Figure 4.9.** Grouping Readers as a Function of their Working Memory Capacity

#### 4.3.2 Discussion

Some of the results displayed in figures 4.7, 4.8, 4.9 deserve further comments.

The strategy anticipate content has often been chosen by group two - low span readers. This type of strategy might be used by low span readers with great ease because anticipating content does not require a great deal of working memory resources (Johnston & Afflerbach, 1985). The use of this particular strategy might indicate a general trend, that is, low-span readers might be trying to formulate a main idea statement before reading.

Another strategy typically chosen by low span readers was use of knowledge and associations. This strategy is not resource consuming either. As Magliano, Trabasso and Graesser (1999) put it, “knowledge is passively and transiently activated during the normal course of reading” (p.620), thus knowledge activation might occur quickly and require fewer working memory resources. To sum up, the strategies which involve knowledge activation (anticipate content and use of knowledge) were typically employed by the low-span group. This result might indicate that such strategies are compatible with readers who have fewer working memory resources at their disposal. However, caution should be taken with the present result: this does not necessarily indicate that high-span readers do not anticipate content or make use of prior knowledge.

Most importantly, anticipating content and using prior knowledge will not contribute to the task of main idea construction unless readers are able to revise and test their prior hypothesising against textual information. That is, if readers rely only on knowledge activation and fail to re-evaluate their initial hypothesis, this knowledge-bias will mislead them; as a result, they will miss the main idea (Carrell, 1988).

As shown in figure 4.7 (above), the group of low-span readers tended to associate the strategy anticipate content with the strategy correct behaviour (readers realised that an assumption was incorrect and made an attempt to review their earlier position). The

association of these two strategies might indicate the following: low span readers put forward an initial hypothesis and were able to recognise that such hypothesis required correction, thus making attempts to correct it. However, this result deserves further comments: one thing is being able to recognise that a comprehension problem exists, another thing is being able to overcome the problem (Gagné, Yekovich & Yekovich, 1993). Indeed, some of the low span readers failed to provide an accurate correction. In other words, it seems that low-span readers tend to commit themselves to an early interpretation (see Whitney, Ritchie & Clark, 1991; Tomich, 1995, for a similar position). Although some of them realized that their early interpretation had problems and made attempts to correct it, they often failed. Indeed, revising and correcting an initial hypothesis certainly require comparing the mistaken assumption to an updating, which requires a great deal of working memory resources. That is, contradictions and inconsistencies will not be noticed by the readers unless the two pieces of incompatible information are activated simultaneously in working memory (van den Broek, Young, Tzeng & Linderholm, 1999); if the information to-be-corrected is no longer available in working memory, readers will have to reinstate it in order to correct the initial assumption. This entire procedure may be too demanding for low-span readers.

In the excerpt below, a low span reader (1.5 in L1 and in L2), is making an attempt to revise his earlier position (“o caso do sol, ok! O sol é um exemplo de estrela”). The reader realises that this initial comment deserves further elaboration and makes an attempt to revise it, explaining that the paragraph is about the life span of a star (“É terceiro parágrafo fala sobre – sobre a existência da estrela, o tempo de existência”). However, this is a very general statement and refers to the entire text, not specifically to the third paragraph. Such general statement reveals only a superficial level of comprehension. Indeed, the reader keeps on re-reading the text and on reporting comprehension failures, but does not manage to revise the initial hypothesis so as to construct an accurate main idea for paragraph. A better main idea

statement for the third paragraph would have been: during the intermediate period of its existence, the star has reached a stage of equilibrium.

Ah, tá! O terceiro parágrafo, fala-se (hes) [da]- da existência<sup>0</sup> que o <ca-> cerca de noventa por cento da sua existência...<sup>0</sup> (hes) mas depois ele não continua: “Durante cerca de 90% da sua existência” o quê? Aí [o]- o caso do sol, ok! O sol<sup>0</sup> é um exemplo de estrela, mas [não]- não tem relação com “[noventa]-noventa por cento da sua existência.” Eu achei que [ficou meio]-<sup>0</sup> faltou alguma coisa nessa parte do texto. Problema de estrutura. Bom, o sol, [aí]- aí depois ele explica melhor: “se encontra na fase intermediária da sua existência, sofrendo mínima <condensa-> condensação. ”Que se relaciona com ligeira contração, mas [não]- não...o <te-> essa parte do texto não é muito claro. É terceiro parágrafo fala [sobre]- (hes) sobre<sup>0</sup> a existência da estrela, o tempo de existência. Mas ela não... essa parte não é uma parte muito clara...(S3)

Reacting to text (readers responded to the text emotionally) was the strategy closer to the point “low L1” - the most representative of low-span readers. In fact, the use of such strategy does not require a great deal of working memory resources. This strategy is related to reader’s personal appraisal of the text, and personal feelings towards the topic of the text rather than an evaluation of their level of comprehension, or an evaluation of strategy effectiveness. In the present investigation, participants often reacted to the L1 text in terms of recognising their lack of familiarity with the content. That is, participants claimed that they were not in the habit of reading texts such as the one in L1. As a participant puts it, “... ‘Partículas de gás’ é o tipo de texto que eu não costumo ler, então, fica confuso...(S6)”.

React to text in terms of form was another strategy used by the low span readers. In the present study, even the low-span readers have been able to recognise that the texts had

problems in terms of cohesive devices and signals. This probably occurred because participants were assigned texts which had been extensively modified: lack of signals was the striking feature of such texts. It is noteworthy that recognising that the text has problems with local cohesion does not necessarily mean overcoming such problems so as to become able to integrate information at a more global level. Indeed, the strategy integrate information has seldom been chosen by participants of the low-span group.

On the other hand, the strategy integrate information has often been used by participants in group one – high span readers (figure 4.7). This probably occurred because, in this study, integrating information was too demanding for readers with low working memory capacity. Such difference in performance between high and low-span readers becomes evident when the task is difficult (Just & Carpenter, 1992). In the present study, as the main ideas had been undersignalled, it was expected that low span readers would find it difficult to integrate the text so as to construct a satisfactory main idea. One possible reason for readers' failures to integrate the text and construct a coherent main idea statement is the absence of relevant information from working memory. Previous research has shown that readers will not be able to detect the relationship between two parts of the text, or between information from the text and information retrieved from long-term memory, unless these pieces of information are active in working memory at the same time (van den Broek et al., 1999). To conclude, in this study, readers were faced with three sources of difficulty. Two of these sources are inherent to the main idea construction task, the first, to assign importance; the second, to maintain the relevant pieces of information in working memory at the same time in order to integrate information and construct the main idea. A third source of difficulty was presented by the experimental texts, they were undersignalled, thus making the task even more demanding for the low-span readers.

The fact that high-span readers were often using an integrative strategy rather than anticipating content may indicate a trend. That is, they tended to construct the main idea either while reading or after reading. It seems that readers with adequate working memory capacity were able to keep their interpretation open and wait to make a final judgement till more text was read (see Whitney et al., 1991; and Tomitch, 1995, for a similar position).

Monitor comprehension is another strategy that has often been used by high-span readers. In the present study, monitor comprehension has been defined as readers' ability to assess their degree of understanding (Block, 1986). In a later study, Block (1992) proposes a more complete conception of monitoring, that is, it consists of three steps: evaluation of comprehension, action, and checking of action. In this study, the scope of monitoring takes into account only the first step of Block's (1992) proposal, namely, evaluation of comprehension. The second step of Block's (1992) proposal, action, is presently under another strategy, namely, correct behaviour. Other researchers such as Rosen and Engle (1997) interpret the process of monitoring in a different context. For them, monitoring is interpreted as the ability to detect errors in tasks of verbal fluency.

The fact that high-span readers were able to monitor comprehension indicates that they were able to identify a comprehension problem, or were at least able to recognise that a problem existed. However, the scope of the strategy monitor comprehension, as it is conceived in the present study (Block, 1986), does not enable us to judge the degree of success obtained by readers when solving their comprehension problems. Still, it is reasonable to assume that when high-span readers identified problems that hindered comprehension, or when they considered the problem important, they allocated resources, and at least made an attempt to take appropriate action. In the excerpt below, a high-span reader (3.5 in L1 and L2) detected a problem and reported taking an action: because s/he lost concentration, s/he read backwards, scanning for key words.

Parei mais ou menos [na metade]- na metade do parágrafo, vou voltar pro início, eu não estava concentrada. O parágrafo se refere às partículas de hidrogênio [que formam]- [que]- que se concentram devido as forças gravitacionais. Quando eu vou tentar fazer o resumo [do]- do parágrafo, eu procuro (hes) identificar algumas palavras-chaves (S5).

High-span readers have also used the strategy comment on behavior (figure 4.7). This result indicates that they might be aware of some of the processes which underlie reading comprehension and be able to assess their strategy effectiveness.

The strategy interpret the text has been used by low and high-span readers, though it is slightly closer to the high span group in the figure 4.7. The use of this strategy involves drawing a final conclusion based on a hypothesis. This strategy is often used to perform one of the operations cited above, draft-and-revise. To perform this operation, readers propose a draft-hypothesis and go on testing it against successive portions of the text till they are able to draw a final conclusion. When performing this operation, readers tend to construct the main idea after reading. The fact that both low and high-span readers took advantage of the strategy interpret the text might indicate a trend: both groups were constructing the main idea after reading. As stated above, high-span readers often constructed the main idea after reading the text. By contrast, low-span readers were not consistent. They would construct the main idea after reading when using the strategy interpret the text, but would also construct it before reading when using the strategy anticipate content.

To conclude, it has been argued that the results in the figures above indicate some general trends. Low-span readers typically employed the strategies anticipate content, use of knowledge, and react to text emotionally. As none of these strategies is resource-consuming,

they might be compatible with readers who have fewer working memory resources at their disposal. In addition, given these results, it is possible to observe that the strategy choice of low-span readers may be related to factors other than working memory capacity (e.g. use of knowledge). By contrast, high-span readers were able to use strategies that demand a greater deal of working memory resources, namely, integrative strategies.

High-span readers usually evaluated their level of comprehension, making attempts to take action when necessary. This does not mean that low-span readers always failed to detect comprehension problems. Indeed, they were able to detect some problems, and made attempts to take action. Despite their attempts, low-span readers often failed to overcome problems even when they used the strategy correct behaviour (e.g. S3– cited above). More specifically, solving comprehension problems involves maintaining distinct pieces of information in working memory at the same time, and evaluating whether such pieces are compatible. This operation might have been too demanding for low-span readers.

High-span readers had enough working memory resources to use an integrative strategy. As a result, they were able to construct the main idea either while reading or after reading the text. In other words, high-span readers might have been able to keep their interpretation open and wait to make a final judgement till more text was read (see Whitney et al., 1991; Tomitch, 1995, for a similar position). It is also noteworthy that although high-span readers loaded working memory with information, they were able to maintain the task goal. Hence, they were able to extract the main idea after reading. By contrast, low span readers often anticipated content, committing themselves to an earlier interpretation, which they often failed to update. However, this does not mean that low-span readers always constructed the main idea before reading. They also used the strategy interpret the text, which might indicate their attempts to construct the main idea after reading.

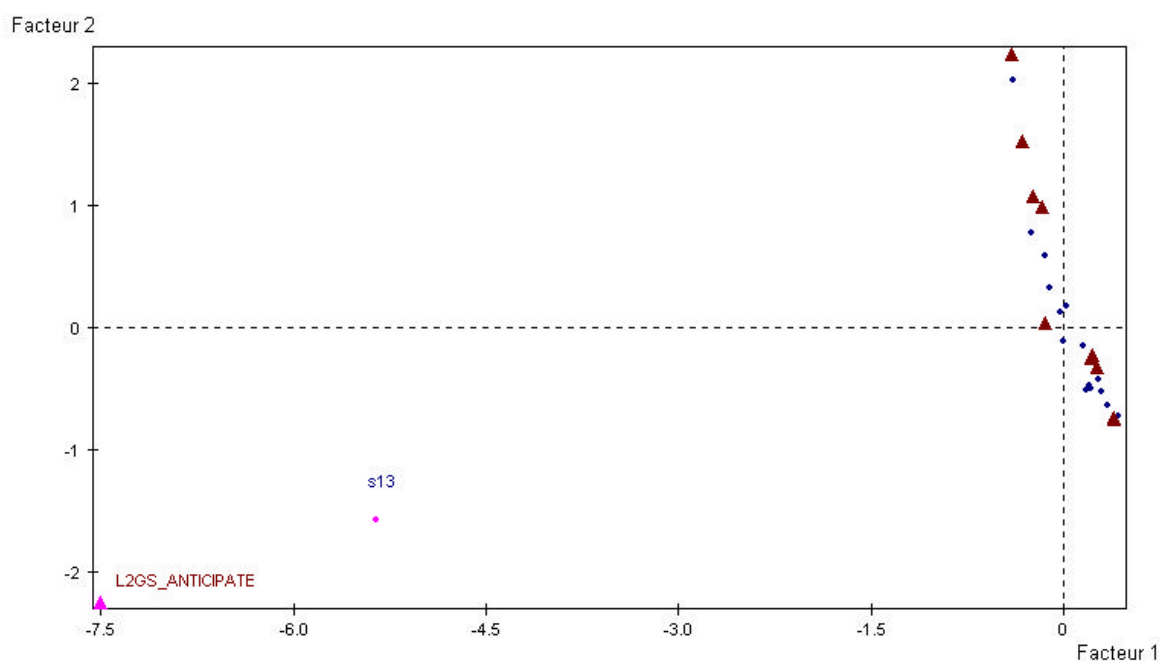


Finally, we point out another interesting result, strategy associations (described above). For instance, the strategies anticipate content and correct behaviour are associated (figure 4.7, above). This association might indicate that readers do more than just choose a single strategy while constructing the main idea of a text. Given that, it is reasonable to assume that the strategies above usually appear in a context of related strategies (see also Johnston & Afflerbach, 1985, for a similar position).

#### 4.3.3 General Comprehension Strategies – English (L2)

As we can see in the figure 4.10 below, participant 13 behaved differently from the rest of the group. Participant 13 was different from the others because he was the only participant who has used the strategy anticipate content. The problem with this participant was that her/his presence prevented us from detecting differences in participants' profile of strategy use in L2. That is, in the presence of this participant, the rest of the participants were all bunched close together, so it was not possible to tell them apart. Given that, participant 13 was considered an outlier and was screened out.

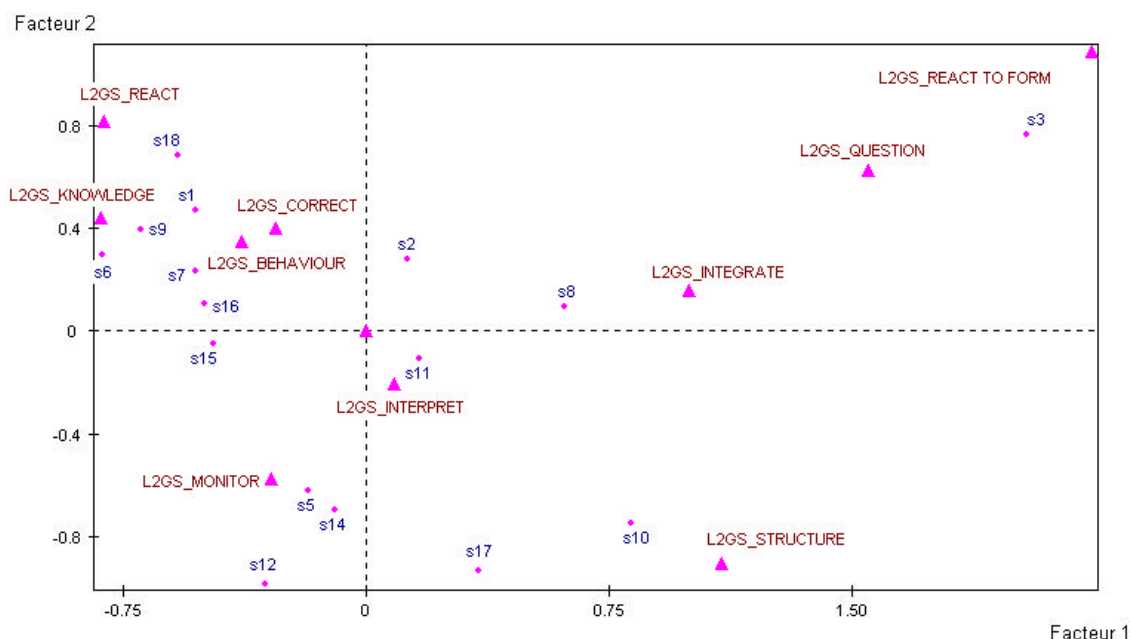
In addition to participant 13 (the outlier), there was another participant who behaved differently from all the rest, namely, participant 3, in the top right-hand corner of the figure. Despite the different behaviour, the presence of participant 3 did not prevent us from detecting differences in the readers' profile of strategy use. Therefore, there was no need to remove participant 3 from the analysis.



**Figure 4.10.** Projection of General Comprehension Strategies (L2) and Participants.

Question (a) investigates whether it is possible to form groups of readers who have a similar profile of strategy use to construct the main idea of an expository text when the main idea is undersignalled (L2).

The answer to question (a) is affirmative. After identifying the outlier, it is possible to form a major group of readers who have a similar profile of strategy use, namely, participants 18, 1, 9, 7, 16, 6, and 2 (figure 4.11, below). Besides this major group, there are two smaller groups of participants who have a similar profile of strategy use, one consists of participants 5, 14, 12. We might also join participant 15 to this latter group. However, caution should be taken because participant 15 seems to be a borderline case (this issue will be discussed below). Another group consists of participants 10 and 17.



**Figure 4.11.** Projection of General Comprehension Strategies (L2) and Participants

Question (b) investigates whether it is possible to form groups of strategies which have typically been chosen by a particular group of participants.

Observing figure 4.11, it is reasonable to assume that the answer to question (b) is affirmative. We can identify groups of strategies which have often been used by a particular group of participants: (a) react to text emotionally and use of general knowledge. Such strategies are close to each other because they have been used in a similar ratio by a specific group of readers (S18, S1, S9, S6); (b) there is still another possibility of grouping strategies in the top left-hand corner of figure 4.11. That is, the strategy use of general knowledge can also be joined to two strategies, namely, comment on behaviour and correct behaviour. These three strategies have often been chosen by a specific group of readers (S7, S16, S2, S1, S6, S9). Participants 1, 6 and 9 are also associated with the former group of strategies which comprise the strategies use of general knowledge and react to text emotionally.

In addition to forming groups of strategies which have been chosen by a specific group of participants, the results in figure 4.11 indicate that groups of participants can also be

associated with a single strategy. For instance, it is reasonable to assume that a group of participants (S5, S14, S12) are associated with a single strategy, namely, monitor comprehension. In other words, participants 5, 14, and 12 have often used the strategy monitor comprehension in a similar ratio. Likewise, another group of participants (S10, S17) are associated with a single strategy, recognise text structure. Moreover, a single participant, S3, is associated with a single strategy, react to text in terms of form.

The results just presented above can be described in a different way. We may also describe figure 4.11 according to the position of the strategies. As we can see, the origin of the figure separates strategies that are in opposite corners of the figure. This opposition is an indication that these strategies have been used in a different ratio by specific participants. For instance, the group of four strategies, react to text emotionally, use of general knowledge, comment on behaviour and correct behaviour, are opposite to the strategy react to text in terms of form. Based on this result, it is reasonable to assume that subjects 7, 16, 2, 1, 6, 9 are close to each other because their profile of strategy use is similar, that is, they have consistently chosen the strategies use of general knowledge, comment on behaviour and correct behaviour. However, such readers have not used the strategies react to text in terms of form. The latter strategy has often been used by subject three.

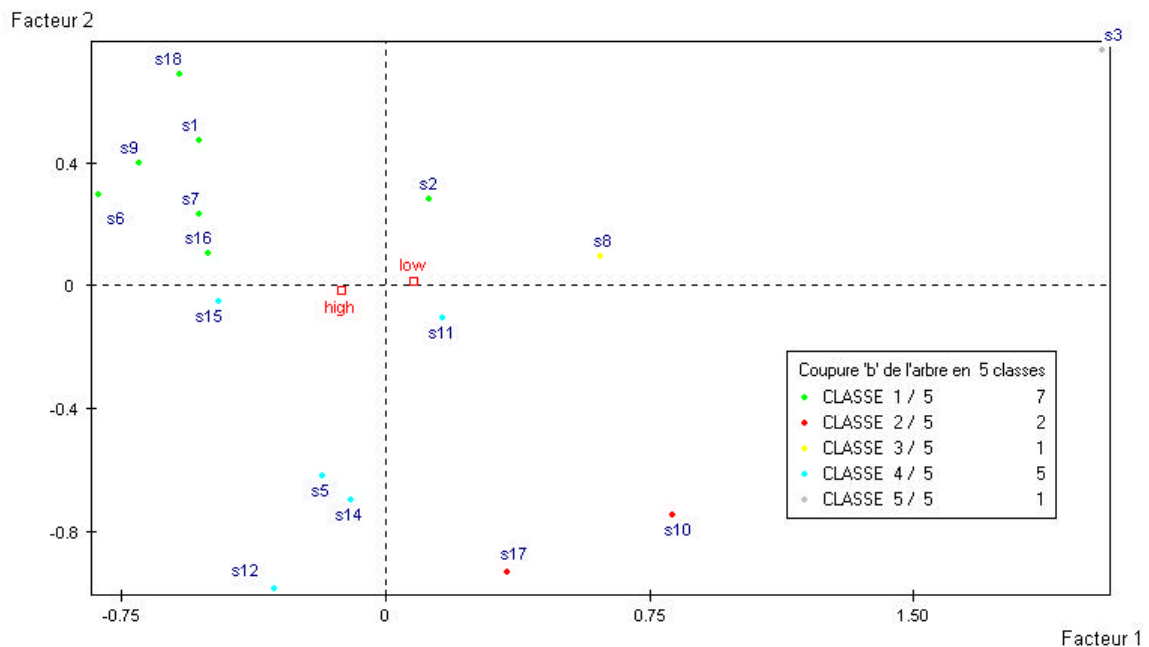
In figure 4.11, we may also observe that the group of four strategies, react to text emotionally, use of general knowledge, comment on behaviour and correct behaviour, are very far from the strategy use of text structure. This result might indicate that the readers 7, 16, 2, 1, 6, 9 (who are associated with the strategies use of general knowledge, comment on behaviour and correct behaviour) have not chosen the strategy use of text structure. The latter strategy has been used by participants 17 and 10.

In addition, we may also notice that the strategy monitor comprehension is opposite to the strategy react to text emotionally. The strategy monitor comprehension has often been

used by subjects 5, 14, and 12. However, the latter group has not used the strategy react to text emotionally. Neither have this group (S5, S14, S12) used the strategy react to text in terms of form.

Question (c) investigates whether reader's profile of strategy use (L2) is associated with their working memory span.

The present data are not conclusive enough for us to back up the claim that readers' profile of strategy use (L2) is associated with differences in working memory capacity. In figure 4.12 below, the point "low", representative of the average profile of the low span group is not far from the point "high", representative of the high span group. This could be an indication that low span's average profile is not so different from high span's average profile of strategy use (L2). Still, these data seem to indicate some trends.



**Figure 4.12.** Grouping participants as a function of their working memory capacity

To answer question (c), an initial attempt was made to group high and low-span participants according to their profile of strategy use. This initial attempt resulted in three major groups. Group one (eight participants) would be associated with the strategies react to text emotionally and use of general knowledge. Group two (seven participants) would be associated with the strategies monitor comprehension and interpret the text. Group three (one participant) would be associated with the strategy react to text in terms of form. However, this initial division was not subtle enough, and revealed only the most obvious differences in group's profile of strategy use. To refine this initial division, a second attempt was made.

The result of this second attempt indicated that it was possible to form five groups of participants, namely, green, red, yellow, blue, grey (figure 4.12, above). The green group consists of seven participants (S18, S1, S9, S6, S7, S16, S2), the red group consists 2 participants (S10, S17), the yellow point represents one participant (S8), the blue group consists of five participants (S12, S14, S5, S15, S11), the grey point represents one participant (S3). It is noteworthy that although participant 15 has been assigned to the blue group, s/he can be considered a borderline case, having characteristics of both the green and the blue group.

As stated above, the difference between the average representative of high and low-span readers is not so perceptible. However, there is a cluster of readers, who stand out as distinct from the other participants, and this particular group are closer to high-span point. To conclude, the profile of strategy use of the green group (S18, S1, S9, S6, S7, S16, S2) differs from four other groups (see figure 4.12) and they tend to be associated with the profile of strategy use of high-span readers.

The members of the blue group (S12, S14, S5, S15, S11) tend to be low-span readers in L2. Next, I report each span-score (L2) of the members of this group, S12= 1.5, S14= 1.5, S5= 3.5, S15= 1.5, S11= 1.5. Four among five members of this group are low-span readers,

but this result only indicates a trend. That is, the group's pattern of strategy use tends to be associated with the profile of strategy use of low-span readers. However, we cannot go so far as to say that low-span readers are associated with a single strategy, monitor comprehension (this particular strategy has often been used by the present group).

We should be cautious when analysing the red group. That is, this group comprises only two participants (S10, S17). Participant 10 is a high-span reader, and scored 4.5 in the reading span test (L2), while participant 17 is a low-span reader, and scored 2 (L2). Because the red group consists of one high and one low-span reader, we shall not assume that this group is associated with either high or low-span's profile.

Other participants distinguish themselves from the rest. However, they are single representatives and do not form a group. Participant 8 (yellow point) is a high-span reader, who scored 3.5 in the reading span test (L2). This high-span participant has often used the strategy integrate the text. As integrative strategies are resource consuming, they tend to be compatible with high-span readers. However, the present data are not conclusive enough for us to make further assumptions. That is, given the profile of a single participant (S8), these data are not enough to back up the claim that the profile of strategy use of high-span readers is associated with the strategy integrate the text. In addition, participant 3 (grey point) is a low-span reader, who scored 1.5 in the reading span test (L2). This low-span participant has consistently used the strategy react to text in terms of form. Again, we shall not assume that the profile of low-span readers is associated with the strategy react to text in terms of form.

To sum up, although the difference between the average profile of high and low-span (L2) readers is not so perceptible, the results displayed in figure 4.12 above indicate a trend. That is, the group (green) closer to the "high" point were consistent in their choice of strategies. That is, participants 18, 1, 9, 6, 7, 16, 2, who tend to be associated with high-span readers, have often used the strategies react to text emotionally, use of general knowledge,

comment on behaviour and correct behaviour in a similar ratio. As for the other major group (blue), all participants (S12, S14, S15, S11) but one (S5) are low-span readers and they have often used the strategy monitor comprehension.

#### 4.3.4 Discussion

Readers' profile of strategy use in L2 was quite different from their profile in L1. First, the difference between the average profile of high and low-span readers is more noticeable in L1 (figure 4.9) than in L2 (figure 4.12). Second, while high-span readers in L1 were able to use strategies that demanded a great deal of working memory resources (i.e. integrate the text), low-span readers in L1 often employed strategies that were not resource consuming, and were compatible with readers who have fewer working memory resources available (i.e. anticipate content, use of general knowledge, react to text emotionally). These latter strategies (use of general knowledge and react to text emotionally) were associated with the profile of low-span readers in L1, but were associated with the profile of high-span readers in L2. Next, I comment on this result.

During the pilot study, an attempt was made to control the level of difficulty of the L1 and the L2 text. Although they were meant to be equally difficult, we might attribute the result above to a difference in the level of difficulty of these texts. That is, participants may have been more exposed to the topic of the L2 text. As a result, they might have had at least some prior knowledge to activate, and the L2 text turned out to be easier than the L1 text. In addition, textual structure differed, that is, the L1 text comprised a description of four periods: birth, youth, and death of a star, while the L2 text was a situation-problem-solution-evaluation text. Another possibility is that participants may have been better acquainted with the



structure of the L2 text. To conclude, the experimental texts differed in the level of difficulty; as a result, readers differed in their profile of strategy use across languages.

The L2 text is concerned with health and recent scientific developments in the drug industry, e.g. patches to dispense drugs such as hormones and insulin inside the body. Because health is a reason of concern to most people, this topic might have been more common as well as more interesting for the participants in the present study. In short, readers might have been low rather than no knowledge about new technologies to deliver drugs through one's body. As they put it, " Ah, já li alguma coisa sobre esse texto...(S7)"; "... eu acho que eu sei disso, porque a família do meu pai é diabética, eu já li muita coisa a respeito, muitos tratamentos sobre a diabete,...(S7)"; "Esse é um tema que já me agrada um pouquinho mais e também foi fácil de leitura... (S9)"; "Esse segundo texto, apesar de ser em inglês, pela própria fal- pelo próprio fato de – de ser – de uma área diferente e que já é de mais interesse fica mais fácil...(S18)". In short, these participants told that they found the L2 text easier than the L1 text. However, the L2 text was not so easy as to enable readers to extract the main idea automatically. As the protocols indicate (Appendix A), most participants were processing at least some parts of the L2 text effortfully (e.g. S11 cited above).

By contrast, the topic of the L1 text (i.e. birth, youth, and death of star) might have been more demanding for the participants in this study. Since they are either students of literature or applied linguistics, they might have faced greater difficulty reading about the life span of a star. As they put it, "...Eu preciso voltar, ler em voz alta, porque o assunto não é – do meu – da – da minha esfera de - de leituras habituais...(S 11)"; "...'Partículas de gás' é o tipo de texto que eu não costumo ler, então, fica confuso...(S6)".

Because the topic of the L2 was more usual, high-span readers often took advantage of the strategy use general knowledge. This strategy might have been effective enough, leading readers to activate the appropriate knowledge. The activation of appropriate knowledge might

enable readers to allocate resources to higher level operations. That is, fewer working memory resources are wasted on local operations such as extracting the meaning of a word from context (Afflerbach, 1990b). As a result, more resources become available for the memory consuming operations that are prerequisites for main idea construction such as assignment of importance and integration of information at a more global level (Afflerbach, 1990b). In short, while reading in L2, assignment of importance and integration of information might have been easier and more straightforward for high span-readers due to activation of appropriate knowledge. As a result, they did not report their strategies to integrate information in L2 as often as they reported in L1. In other words, because the topic of the L1 text was unfamiliar, high-span readers had to make a greater effort to construct the main idea, and their protocols often revealed the use of memory consuming strategies such as integrate the text.

It is noteworthy that high-span readers did not fail to integrate the L1 text even though the topic was difficult for them. Results indicate that high-span readers had enough working memory resources to use integrative strategies in L1, so they could overcome their difficulties. Indeed, the results of the descriptive statistical analysis (section 4.1 above) indicate that there is no statistically significant difference between the means for the reading ability measures across languages. To conclude, it is reasonable to make two assumptions: (1) high-span readers were able to construct the main ideas for both texts (L1 and L2): they were able to perform the integrative operations for the main idea construction in L1 as well as in L2. However, due to the difference in the level of difficulty of the texts, there is a difference between high-span's profile of strategy use across languages: high-spans tend to report integrative strategies for the L1 text and knowledge activation strategies for the L2 text. (2) This result might also indicate that high-span readers tend to act strategically. That is, whenever it is possible, they put prior knowledge to good use. As a result, their working

memory resources become available for a cognitively demanding task such as main idea construction (L2).

Low-span readers have made attempts to activate prior knowledge, using the strategies anticipate content and use of general knowledge while reading in L1 (figure 4.7). However, these strategies were not effective enough to enable the low-span readers to construct a reasonable main idea for the L1 text. This probably occurred because they did not have the appropriate prior knowledge to activate while reading in L1. In addition, low-span readers often failed to succeed in their attempts to correct inaccurate knowledge-based assumptions. In short, the strategies which involve knowledge activation are effective as long as readers have the appropriate knowledge to activate, and as long as they manage to update premature assumptions when new information comes in.

High-span readers tended to associate the strategy use of knowledge with the strategy correct behaviour while reading in L2 (figure 4.11). The association of these strategies occurred in L1 as well (figure 4.7). This result might indicate that both L1 and L2 readers were aware of how important it is to review their knowledge-based assumptions as new information comes in. However, in L1, the strategy correct behaviour was used by low-span readers, who often failed to revise their position. As stated above, these low-span readers might have been able to recognise that their position required correction but failed to provide it. In L2, the same strategy was used by high-span readers, and they were often able to revise their position, providing a reasonable correction. To sum up, unlike low-span participants (L1), high-span participants were successful in providing corrections (L2). In the excerpt below, the participant, who is a high-span reader, and scored 3.5 in the reading span test (L2), corrects his former assumption. Initially, the participant claims that the L2 text refers to illicit drugs such as cocaine and heroin. However, the participant finds out that he has been mistaken, and that the text actually refers to therapeutic drugs that have a good effect on one's

health. The participant used the expression “na verdade”, to indicate that he has corrected his/her earlier assumption.

”...o texto inteiro ainda está falando sobre0 [a]-0 os medicamentos que, no caso, primeiro eu tinha achado que falaria sobre0 (hes) drogas como a cocaína ou heroína, mas na verdade [é uma]-0 está falando de algo positivo para ajudar as pessoas, <na-> não pra0 prejudicar...” (S9) (emphasis added).

As stated above, high-span participants tended to associate the strategy use of knowledge with the strategy correct behaviour while reading in L2. This association might indicate that high-span readers were aware of the risk of being incorrect when they formulated a knowledge-based assumption, or even a draft of the main idea, so whenever they felt it was necessary, they revised their earlier position. The fact that high-span readers associated the strategy use of knowledge with the strategy correct behaviour might have enabled them to perform operations which involve correcting and revising an earlier position, namely, topic-and-comment, draft-and-revise. Topic-and-comment was a halfway point, that is, readers formulated a topic, but were unable to qualify this topic with a conclusive comment. Under these circumstances, a final judgement was reserved till more text was read (Johnston & Afflerbach, 1985). Draft-and-revise was another halfway point, that is, readers were able to make a rough draft of the main idea. However, they were dissatisfied with the draft and went on to revise it until the main idea statement felt more accurate (Johnston & Afflerbach, 1985). To conclude, it is reasonable to make two assumptions: (1) the fact that high-span readers were able to perform the operations of topic-and-comment, and draft-and-revise might indicate that they were able to respond to their concerns. That is, these high-span readers were able to recognise that only a topic, or a draft had been constructed, and were able to provide

further qualification and even correction. (2) Although high-span readers activated prior knowledge while reading in L2, they did not commit themselves to an early interpretation. To perform the operations topic-and-comment, draft-and-revise, it was necessary to wait for further information before reaching a final conclusion. As a result, the main idea was constructed after reading.

As stated above, readers' profile of strategy use in L2 differs from their profile in L1. The following result contributes to this claim: high-span readers have often chosen the strategy react to text emotionally while reading in L2 (figure 4.11); by contrast, low-span readers have chosen such strategy while reading in L1 (figure 4.7). As stated above, the use of this strategy does not require a great deal of working memory resources. Therefore, the strategy might have been chosen by readers regardless of their working memory span. Given this result, another point can be raised, strategy choice may depend on factors other than working memory capacity.

The strategy react to text emotionally is concerned with reader's personal response to the text. In the present study, high-span's response to the L2 text was different from low-span's response to the L1 text. Low-span readers often reacted to the L1 text by recognising their lack of familiarity with the content. As participant six puts it, "...'Partículas de gás' é o tipo de texto que eu não costumo ler, então, fica confuso...(S6)". High-span readers reacted differently to the L2 text. They reacted by comparing the L1 to the L2 text. For instance, "Esse é um tema que já me agrada um pouquinho mais e também foi fácil de leitura... (S9)". In addition, high-span readers reacted to the L2 text by giving an appraisal of the new technology being described and even questioning it. As we can see in the next quotation, participant one questioned whether the technology that is said to be the latest development is really innovative, "...microagulhas, né? Apesar de serem pequenas, na minha opinião ainda são agulhas, então, é um, apenas um – uma – um melhoramento de um –um método mais

antigo, né? ele tem que ser por agulhas (S1)”. There is a possible reason why participants were more critical of the information presented in the L2 text: the topic of the L2 text might have been more common and more interesting than the topic of the L1 text; as a result, participants had something to say about it. By contrast, low span readers might have been too unfamiliar with the topic of the L1 text to express their personal opinion about the topic or even question information.

In addition to associating the strategy correct behaviour with the strategy use of knowledge, high-span readers also associated the strategy use of knowledge with the strategy react to text emotionally while reading in L2 (figure 4.11). As high-span readers chose the strategy use of knowledge, they might have activated the appropriate knowledge to read the L2 text. This knowledge might have enabled readers to find some information that encouraged a more personal and critical reaction to the L2 text.

High-span readers have used the strategy comment on behavior while reading in L1 as well as in L2 (figure 4.7 and 4.11 respectively). The use of this strategy indicates that high-span readers might be aware of some of the processes which underlie reading comprehension and might be able to assess their strategy effectiveness in both languages. In addition, high-span readers also associated the strategy comment on behaviour with the strategy correct behaviour while reading in L2 (figure 4.11). The association of these strategies might indicate that high-span readers were not only assessing the effectiveness of their actions through the strategy comment on behaviour, but they were also making adjustments to these actions when the need arose.

To sum up, the difference between the average profile of high and low-span (L2) readers is not so perceptible in L2 as it is in L1. However, the results displayed in the figure 4.12 (above) indicate a trend. That is, there is a cluster of readers, who stand out as distinct from the other participants. This cluster forms a group positioned next to high-span point. It

has been argued above that the profile of strategy use of this group (S18, S1, S9, S6, S7, S16, S2) differs from the other groups and they tend to be associated with the profile of strategy use of high-span readers. This group tends to be associated with the following strategies: react to text emotionally, use of general knowledge, correct behaviour, and comment on behaviour and process. Furthermore, it has also been argued this group of high-span readers tends to associate strategies. First, they associated the strategy use of general knowledge with the strategy correct behaviour. This association indicates that high-span readers activated prior knowledge while reading in L2, but they were also able to update their knowledge-base assumptions. As a result, they did not commit themselves to an early interpretation based on prior knowledge. They were able to update their interpretation before reaching a final conclusion. Second, high-span readers also associated the strategy use of general knowledge with the strategy react to text emotionally. Such association might indicate that knowledge activation might have led readers to respond more critically to the L2 text. Third, high-span readers also associated the strategy comment on behaviour with the strategy correct behaviour. The association of these strategies might indicate that high-span readers were both assessing the effectiveness of their actions and adjusting these actions when the need arose.

As for the other major group, all participants (S12, S14, S15, S11) but one (S5) are low-span readers and they have often used the strategy monitor comprehension. The fact that these low-span readers were able to use the strategy monitor comprehension indicate that they were able to identify a comprehension problem, or were at least able to recognise that a problem existed. However, the scope of the strategy monitor comprehension, as it is conceived in the present study (Block, 1986), does not enable us to judge the degree of success obtained by readers when solving their comprehension problems while reading in L2. It is noteworthy that while this strategy has been used by low-span readers in L2, it has been used by high-span readers in L1. As stated above, when L1 high-span readers identified

problems that hindered comprehension, they allocated resources, and at least made an attempt to take appropriate action. On the other hand, L2 low-span readers were able to recognise that a problem existed, but the present data indicate that they did not take further action. Indeed, the strategy monitor comprehension is alone (figure 4.11). This might indicate that low-span readers failed to associate the strategy monitor comprehension with another strategy that would enable them to solve their problems.

#### 4.4 Working Memory as Efficiency at Processing Information or as a General Capacity?

According to Daneman and Carpenter (1980), efficiency at the specific reading comprehension processes is a source of individual differences in working memory capacity. As they put it, working memory performs processing and storage functions that share the same pool of limited resources. Inefficient processing consumes a great deal of the available resources, thus wasting resources that could be used to store information in working memory. Another possible explanation for individual differences in working memory capacity has been proposed by Just and Carpenter (1992). They explained individual differences in working memory in terms of a general capacity for language. According to their framework, working memory limitations have an effect upon performance only when the task is so demanding as to strain capacity.

One assumption is that processing efficiency can account for the results above. That is, the experimental texts were difficult enough to tax readers' working memory and prevent them from constructing the main idea automatically. As a result, readers were led to process the text effortfully and to monitor for both content and strategy use. Despite the fact that both low- and high-span readers were processing the text effortfully, only high-span readers had enough resources to cope with the demands of constructing the main idea for a difficult text.



In other words, it seems that high-span readers are better able to overcome processing bottlenecks and; consequently, they have residual resources available for higher level processes such as integrating and extracting the main idea after reading the text. That is, the assumption is that there is a trade-off between the processing and storage functions of working memory. High-spans did not use up their resources when they faced processing bottlenecks. As a result, they still had enough working memory resources available to maintain their interpretation open till they have read further; thus becoming able to integrate the information and extract the main idea at the right moment.

Caution should be taken with a processing efficiency explanation, because it assumes that processing and storage share the same pool of resources. This trade-off assumption has recently been disputed. Baddeley and Logie (1999) together with Engle, Tuholski, Laughlin and Conway (1999) argue that storage and processing do not share the same pool of resources. Their alternative view is that these cognitive functions are performed by separate components of working memory, the processing/controlling function is supported by the central executive, while the storage is supported by the slave systems in Baddeley's framework, or short-term memory in Engle's et al. framework. Despite this controversy, it seems too early to discard a processing efficiency explanation.

Although the result above may be interpreted in terms of efficiency at specific processes, we do not rule out the possibility that working memory capacity can also be related to a general capacity for language. In the present study, we did not conduct tests which would enable us to choose between the processing efficiency or the general capacity explanations. In the end, these two explanations might be compatible (Just & Carpenter, 1992). It is reasonable to assume that higher-span readers have a higher working memory capacity, or more attentional resources available to cope with a demanding comprehension task. In addition, it

might be a simplification to attribute individual differences in working memory only to a processing efficiency explanation.

Results above indicate that high-span readers were able to construct the main idea significantly more often than were low-span readers. These results can also be interpreted in the light of Just and Carpenter's (1992) assumptions. That is, differences between high and low-working-memory readers were manifest because the task was so resource-consuming that it exceeded the supply of resources available to the working memory system. In line with this position, Engle, Kane and Tuholski (1999) argue that individual differences on measures of working memory capacity will arise only in working-memory-demanding situations, that is, situations that demand control of attention. Rosen and Engle (1998) also subscribe to this position: "We have argued that working memory or central executive capacity will not be important to all forms of information processing. For example, it is now clear that much of our processing can and does occur relatively automatically (Shiffrin, 1988) and individual differences in working memory will not be reflected in those situations" (p.418).

In the present study, due to their higher-capacity, higher-span readers were better equipped to cope with the cognitive demands of the main idea construction, when the construction was deautomated (the difficulty of the text led readers to deautomate the construction, in other words, the text had an impact on the kind of processing that was involved in the construction task). The latter assumption is consistent with Kintsch's (1998) as well as with Bereiter, Burtis and Scardamalia's (1988) views. Overall, high-span readers (L1 and L2) did not commit themselves to a premature interpretation. They tended to wait till they gathered further information and felt confident enough to extract the main idea of the text. Although high-span readers often loaded working memory with information, they were able to maintain the task goal so as to extract the main idea after reading. In short, the ability to actively maintain the task goal in working memory so as to construct the main idea after

reading even in the face of loosely connected information, as it happened when readers were exposed to undersignalled texts, is related to working memory capacity.

#### 4.5 What Would Be the Resources Underlying Working Memory Capacity?

According to Rosen and Engle (1998), the finding that working memory relates to a wide variety of higher level cognitive tasks is important in itself. However, it does not provide researchers with further information about the mechanisms responsible for this relationship. Given that, a crucial question has guided the studies of Engle and his associates over the past 10 years: what is measured by the working memory span tasks that is also common to higher-level cognitive tasks, that is, what drives this relationship? According to Engle, Kane and Tuholski (1999), it is the ability to control attention. As they put it, the capacity of working memory is in fact “the capacity for controlled, sustained attention in the face of interference and distraction” (p.104).

In the present investigation, given that the results point to a relationship between working memory capacity and the main idea construction task (when the main idea is undersignalled), the important question is: what is this source of communality that drives the relationship between working memory and the construction task? Our argument is that both the span task and the construction task demand control of attention. In short, the present study subscribes to Engle’s et al. (1999) position.

Engle et al. (1999) go on to describe some situations which reflect differences in capability for controlled attention, that is, “when task goals may be lost unless actively maintained in working memory” (p.104); “when error monitoring and correction are controlled and effortful” (p. 104). In this study, the processes involved in the main idea construction task also required the ability to actively maintain thematic information in working memory even in the presence of loosely connected information as well as the ability

to monitor and correct for errors. However, further research is needed to investigate whether the type of maintenance of goal information, monitoring and updating that took place during the present main idea construction task would really correspond to the same situations as the ones described by Engle et. al. Although we agree with Engle's assumption that the common point underlying the relationship between working memory span tasks and complex cognitive tasks is the ability to control attention, Engle's tasks are not directly related to reading comprehension. In fact, there are several procedural differences between our main idea construction task and Engle's et al. higher-level cognitive task. For instance, Rosen and Engle (1998) explain that individual differences in working memory capacity appear when "monitoring for errors is required because elements of the task automatically induces thoughts or behaviours inappropriate to the current task" (p.419). This is the type of monitoring that took place in the name generation task (Rosen & Engle, 1997, cited above), but it does not seem to be the same type of monitoring that occurred in the present main idea construction task.

To conclude, our basic assumption was that as the main idea was not obviously stated, the process of main idea construction was deautomated. That is, the main idea construction stopped being an automatic process thus becoming a process executed under cognitive control. Given the description of the verbal protocols (above), this assumption was confirmed. The construction was often a working-memory demanding process which required (1) keeping information relevant to the task in an active state in working memory even in the face of loosely connected information; (2) monitoring the coherence of the evolving macrostructure; (3) updating the evolving macrostructure; (4) strategically using textual and content knowledge to identify information relevant to the construction task. In fact, results indicate that higher span readers were able to cope with the demands of updating and correction so that they were not trapped into premature interpretations.

## CHAPTER 5

### 5 FINAL REMARKS, LIMITATIONS, SUGGESTIONS, AND IMPLICATIONS

#### 5.1 Final Remarks

The present research had three main objectives. The first investigated the relationship between measures of working memory capacity (L1/L2) and of reading ability (L1/L2), and was unfolded into six specific hypotheses: (a) working memory as measured in L1 would correlate with reader's ability to construct the main idea in L1; (b) working memory as measured in L1 would correlate with reader's ability to construct the main idea in L2; (c) working memory as measured in L2 would correlate with reader's ability to construct the main idea in L2; (d) working memory as measured in L2 would correlate with reader's ability to construct the main idea in L1; (e) there would be a correlation between working memory capacity across languages; (f) readers' ability to construct the main idea in L1 would correlate with readers' ability to construct the main idea in L2.

To accomplish the first objective, mainstream research on individual differences in working memory capacity was followed, that is, the Pearson Product Moment Coefficient of Correlation was used to address the six hypotheses. In addition, due to the number of participants in this study, and the nature of the data, another statistical test, Spearman's Correlation Coefficient for ranked data has been performed to confirm the results of the Pearson Coefficient of Correlation (see Appendix K for the results of Spearman's rho).

The second objective was formulated as a research question which set out to investigate how readers conceive the task of main idea construction (L1 and L2) when the texts are undersignalled. In order to answer this question, the strategies used by readers were

described, namely strategies to construct the main idea before, during and after reading the texts (L1 and L2) as well as strategies to assign importance to information. Data, which consist of excerpts from the think-aloud protocols, were presented and analysed.

The third objective investigated three research questions: (a) whether it was possible to form groups of readers who had a similar profile of strategy use to construct the main idea of an expository text (L1 and L2) when the main idea was undersignalled; (b) whether it was possible to form groups of strategies which had typically been chosen by a particular group of participants. As the answers to questions (a) and (b) were affirmative, question (c) pursued the investigation, examining whether working memory capacity was associated with the specific strategies readers used to construct the main idea when the texts (L1 and L2) were undersignalled.

The third objective was descriptive and exploratory in nature. In other words, it was not concerned with formulating and testing a hypothesis, instead, the research questions above were investigated. To answer the latter questions, data was displayed on frequency tables (subjects vs. strategies); in addition, two statistical techniques were used, namely, the Simple Correspondence Factor Analysis (Escofier & Pagès, 1992), and the Cluster Analysis (Escofier & Pagès, 1992), the results of the latter statistical analyses were displayed in several figures. Next, I summarise the major findings of the study.

#### 5.1.1 Results of Statistical Correlational Analyses on the Reading Span Test and Reading Comprehension Measures.

Results indicate the following: the variable working memory, as measured by the L1 reading span test, has a role in the relationship between working memory capacity and the main idea construction task in L1 as well as in L2. The variable working memory, as

measured by the L2 reading span test, does not have a role in the relationship between working memory capacity and the construction task in L1; neither does it have a role in the relationship between working memory capacity and the construction task in L2 at Pearson's coefficient of correlation, but it has a relationship at Spearman's. In addition, a fairly strong relationship has been found between working memory capacity across languages. On the other hand, a relationship has not been found between readers' ability to construct the main idea across languages. The latter result was unexpected.

#### 5.1.2 Description of the Strategies Used by Readers in order to Construct the Main Idea before, during and after Reading a Text

Data at hand indicates that readers sometimes used the strategy anticipate content to construct the main idea before reading. When readers have prior knowledge about the content of the text, this strategy, anticipate content, tends to be efficient and generate a reasonable main idea spending fewer working memory resources. However, in the present study, participants were low knowledge about the topic of the L1 text. As a result, the strategy often failed and the initial hypothesis had either to be replaced or revised. The revising of a premature hypothesis was too demanding for low-span readers. This was particularly true when low-span readers were reading in L1, which was a more difficult text for participants in the present investigation.

In addition, readers also made attempts to construct the main idea while reading by means of the strategy integrate information, that is, participants condensed smaller chunks of the text into summary-words so as to break the construction task into more manageable stages and make further progress towards the main idea construction.

To construct the main idea after reading a paragraph or an entire text, readers performed some operations which have been classified as listing, topic-and-comment, draft-and-revise (Johnston & Afflerbach, 1985; Afflerbach, 1990b). As for listing, readers skimmed through the text selecting and “listing” important words or phrases (Johnston & Afflerbach, 1985, p. 213). However, listing by itself might not lead readers to extract the main ideas. Readers will not be able to extract the main ideas unless they have enough working memory resources to use the strategy integrate the text.

Readers often found that after reading a paragraph they were only halfway towards the main idea. These halfway points indicate that readers were performing the operations of topic-and-comment and draft-and-revise. The operation of topic-and-comment and draft-and-revise are more responsive and memory-demanding than the operation of listing for two reasons: (1) while performing the operations of topic-and-comment and draft-and-revise, the reader also skimmed and listed parts of the texts; however, the reader seemed to have enough working memory resources to use the strategy integrate the text. (2) The reader is able to recognise that only a topic, or a draft has been constructed, but such topic (or draft) still requires further qualification or revision.

The operation of draft-and-revise seems to be similar to the one of topic-comment; however, it is a little more ambitious (Johnston & Afflerbach, 1985). That is, there might be a possibility that readers are incorrect when they propose a first draft, but they become aware of the risk, and whenever it is necessary, they will revise their earlier position. This revision is always working memory demanding because it requires keeping information relevant to the task active in working memory, monitoring the coherence and updating the evolving macrostructure. To perform the operation of draft-and-revise, readers often used strategies such as integrate and interpret the text, this is particularly true for high-span readers while



reading in L1 (as shown in figure 4.7, above). Such strategies might indicate that they were able to construct a final main idea conclusion based on an earlier draft.

### 5.1.3 Knowledge – Based Cues as a Key Factor in Assignment of Importance

In the present study, the topics of both texts were meant to be unfamiliar to readers. Although both texts were meant to be equally unfamiliar, the L2 text turned out to be more familiar than the L1 text. Still, the L2 text was not so familiar as to enable readers to construct the main idea automatically. Due to lack of familiarity with the topic of the L1 text, when readers found something familiar such as a word or a phrase, the familiar item was assigned importance so as to provide readers with a way into the text. Sometimes, specific words were used as some sort of foundation out of which the main idea statements were built (see also Johnston & Afflerbach, 1985).

### 5.1.4 Text-based Cues as a Key Factor in Assignment of Importance

Readers may assign importance by noting the author's repeated use of the same concept. The overlapping concepts can be used as a key for constructing a main idea statement for the entire paragraph (see also Kintsch & van Dijk, 1978; van Dijk & Kintsch, 1983). In addition, readers were also taking advantage of text structure. This strategy can be used regardless of readers' knowledge of specific content domain and; consequently, it can be used in situations in which the reader lacks relevant content knowledge (see also Johnston & Afflerbach, 1985, for a similar position).

In short, in the process of main idea construction, keeping relevant information active in working memory often requires monitoring the coherence of the evolving macrostructure

and strategically using structural and content knowledge to identify relevant text information and to retrieve relevant information from long-term memory. It seems that when readers lacked the relevant content knowledge, this is particularly true while they were reading in L1, they tended to focus on already familiar phrases which served as an “anchor” (Johnston & Afflerbach, 1985, p.215), that is, which served as the base of the comprehension process.

#### 5.1.5 How Readers’ Profile of Strategy Relates to Differences in Working Memory

##### Capacity

Overall, the results indicate some trends, that is, the present data are not conclusive enough for us to back up the claim that readers’ profile of strategy use is associated with differences in working memory capacity, in addition, there are factors other than working memory capacity involved in strategy choice. Still, the present results suggest that to a certain extent readers conceive the task of extracting the main idea of a text (L1 and L2) as a function of their working memory capacity; and these readers make sense of what they are reading (L1 and L2) according to the constraints imposed by working memory limitations.

L1 reading. Results indicate the following trend: while reading in L1, high-span readers had enough working memory resources to use an integrative strategy. As a result, they were able to construct the main idea either while reading or after reading the text, performing the operations such as topic-and-comment and draft-and-revise. In other words, high-span readers might have been able to keep their interpretation open and wait to make a final judgement till more text was read (see Whitney et al., 1991; Tomitch, 1995, for a similar position). By contrast, low-span readers tended to anticipate content, committing themselves to an early interpretation, which they often failed to update. However, this does not mean that

low-span readers always constructed the main idea before reading. They also used the strategy interpret the text, which might indicate their attempts to construct the main idea after reading.

Whitney, Ritchie, and Clark (1991, cited above) have found that, when processing ambiguous information, high working-memory subjects managed to maintain irrelevant and unnecessary information for a longer period of time than did low working-memory subjects. In contrast, Gernsbacher and Faust (1991, as cited in Engle, 1996) have found that subjects who have high comprehension ability managed to inhibit irrelevant and unnecessary information faster than did low-comprehension subjects. Because measures of working memory capacity and measures of reading comprehension are highly correlated (Daneman & Carpenter, 1980), it is quite safe to assume that high-comprehension subjects behave similarly to high working-memory subjects.

There are several procedural differences between the two studies (between Whitney et al., as cited above and Gernsbacher & Faust, as cited in Engle, 1986). As a result, the contradiction might arise from the type of experimental task participants were required to perform. It is noteworthy that Engle and his associates have found a way out of this controversy. According to their framework, a high-capacity subject, or a subject who has a great deal of working memory resources available, is able to keep ambiguous, and irrelevant information available if the task encouraged such a strategy but to inhibit the irrelevant information if the task encouraged that strategy. In short, according to Engle, the conclusions of either studies are acceptable, considering that results depend on the specific demands of the experimental task. The results of the present investigation are consistent with Whitney's et al. views (see also Tomitch, 1995, for a similar position). It seems that the experimental texts (undersignalled texts) favour doubts and uncertain meanings. As a result, high-span readers were led to wait till they gathered further information and felt confident enough to extract the main idea of the text. It is also noteworthy that high-span readers might even have loaded

working memory with information; however, they were able to maintain the task goal. Hence, they managed to extract the main idea after reading the text.

L2 reading. While reading the L2 text, assignment of importance and integration of information might have been easier and more straightforward for high span-readers due to activation of appropriate knowledge. As a result, they did not report their strategies to integrate information in L2 as often as they reported in L1. In other words, because the topic of the L1 text was unfamiliar, high-span readers had to make a greater effort to construct the main idea, and their protocols often revealed the use of memory consuming strategies such as integrate the text. This does not mean that high-span readers failed to integrate the text while reading in L2, it just means that they did not report integrative strategies in L2 as often as they did in L1.

High-span readers tended to associate the strategy use of general knowledge with the strategy correct behaviour while reading in L2. This association indicates that high-span readers activated prior knowledge, but were aware of the need to update their knowledge-base assumptions. As a result, they avoided committing themselves to an early interpretation based on prior knowledge. Results indicate that they were often able to revise their interpretation before reaching a final conclusion, this trend could be an indication that they were performing the operation of draft-and-revise.

Low-span readers have often used the strategy monitor comprehension while reading in L2. The fact that these low-span readers were able to use the strategy monitor comprehension indicate that they were able to identify a comprehension problem, or were at least able to recognise that a problem existed. It is noteworthy that while this strategy has been used by low-span readers in L2, it has been used by high-span readers in L1. As stated above, when L1 high-span readers identified problems that hindered comprehension, they allocated resources, and at least made an attempt to take appropriate action. On the other

hand, L2 low-span readers were able to recognise that a problem existed, but the present data indicate that they did not take further action. Indeed, the strategy monitor comprehension is alone (figure 4.11). This might indicate that low-span readers failed to associate the strategy monitor comprehension with another strategy that would enable them to solve their problems.

The results that have been discussed in chapter 4 (above) were concerned with general comprehension strategies. As for the local strategies (L1 and L2), the statistical techniques, namely, the Simple Correspondence Factor Analysis and the Cluster Analysis were also performed for them. When local strategies were investigated, results indicated the following: the difference between the average profile of high and low-span readers was not perceptible in L1 nor was the difference perceptible in L2. The speculation is that most of the local strategies might not be memory-demanding, in this case, differences between high and low-span readers did not arise (Just & Carpenter, 1992). Therefore, we did not mention local strategies in chapter 4.

#### 5.1.6 Strategy Associations

These associations might indicate that readers do more than just choose a single strategy at a time while constructing the main idea of a text. Given that, it is reasonable to assume that the strategies above usually appear in a context of several related strategies (see also Johnston & Afflerbach, 1985, for a similar position). In chapter 4, we have described how general comprehension strategies relate to each other, and how they relate to readers' working memory capacity (the statistical techniques - Cluster Analysis - and Simple Correspondence Factor Analysis, Escofier & Pàges, 1992, enabled us to describe these relationships). However, it would also have been interesting to describe how general comprehension strategies relate to local strategies. Although the present study did not focus on this latter relationship, one may observe a trend: local and general comprehension

strategies tend to go together. That is, local strategies such as re-reading and translation, when used judiciously, might provide readers with pieces of information which are necessary for the main idea construction task. However, the main idea will be constructed on condition that the reader is able to integrate the pieces of information, which is a memory demanding operation (e.g. an excerpt from the protocol of participant 11 - cited above). That is, listing information through rereading and translation is useful only if the reader manages to integrate and make sense out of the information that has been listed. Local strategies such as translation and re-reading may also indicate the existence of processing bottlenecks.

When readers were able to recognise their processing difficulties they sometimes related local to general comprehension strategies. In one of the excerpts cited above, the reader (S11) put to use some local strategies (e.g. re-read, and translation) thus slowing down the pace of processing. The use of local strategies might indicate that the reader is faced with processing bottlenecks but is trying to take some action to overcome them. Participant 11 (cited above) related a local (reread) to a general comprehension strategy (integrate the text). That is, the participant reread pieces of the text, and loaded working memory so as to postpone the construction of the main idea till more information was gathered (see the excerpt cited above). Rereading was also used when readers scanned the text in order to find a source of difficulty. On the other hand, readers might fail to overcome processing bottlenecks even when they slow down their pace of reading and take advantage of local strategies. To sum up, the use of such strategies (i.e. re-reading and translation) may not always indicate that reader's will be able to relate them to a global integrative strategy so as to construct the main idea in the end (see the excerpt cited above - S3).

### 5.1.7 The Resources Underlying Working Memory Capacity

In this investigation, we follow Engle and his associates (Engle, Tuholski, Laughlin & Conway, 1999; Kane, Bleckely, Conway & Engle, in press; Rosen & Engle, 1997, cited above) who claim that the capacity of working memory is in fact the capacity to control attention. Our research is in line with Engle's argument that the ability to "control attention" mediates the correlation between working memory span and complex cognitive tasks. What Engle and his group have done is to select a task which demands control of attention (i.e. monitoring and updating of the content of working memory; inhibition and suppression of preponent responses; switching attention between tasks, among others) then investigate how this task relates to individual differences in working memory span.

On the one hand, the present study follows Engle's argument that attention is the resource underlying working memory capacity; on the other hand, this study is different from Engle's studies because his tasks are not reading comprehension tasks. Here, Engle's construct, 'working attention', has been applied to reading comprehension, more specifically, to the main idea construction tasks (L1 and L2).

The present argument is the following: the task of main idea construction in an undersignalled text requires a great deal of working memory resources. Some processes involved in main idea construction (i.e. maintenance of thematic information in working memory, monitoring and updating of an evolving macrostructure) seem roughly analogous to the tasks described by Engle et al (1999), which are assumed to require control of attention. However, further research is needed to investigate whether the type of maintenance, monitoring and updating that takes place during the present main idea construction task would really correspond to the type of monitoring and updating of the tasks described by Engle et al.

## 5.2 Limitations of the Study

Sample size. A sample of 18 participants is considered too small to allow the experimenter to make generalizations. Most studies in the area of individual differences in working memory capacity have larger sample sizes. To cite just two of them, the study of Budd, Whitney, and Turley (1995) had 96 participants; the study of Miyake, Just, and Carpenter (1994) also had 96 participants. In conclusion, the results presented just above are relative to our sample.

Participants' level of proficiency in English. Participant's level of proficiency was not strictly controlled. Although some measures were taken to ensure a certain degree of uniformity in participant's language experience, participants were expected to differ in the level of L2 proficiency.

All participants were enrolled in the graduate course at UFSC, studying either applied linguistics or literature in English. A reasonable level of proficiency is a pre-requisite for joining a graduate course in English: (a) these graduate students have already undergone a written and an oral entrance examination in English; (b) they were required to speak English in class and to write their assignments in English; (c) most of these students were already teachers of English as a foreign language, or were going to make English into a profession. In short, the fact that all participants belonged to the same group at the university may have ensured a certain degree of uniformity in language experience. However, this was not a way of indexing participant's level of proficiency in L2 or their reading ability. Therefore, it was expected that participants would possibly differ in the level of L2 proficiency.

Despite this expected difference, which might have influenced the results, it seems that participants had such a good level of proficiency in English that the results of the experiment could be attributed to individual differences in working memory capacity and in reading



ability, but not simply to differences in language proficiency. The results of the descriptive statistics for the measures of working memory capacity and reading ability tend to support this claim. That is, there was no statistically significant difference between the means of the reading span tests across languages. Neither was there a statistically significant difference between the means for the measures of reading ability across languages. If participants had not been so proficient in L2, they would have performed worse in L2 than in L1.

Fortkamp (2000) has raised an important point concerning the problem of assessing participant's language proficiency. According to her, if experimenters have an index of each participant's level of proficiency, it will be possible for them to partial out this value out of the statistical analysis; as a result, the experimenter will at least become aware of the effect of L2 knowledge on the variables being investigated. However, indexing language proficiency is not as simple as it may seem to be, it is not just a matter of applying a proficiency test. As Fortkamp (2000) puts it, a valid and reliable measure of L2 proficiency has not been devised yet by L2 researchers. She goes on to say that the "the very concept of 'proficiency' is problematic in the field" (p.208).

Hulstijn and Bossers (1992) argue that a broader componential perspective would enable researchers to understand better the construct of L2 proficiency. This construct would include not only L2-specific factors (such as grammar and vocabulary) but also non-L2-specific factors (such as fluency of speech delivery and general reading skills). As they put it, "rather than being an interfering task factor, which block our view of language proficiency and are mainly a methodological nuisance, non-L2-specific factors help us to understand the componential nature of the notion of second language proficiency"(p.352). Another important point raised by Hulstijn and Bossers (1992) is that "non-L2-specific factors do not exist in a vacuum" (p.352). These researchers argue such factors may be brought about by the task at hand, thus contributing to form an essential part of the skills necessary to fulfil the task.

The present study subscribes to Hulstijn and Bossers' position; still, it seems to us that it is quite important to specify clearly what would be these variables (non-L2-specific as well as L2-specific) that would contribute to constitute the construct of language proficiency, and we might also argue that working memory capacity should be included as one of the non-L2-specific variables.

Participants' motivation. The variable motivation has not been controlled either. According to researchers such as Fortkamp (2000) as well as Just and Carpenter (1992), performance differences can be influenced by both cognitive and by motivational factors. Fortkamp mentions the possibility that lower-span readers may be lower-spans because they do not make as much effort as higher-span readers to perform the working memory span tasks; as a result, their performance is worse. Furthermore, readers' level of motivation might probably have an effect on their strategy choice. In fact, there is no denying that most language studies are conducted in an artificial environment, so experimenters should find ways of motivating their participants. At least, as the present study was conducted on a voluntary basis, participants were never performing against their will.

Factors involved in strategy choice. It is likely that some strategies are used effectively on condition that readers have enough working memory resources available. For instance, in the present study, higher-working memory readers could take advantage of integrative strategies which led them to integrate the L1 text at a more global level and extract the main idea. However, there may be factors other than working memory capacity which are involved in strategy choice, for instance, activation of relevant knowledge, reader's goals (Aebersold & Field, 1997), the task, the type of text, reader's level of motivation could also be one of these factors. Further research is needed to investigate what are the factors involved in strategy choice, how these factors affect strategy choice, and whether factors such as knowledge activation and reader's level of motivation can ever make up for lack of working memory

resources. In short, it seems that strategy choice is defined by a broader context and the circumstances in which the reading task takes place.

Assessment of working memory capacity. The working memory span test followed some criteria in order to avoid floor effects due to task difficulty. The sentences used in the span test in English were borrowed from Harrington and Sawyer (1992), who have already used them successfully. The sentences were active and controlled for length. In addition, the final words of each sentence were controlled for type and length. As for the span test in Portuguese, the 42 sentences were taken from popular magazines (i.e. *Veja*, *Isto É*, *Superinteressante*) as well as from the newspapers (i.e. *Folha de São Paulo*). These sentences were controlled for length so as to be as long as the sentences in English, and the final words were also controlled for type and length. However, the sentences in Portuguese were not controlled for syntactic complexity.

Previous research has shown that (a) it is important to consider how many items one can store in working memory at any one time; (b) it is also important to consider how long it takes for the memory trace to decay. Given that, Rothe-Neves (2000) pointed to the importance of controlling the variables involved in the sentences of the reading span test. He developed a list of syntactic structures found in sentences of Brazilian Portuguese. Not only is Rothe-Neves concerned with the syntactic structure of the sentences of the span test, but he has also developed some criteria to control the structure of the syllable in the sentence final word. These criteria as well as list of syntactic structures were used by Rothe-Neves to develop a working memory span test which aims to offer new insights into the comprehension of sentences of Brazilian Portuguese. Although the sentences in the present investigation were not strictly controlled for syntactic complexity, this study subscribes to Rothe-Neves' position.

Rate of display of sentences of the reading span test. Unlike most span tests in which subjects are required to read the sentences aloud (Daneman & Carpenter, 1980), in the present test, the sentences were presented visually on a computer screen one at a time. Individual sentences were displayed at a rate of 9 seconds in the middle of the screen.

During the pilot study, we followed previous researchers: Budd, Whitney, and Turley (1995). Their span test was presented visually and individual sentences were displayed at a rate of 7 seconds. However, Budd et al. have used an overhead projector while in our pilot study the sentences were presented on a computer screen. The major finding of the pilot study was concerned with the rate of presentation of individual sentences. In fact, an interesting point was raised by participants. A majority of participants in the pilot study claimed that the presentation was too fast. This seemed a fair comment because participants in Budd et al.'s study were tested in L1 while participants in the present study were tested in both L1 and L2. Based on participants' comments, it was decided that in the real experiment the sentences would be displayed at a rate of 9 seconds instead of 7 seconds (Budd et al.'s study).

It would have been better to calculate how many milliseconds it takes readers to read each word, then, calculate the mean in order to find out how many milliseconds it takes to read the whole sentence. However, since it was not possible to perform this type of measurement, participants' feedback on the pilot study was used to decide the rate of display of each sentence.

Assessment of reading ability. An attempt was made to control the level of difficulty of the L1 and the L2 text through interviews with judges and participants who took part in the pilot study. However, tests of readability were not conducted. Kintsch and van Dijk's (1978) position was taken into consideration. According to them, "conventional accounts of readability have certain shortcomings" (p. 372). They explain that readability is not only a

property of the text, but it is also related to reader's factors. One of these factors may be their working memory capacity.

Although the texts (L1 and L2) were meant to be equally difficult, participants may have been more exposed to the topic of the L2 text. As a result, they might have had at least some prior knowledge to activate, and the L2 text turned out to be easier than the L1 text. In addition, textual structure differed, that is, the L1 text comprised a description of four periods: birth, youth, and death of a star, while the L2 text was a situation-problem-solution-evaluation text. Possibly, participants may have been better acquainted with the structure of the L2 text. To conclude, the experimental texts differed in the level of difficulty.

It is noteworthy that high-span readers did not fail to integrate the L1 text even though the topic was difficult for them. Results indicate that high-span readers had enough working memory resources to use integrative strategies in L1, so they could overcome their difficulties. Indeed, the results of the descriptive statistical analysis above indicate that there is no statistically significant difference between the means for the reading ability measures across languages. To conclude, it is reasonable to assume that high-span readers were able to construct the main ideas for both texts (L1 and L2). They were able to perform the integrative operations for the main idea construction in L1 as well as in L2. However, due to the difference in the level of difficulty of the texts, there is a difference between high-span's profile of strategy use across languages: high-spans tend to report integrative strategies for the L1 text and knowledge activation strategies for the L2 text.

As far as the correlations between the measures of reading ability across languages are concerned, there is one unexpected result: the correlation between reader's ability to construct the general main idea of the texts in L1 and L2 did not reach significance. Because of the fairly strong correlation between working memory capacity and reading ability (Daneman & Carpenter, 1980), it was expected that the correlation between measures of reading ability

across languages would have a considerable overlap with the correlation between measures of working memory capacity across languages. While the correlation between measures of working memory capacity across languages was found, the correlation between measures of reading ability across languages was not. A possible explanation for this unexpected result has not been found.

As reported above, Hulstijn and Bossers tested the following hypothesis: there would be a stronger relationship between L1 and L2 reading comprehension for the most skilled L2 readers of their sample. They calculated the Pearson Correlations between L1 and L2 reading comprehension for two groups: a group of the least and a group of most skilled readers of their sample. The correlation was almost non-existent for the least skilled readers and moderate for the most skilled readers. According to their interpretation, these results indicate a trend, that is, the contribution of L2-non-specific factors such as L1 reading ability was more important for the most skilled readers.

In the present investigation, given that readers were already quite proficient in L2, it seemed reasonable to assume that there would be a strong relationship between L1 and L2 reading comprehension. However, this expectation was not met.

Definition of main ideas. The criteria established to define the main ideas of the texts in this investigation was based on text structure and textual cues (i.e. graphic, syntactic, lexical, and structural signals). We argue that a definition of main idea should be genre-based, taking into account not only the content and the conventional schematic structure of the genre but also its communicative purpose (see Swales, 1993, for a definition of genre)

Statistical techniques. The Pearson Correlation, which has been presently used, is the statistical technique most commonly used in studies about individual differences in memory capacity (Fortkamp, 2000). In fact, this is valid a technique, but such correlations are not to be interpreted as cause-effect relationships. Indeed, Fortkamp has argued that it would be

worthwhile using more powerful techniques to elucidate the relationship between working memory and complex cognitive tasks. For instance, given that Miyake and Friedman (1998) used path analysis, they were able to track causal relations among their four variables.

The other statistical techniques presently used, namely, the Simple Correspondence Factor Analysis (Escofier & Pagès, 1992), and the Cluster Analysis (Escofier & Pagès, 1992) are not usually used in mainstream research on individual differences in working memory. These techniques were used here because this study drew on different research traditions: firstly, following mainstream research on working memory, correlational quantitative techniques were used in order to investigate the relationship between working memory capacity and reading ability. The second part of the study departed from mainstream research on working memory because it involved qualitative differences in memory capacity. Raw frequencies of verbal reports of strategies had to be transformed into percentage ratio and displayed on frequency tables so that the Simple Correspondence Factor Analysis plus the Cluster Analysis could be performed (Escofier & Pagès, 1992). These techniques were used in order to investigate a particular type of association, that is, whether reader's profile of strategy use associate with their working memory span. As these techniques are not usually found in mainstream research on working memory and they do not allow us to test a hypothesis, the second part of this study is entirely tentative and exploratory.

### 5.3 Suggestions for Further Research

The correlation between working memory and L2 reading performance. L2 acquisition researchers tend to assume that learners have a perfect command of their L1, thus, in terms of L1 performance, L2 learners are often considered as members of a homogenous set of individuals who only differ in L2-specific proficiency (Hustijn & Bossers, 1992). However, it

is important for reading researchers to take into account that not only do L2 readers differ in terms of their command of L2, but they may also differ in terms of several other factors such as general reading skills and working memory capacity. Therefore, the relationship between working memory capacity and L2 reading really deserves to be further investigated. In fact, there is a specific point which needs to be focused on: whether the correlation between working memory and L2 reading performance would increase as reader's level of L2 proficiency improves.

On the basis of Hulstijn and Bossers' (1992) data, Miyake and Friedman suggest that the contribution of L2-specific and non-L2-specific factors might change throughout the process of L2 acquisition. That is, at the beginning stages of L2 acquisition, L2 reading performance seems to rely on learner's L2-specific knowledge such as vocabulary and grammar. As proficiency in L2 improves, the contribution of L2-specific factors becomes less significant while the contribution of non-specific factors such as working memory may become more significant. Given that, it would be interesting to investigate whether the contribution of working memory to L2 reading performance increases as a function of improvement in L2 proficiency.

Level of proficiency in L2. It is important to bear in mind that most of the studies reviewed above, in chapter 2 (Berquist, 1997; Fortkamp, 2000; Harrington & Sawyer, 1992; Miyake & Friedman, 1998) were conducted with participants who were already quite proficient in L2, so it would also be worth measuring the working memory capacity of less proficient participants in L2. It is noteworthy that it might not be possible to test real beginners because some threshold knowledge of L2 is essential at least to avoid a floor effect on the Reading Span Test.

It would be interesting to observe L2 learners over a period of time in order to investigate to what extent working memory capacity (indexed L2) improves as a function of



improvement in language proficiency. To my knowledge, no longitudinal study has ever been carried out.

Strategies for main idea construction in a specific genre. Williams (1988) has raised the point that researchers, teachers, and readers often fail to consider the differences that exist among text types when establishing the criteria to define the main idea of a text. According to Williams, the definition of term main idea should be specific to each genre. In addition, although the principles of main idea construction may be quite general, the construction of main idea in each genre may require the use of some particular knowledge and strategies (Kintsch, 1998). Swales (1993) has reported previous research which taps into the processing strategies used by experts for a specific genre. According to him, this type of research unveils reading behaviours which tend to differ from those researchers expect to find; in addition, it serves “to throw light on how, why, and to what extent genre-texts evolve in response to processing strategies” (p.14). Given that, it seems to us that there is a need to investigate the strategies readers use to extract the main ideas in specific genres. It also seems important to investigate to what extent main idea construction strategies are specific to each type of genre.

#### 5.4 Pedagogical Implications

Hare and Bingham (1986) as well as Tomitch (2000b) bring up the point that main ideas are not being properly taught. Hare and Bingham have argued that children are often asked to find the main idea in a text, but they are not taught how to find it. Tomitch has found out that (EFL/ESL) material writers provide readers with practice at tasks involving main ideas, but do not provide them with explicit instruction on how to extract the main ideas. Tomitch claims that readers who do not possess this skill are not being taught it; as a result, they will not acquire it.

Another point raised by Tomitch (2000b) is that skilled readers are able to identify and construct the main ideas of a text, but find it difficult to verbalize their criteria for identification and construction. However, it is important to make these criteria explicit in order to help those less skilled readers, who fail to construct the main ideas. That is, once the criteria have become explicit, it can serve as a guideline for the less skilled readers to carry out the construction task.

Researchers such as Aulls (1986) also argue in favour of explicit main idea instruction. According to him, teachers should take two steps to improve the quality of main idea instruction: to specify what the main idea is, and also to explain to readers how to identify and construct main ideas. In this study, we subscribe to Aulls' position and make a further suggestion, that is, the definition of main idea should be based on the genre of the text, taking into account not only the content but also the communicative purpose, and the conventional schematic structure of the genre (see Swales, 1993, for definition of genre).

Hare and Bingham (1986) have also suggested some points to be taken into account in main idea instruction. First, teachers should help readers become aware that texts have hierarchies of ideas and that top level ideas are considered the most important ones. Second, they should help readers make a distinction between textual and contextual importance. Textual importance refers to how importance is assigned by the author of the text while contextual importance refers to reader's assignment of importance according to their personal interest, task goals, prior knowledge, and a broader social context. Third, teachers should lead readers to recognise how textual importance is signalled through graphic, syntactic, lexical, structural and other cues. Fourth, it is also important for teachers to help readers recognize how structural differences between text-types can affect the identification of important ideas. According to our present view, Hare and Bingham have a point. However, there is a need to go a step beyond recognizing structural differences. Following Swale's (1993) perspective on

genre analysis, texts differ not only in terms of their conventional schematic structure, but also they also differ in terms of their communicative purpose. That is, main idea instruction should also taken into that text-types differ in terms of their communicative purpose.

According to Tomitch (1995), some processes such as recognition of text structure are amenable to instruction and practice. In fact, there is a good reason for instructing readers (L1 and L2) to recognize and make use of text structure as well as lexical, graphic, and syntactic signals which mark text structure. If one of the possible explanations for the working memory phenomenon is processing efficiency, the greater the automaticity readers have in some processes (e.g. recognition of text structure), the larger the working memory capacity a reader has to operate with. In short, there is some hope that improvement in efficiency of some processes will lead reader's to release working memory resources to perform other memory-demanding processes such as integrating the text and monitoring comprehension, which might eventually contribute to the task of main idea construction.

## 6 REFERENCES

- Aebersold, J. A. & Field, M. L. (1997). From reader to reading teacher: issues and strategies for second language classroom. Cambridge: Cambridge University Press.
- Afflerbach, P. (1990a). The influence of prior knowledge and text genre on reader's prediction strategies. Journal of Reading Behaviour, 22 (2), 131-148.
- Afflerbach, P. P (1990b). The influence of prior knowledge on expert readers' main idea construction strategies. Reading Research Quarterly, 25 (1), 31-46.
- Afflerbach, P. P. & Johnston, P. H. (1986). What do experts readers do when the main idea is not explicit.? In J. F. Baumann (Ed.), Teaching main idea comprehension (pp. 49-72). Newark, Delaware. International Reading Association.
- Atkinson, R. C. & Shiffrin, R. M. (1971). The control of short-term memory. Scientific American, 225 (2), 82-90.
- Aulls, M. W. (1986). Actively teaching main idea skills. In J. F. Baumann (Ed.), Teaching main idea comprehension (pp. 96-132). Newark, Delaware. International Reading Association.
- Baddeley, A. D. (1990). Human memory: Theory and practice. Hove, UK: Lawrence Erlbaum Associates.
- Baddeley, A. D. (1992). Is working memory working? The fifteenth Barlett lecture. The Quarterly Journal of Experimental Psychology, 44 A (1), 1-33.
- Baddeley, A. D. (1996). Exploring the central executive. The Quarterly Journal of Experimental Psychology, 49 A, 5-28.
- Baddeley, A. D. (2000). The episodic buffer: A new component of working memory? Trends in Cognitive Science, 4 (11), 417-423.
- Baddeley, A. D. & Hitch, J. G. (1994). Developments in the concept of working memory. Neuropsychology, 8 (4), 485-493.
- Baddeley, A. D. & Logie, R. H. (1999). Working memory: The multiple component model. In A. Miyake & P. Shah (Eds.), Models of working memory: Mechanisms of active maintenance and executive control, (pp. 28-61). Cambridge: Cambridge University Press.
- Bereiter, C., Burtis, J. P., Scardamalia, M. (1988). Cognitive operations in constructing main points in written composition. Journal of Memory and Language, 27, 261-278.
- Berquist, B. (1997). Individual differences in working memory span and L2 proficiency: capacity or processing efficiency. In A. Sorace, C. Heycock, and R. Shillcock (Eds.), Proceedings of GALA '97 conference on language acquisition ,(pp. 468-473). Edinburgh: Human Communication Research Centre, University of Edinburgh.

- Block, E. (1986). The comprehension strategies of second language readers. Tesol Quarterly, 20(3), 463-94.
- Block, E. (1992). See how they read: comprehension monitoring of L1 and L2 readers. Tesol QUARTERLY, 26 (2), 319-343.
- Brown, A. L. & Day, J. D. (1983). Macrorules for summarising texts: The development of expertise. Journal of Verbal Learning and Verbal Behaviour, 22, 1-14.
- Budd, D., Whitney, P., & Turley, K. J. (1995). Individual differences in working memory strategies for reading expository text. Memory & Cognition, 23 (6), 735-48.
- Cantor, J. & Engle, R. W. (1993). Working memory capacity as long-term memory activation: An individual-differences approach. Journal of Experimental Psychology, 19 (5), 1101-1114.
- Carrell, P. L. (1985). Facilitating ESL reading by teaching text structure. Tesol QUARTERLY, 19 (4), 727-52.
- Carrell, P. L. (1988) Some causes of text boundness and schema interferences in ESL reading. In P. Carrell, J. Devine, & D. E. Eskey (Eds.), Interactive approaches to second language reading, (pp. 101-13). New York: Cambridge University Press.
- Cavalcanti, M. C. (1987). Investigating FL reading performance through pause protocols. In C. Faerch & G. Kasper (Eds.), Introspection in second language research (pp. 230-250). Philadelphia: Multilingual Matters.
- Chamblis, M. J. (1995). Text cues and strategies successful readers use to construct the gist of lengthy written arguments. Reading Research Quarterly, 30 (4), 778-806
- Cohen, A. D. (1998). Strategies in learning and using a second language. New York: Addison Wesley Longman Limited.
- Conway, A. R. A. & Engle, R. W. (1994). Working memory and retrieval: A resource-dependent inhibition model. Journal of Experimental Psychology: General, 123, 354-373.
- Coté, N. & Goldman, S. R. (1999). Building representations of informational text: evidence from children's think aloud protocols. In H. van Oostendorp & S. R. Goldman (Eds.), The construction of mental representations during reading. (p.p. 169-93). Mahwah, New Jersey: Lawrence Erlbaum Associates.
- Cunningham, J. W. & Moore, D. W. (1986). The confused world of main idea. In J. F. Baumann (Ed.), Teaching main idea comprehension (pp. 1-17). Newark, Delaware. International Reading Association.
- Daneman, M. & Carpenter, P. A. (1980). Individual differences in working memory and reading. Journal of Verbal Learning and Verbal Behaviour, 19, 450-466.

- Daneman, M. & Carpenter, P. A. (1983). Individual differences in integrating information between and within sentences. Journal of Experimental Psychology: Learning, Memory, and Cognition, 9, 561-584.
- Daneman, M. & Green, I. (1986). Individual differences in comprehending and producing words in context. Journal of Memory and Language, 25, 1-18.
- Daneman, M. & Merikle, P. M. (1996). Working memory and language comprehension: A meta-analysis. Psychonomic Bulletin & Review, 3(4), 422-433.
- Daneman, M. & Tardiff, T. (1987). Working memory and reading skill re-examined. In M. Coltheart (Ed.), Attention and Performance, (Vol. 12, p.p. 491-508). Hillsdale, NJ: Lawrence Erlbaum.
- Engle, R. W. (1996). Working memory and retrieval: An inhibition-resource approach. In J. T. E. Richardson, R. W. Engle, L. Hasher, R. H. Logie, E. R. Stoltzfus, & R. T. Zacks (Eds.), Working memory and human cognition, (p.p. 89-119). Oxford, Oxford University Press.
- Engle, R. W., Cantor, J., & Carullo, J. J. (1992). Individual differences in working memory and comprehension: A test of four hypotheses. Journal of Experimental Psychology: Learning, Memory and Cognition, 18 (5). 972-992.
- Engle, R. W., Carullo, J. J., & Collins, K. W. (1991). Individual differences in the role of working memory in comprehension and following directions in children. Journal of Educational Research, 84, 253-262.
- Engle, R.W., Kane, M. J., & Tuholski, S. W. (1999). Individual differences in working memory capacity and what they tell us about controlled attention, general fluid intelligence, and functions of the prefrontal cortex. In A. Miyake & P. Shah (Eds.), Models of working memory: Mechanisms of active maintenance and executive control, (pp. 102-134). Cambridge: Cambridge University Press.
- Engle, R. W. & Oransky, N. (1999). Multi-store versus dynamic models of temporary of temporary storage in memory. In R. J. Stenberg (Ed.), The nature of cognition (p.p. 515-555). Cambridge, MA: The MIT Press.
- Engle, R.W., Tuholski, S. W., Laughlin, J. E., & Conway, A. R. A. (1999). Working memory, short-term memory, and general fluid intelligence: A latent variable approach. Journal of Experimental Psychology: General, 128 (3), 309-331.
- Ericsson, K. A. & Simon, H. A. (1980). Verbal reports as data. Psychological Review, 87 (3), 215-251.
- Ericsson, K. A. & Simon, H. A. (1987). Verbal reports on thinking. In C. Faerch & G. Kasper (Eds.), Introspection in second language research (pp. 25-53). Philadelphia: Multilingual Matters.
- Escofier, B. & Pagès, J. (1992). Análisis factoriales simples y múltiples: Objetivos, metodos y interpretación. Bilbao: Servicio Editorial de la Universidad del País Vasco.

- Existência tumultuada: Como nascem, vivem e morrem as estrelas? (2001, August) Superinteressante Especial: O Melhor de Superintrigante, Mundo Estranho, 16-7.
- Fletcher, C. R. (1986). Strategies for allocation of short-term memory during comprehension. Journal of Memory and Language, 25, 43-58.
- Fortkamp, M. B. M. (2000). Working memory capacity and L2 speech production: An exploratory study. Unpublished doctoral dissertation, Universidade Federal de Santa Catarina, Florianópolis.
- Gagné, E. D., Yekovich, C.W. & Yekovich, F.R (1993). The cognitive psychology of school learning. chap. 12, Reading, pp. 267-312. New York: Harper Collins College Publishers.
- Gathercole, S. E. & Baddeley, A.D. (1993). Working memory and language. Hove, UK: Lawrence Erlbaum Associates.
- Gernsbacher, M. A. (1997). Two decades of structure building. Discourse Process, 23, 265-304.
- Griffith, M. (2001, July) Sol pra contrariar: Esfriamento global. Superinteressante, 19.
- Hare, V. C. & Bingham, A. B. (1986). Teaching students main idea comprehension: alternatives to repeated exposures. In J. F. Baumann (Ed.), Teaching main idea comprehension (pp. 179-194). Newark, Delaware. International Reading Association.
- Harrington, M. & Sawyer, M. (1992). L2 working memory capacity and L2 reading skill. Studies in Second Language Acquisition, 14, 25-38.
- Heist, A. (2001, Summer). Drug delivery: Getting under the skin. Popular Science, 15, 65.
- Hoey, M. (1994). Signalling in discourse: a functional analysis of a common discourse pattern in written and spoken English. In M. Coulthard (Ed.), Advances in written text analysis (p.p. 26-45). London: Routledge.
- Hosenfeld, C. (1977). A preliminary investigation of the reading strategies of successful and nonsuccessful second language learners. System, 5 (2), 110-123.
- Hulstijn, J. H. & Bossers, B. (1992). Individual differences in L2 proficiency as a function of L1 proficiency. European Journal of Cognitive Psychology, 4, 341-353.
- Johnston, P. & Afflerbach, P. (1985). The process of construction main ideas from text. Cognition and Instruction, 2, 207-232.
- Just, M. A. & Carpenter, P. A. (1992). A capacity theory of comprehension: individual differences in working memory. Psychological Review, 99, 122-149.
- Just, M. A., Carpenter, P. A. & Keller, T. (1997). The capacity theory of comprehension: new frontiers of evidence and arguments. Psychological Review, 103 (4), 773-780.

- Kane, M. J., Bleckley, M. K., Conway, A. R. A., & Engle, R. W. (in press). A controlled-attention view of working memory capacity. Journal of Experimental Psychology: General.
- King, J. & Just, M. A. (1991). Individual differences in syntactic processing: the role of working memory. Journal of Memory and Language, 30, 580-602.
- Kintsch, W., & van Dijk, T. A. (1978). Toward a model of text comprehension and production. Psychological Review, 85 (5), 363-94.
- Kintsch, W. (1998). Comprehension: A paradigm for cognition. Cambridge: Cambridge University Press.
- Logie, R. H. (1996). The seven ages of working memory. In J. T. E. Richardson, R. W. Engle, L. Hasher, R. H. Logie, E. R. Stoltzfus, & R. T. Zacks (Eds.), Working memory and human cognition, (p.p. 31-65). Oxford, Oxford University Press.
- Magliano, J. P., Trabasso, T. & Graesser, A. C. (1999). Strategic processing during comprehension. Journal of Educational Psychology, 91 (4), 615-629.
- Masson, M. E. J. & Miller, J. A. (1983). Working memory and individual differences in comprehension and memory of text. Journal of Educational Psychology, 75, 314-318.
- Matos, M. V. (1999). The use of metacognitive strategies for main idea identification in expository texts: A perspective on instruction. Unpublished Master's thesis. Universidade Federal de Santa Catarina, Florianopolis.
- Meyer, B. J. F. , Brandt, D. M. & Bluth, G. J. (1980). Use of top-level structure in text: Key for reading comprehension of ninth-grade students. Reading Research Quarterly, 16, 72-103.
- Miller, G.A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychological Review, 63, 81-97.
- Mills, C. B., Diehl, V. A., Birkmire, D. P., & Mou, L. C. (1993) Procedural text: Predictions of importance ratings and recall by models of reading comprehension. Discourse Process, 16, 279-315.
- Miyake, A. & Friedman, N. P. (1998). Individual differences in second language proficiency: working memory as language aptitude. In A. F. Healy, & L. E. Bourne, Jr (Eds.), Foreign language learning: Psycholinguistic studies on training and retention, (pp. 339-364). Mahawah, NJ: Lawrence Erlbaum.
- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., & Howerter, A. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. Cognitive Psychology. 41, 49-100.



- Miyake, A., Just, M. A., & Carpenter, P. A. (1994). Working memory constraints on the resolution of lexical ambiguity: Maintaining multiple interpretations in neutral contexts. Journal of Memory and Language, 33, 175-202.
- Miyake, A. & Shah, P. (1999). Toward a unified theories of working memory: emerging general consensus, unresolved theoretical issues, and future research directions. In A. Miyake & P. Shah (Eds.), Models of working memory: Mechanisms of active maintenance and executive control, (pp. 442-481). Cambridge: Cambridge University Press.
- Mota, M. B. (1995). Working memory capacity and L2 fluent speech production. Unpublished Master's thesis. Universidade Federal de Santa Catarina, Florianopolis.
- Olshavsky, J. E. (1977). Reading as problem solving: an investigation of strategies. Reading Research Quarterly, 12 (4), 654-674.
- Pritchard, R. (1990). The effects of cultural schemata on reading processing strategies. Reading Research Quarterly, 25 (4), 273-295.
- Richards, J. C., Platt, J. & Platt, H. (1992). Dictionary of language teaching & applied linguistics. Edinburgh Gate, Harlow: Longman Group UK Limited.
- Richardson, J. T. E. (1996). Evolving Issues in working memory. In J. T. E. Richardson, R. W. Engle, L. Hasher, R. H. Logie, E. R. Stoltzfus, & R. T. Zacks (Eds.), Working memory and human cognition, (p.p. 3-30). Oxford, Oxford University Press.
- Riley, G. L. & Lee, J. F. (1996). A comparison of recall and summary protocols as measures of second language reading comprehension. Language Testing, 1, 173-87.
- Rosen, V. M. & Engle, R. W. (1997). The role of working memory capacity in retrieval. Journal of Experimental Psychology, 126 (3), 211-227.
- Rosen, V. M. & Engle, R. W. (1998). Working memory capacity and suppression. Journal of Memory and Language, 39, 418-436.
- Rothe-Neves, R. (2000). Mémória de trabalho e processamento sintático. In V. G. Hasse, R. Rothe-Neves, C. Kappler, M. L. M. Teodoro, G. M. O. Wood (Eds), Psicologia do desenvolvimento - Contribuições interdisciplinares, (p.p. 111-19). Belo Horizonte, MG: Editora Health.
- Sarig, G. (1989) Comprehension – promoting strategies: The sum of the parts and the whole. Ilha do Desterro, 21 (1), 43-72.
- Schellings, G. L. M. & Van Hout-Wolters, B. H. A. M. (1995). Main points in an instructional text, as identified by students and by their teachers. Reading Research Quarterly, 30 (4), 742-756.
- Shah, P. & Miyake, A. (1999). Models of working memory: An Introduction. In A. Miyake & P. Shah (Eds.), Models of working memory: Mechanisms of active maintenance and executive control, (pp. 1-27). Cambridge: Cambridge University Press.

- Shallice, T. & Burgess, P. W. (1993). Supervisory control of thought and action. In A. D. Baddeley and L. Weiskrantz (Eds.), Attention, selection, awareness and control: A tribute to Donald Broadbent (p.p. 171-187). Oxford: Oxford University Press.
- Swales, J. M. (1993) Genre analysis: English in academic and research settings. Cambridge: Cambridge University Press.
- Tomitch, L. M. B. (1995). Reading: Text organisation perception and working memory capacity. Unpublished doctoral dissertation, Universidade Federal de Santa Catarina, Florianópolis.
- Tomitch, L. M. B. (1996). Individual differences in text organization perception and working memory capacity. Revista da ANPOLL, 2, 71-93.
- Tomitch, L. M. B. (1998). Leitura: percepção da organização textual e a capacidade de memória operacional. Revista Intercâmbio, VII, 19-35.
- Tomitch, L.M.B. (2000a). Individual differences in working memory capacity and the recall of predicted elements in the text. Linguas Modernas, 26-27, 31-51.
- Tomitch, L. M. B. (2000b). Teaching main ideas: Are we really teaching? Linguagem & Ensino, 3 (1), 45-53.
- Trabasso, T. & Magliano, J. P. (1996) Conscious understanding during comprehension. Discourse Process, 21 (3), 255-287.
- Trabasso, T. & Suh, S. (1993). Understanding text: Achieving explanatory coherence through on-line inferences and mental operations in working memory. Discourse Processes, 16 (1-2), 3-34.
- Trabasso, T., Suh, S., Payton, P., & Jain, R. (1995). Explanatory inferences and other strategies during comprehension and their effect on recall. In R. F. Lorch & E. J. O'Brien (Eds.), Sources of coherence in reading (p.p. 219-239). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Tulving, E. (1985). How many memory systems are there? American Psychologist, 40 (4), 385-398.
- Turner, M. & Engle, R. (1989). Is working memory capacity task dependent? Journal of Memory and Language, 28, 127-54.
- Urquhart, S. & Weir, C. (1998). Reading in a second language: Process, product, and practice. New York: Addison Wesley Longman
- van Dijk, T. & Kintsch, W. (1983). Strategies of discourse comprehension. New York: Academic Press
- van den Broek, P., Young, M., Tzeng, Y., & Linderholm, T (1999) The landscape model of reading: Inferences and the online construction of a memory representation. In H. van

Oostendorp & S. R. Goldman (Eds.), The construction of mental representations during reading. (p.p. 71-98). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Waugh, N. C. & Norman, D. A. (1965). Primary memory. Psychological Review, 72 (2), 89-104.

Whitney, P., Ritchie, B. G. & Clark, M. B. (1991). Working memory capacity and the use of elaborative inferences in text comprehension. Discourse Processes, 14, 133-145.

Williams, J. P. (1988). Identifying main ideas: A basic aspect of reading comprehension. Topics in Language Disorders, 8 (3), 1-13.

Winograd, P. N. & Bridge, C. A. (1986). The comprehension of important information in written prose. In J. F. Baumann (Ed.), Teaching main idea comprehension (pp. 19-23). Newark, Delaware. International Reading Association.

Yoshida, M. (2000). Working memory capacity and the use of inference in L2 reading. Paper presented at the American Association for Applied Linguistics. 2000 Annual Conference, Vancouver, Canada.

## APPENDIX A: VERBAL PROTOCOLS

Since verbal protocol data are in Portuguese (participants' L1), the symbols used for transcribing data are also in Portuguese.

## Transcription symbols

Números 5 e 6 colocados embaixo de 0 ou de sinais de pontuação significam pausas:

5 – pausa curta

6 – pausa longa

Dois pontos (:) colocados embaixo de letras significam alongamento da fala.

(hes) = hesitação

(riso) = riso do informante

(toss) = tosse ou pigarro

(inint) = palavra ou trecho de fala ininteligível.

(sussurros) = quando o informante fala muito baixo e não há compreensão.

<...-> símbolo utilizado para representar palavras incompletas.

[...]- símbolo utilizado para representar gaguejo, repetição ou correção da fala.

("...") = símbolo utilizado para representar trecho ou palavra de compreensão duvidosa.

"..." = símbolo utilizado para representar citação dos textos lidos pelos informantes.

Subject 1 (October 01)

Text 1- L1

No primeiro parágrafo o cientista tenta explicar como se formam as estrelas. Essa está bem  
6 6  
fácil, eu não sabia que era tão fácil assim.  
6

O segundo parágrafo, ele explica melhor como se dá essa reação química que provoca o  
:6 6 :  
surgimento (hes) das estrelas. Eu tive que reler o primeiro parágrafo pra poder (hes) unir a  
6  
informação do primeiro pro segundo.  
6

O terceiro parágrafo fala sobre (hes) [o <pro->- [o]- no processo de transformação durante  
:6  
o tempo de vida de uma estrela. E diz que noventa por cento, ou seja, na maioria desse tempo  
:5  
(hes) as estrelas não sofrem nenhuma (hes) transformação (hes) importante.  
6 6

E o quarto parágrafo fala [da]- [do]- do processo de extinção [da]- das estrelas. Em que  
: 6 : 6 : 5 : 6  
acontece a reação química nuclear que existe quando a estrela está pra se esgotar. E é um...  
:  
6 :  
pô, é um processo muito (hes) complexo que altera profundamente a (hes) as características  
6  
da estrela (hes) e que (hes) leva a sua, faz com que ela (hes) aumente de tamanho.  
5 6 6

E o quinto parágrafo fala [da]- da última fase [de]- do ciclo de vida de uma estrela e (hes)  
:  
: 6 5 6

diz que dependendo [do]- da massa da estrela ela0 (hes) quatro poderá se transformar em  
 quatro0 tipos [de]- [de]-0 [de]- de <fenô-> de fenômeno, de... A estrela [pode]- pode  
 sofrer quatro (hes) alterações. Ela pode se tornar0 quatro coisas diferentes, então,  
 dependendo [da]- da massa0 da estrela. (hes) eu não saberia (hes) explicar com as minhas  
 próprias palavras quais são [esses]- esses quatro tipos [de]- de0 estrelas, nem como elas  
 [se]-0 [se]-0 se formariam a partir desse processo [de]- [de]-0 de transformação final.  
 Eu teria que reler0 mais [esse]- esse último parágrafo [pra <po->]- pra poder explicar  
 melhor esses quatro tipos de0 novas estrelas que [se]- se formariam a partir de um...  
 Bem, o texto, no geral, (hes) a idéia principal é explicar desde como se formam0 as  
 estrelas. (hes) Então, o <cien-> o cientista explica como se dá a origem das <es-> das  
 estrelas. (hes) Diz que no... a maior parte [dos]- [da]- de sua existência, noventa por cento  
 da sua existência, ela... as estrelas [se]- se [mantêm]- mantêm as mesmas características.  
 Mas no processo0 de extinção, (hes) dependendo da massa que ela tiver, ela poderá se0  
 (hes) transformar em [quatro tipos]- quatro ou cinco tipos diferentes [de]- [de]-0 de estrelas.  
 São estrelas [de]- de nêutrons ou um buraco negro0 ou uma supernova. É isso.

## Text 2- L2

(hes) O primeiro parágrafo fala, (hes) diz que no <fu-> no futuro (hes) os remédios que nós  
 tomamos (hes) [serão]-0 (hes) serão tomados não mais através [de]-0 de pílulas ou injeções.  
 O segundo parágrafo (hes) diz que0 algumas (hes) drogas como a nicotina [e os]- e alguns  
 hormônios são já administrados pela pele0 e aqui eu acho que é um...0 Mas ele diz que0 não  
 aqui eu acho que está mal formulado. Diz [que a]- que as moléculas de insulina são muito  
 grandes [não]- elas não conseguem [ser]- (hes) serem absorvidas pela pele. [Então, não]-0  
 então, têm [essa]- [esse]- umas podem ser administradas pela pele, outras não são (hes)  
 outras não, pelo menos a insulina.  
 O terceiro parágrafo [diz]-0 (hes) fala de [um]- um novo procedimento, novo0 aparelho pra  
 administração [de]- de drogas. E apesar de ele ter dito no primeiro parágrafo que0 no futuro  
 os remédios não <se-> (hes) seriam tomados de forma0 diferente, né? Não através de pílulas  
 [ou <a->]- ou agulhas. Aqui [ele se]- ele diz que esse novo aparelho0 estaria na verdade  
 utilizando quatrocentas0 (hes) microagulhas, né? Apesar de serem pequenas, na minha opinião  
 ainda são agulhas, então, (hes) é um, apenas [um]- [uma]-0 um melhoramento de [um]- um  
 método mais antigo, né? ele tem que ser0 (hes) por agulhas.

Uma das vantagens (hes) o quarto parágrafo diz que uma das vantagens desses0 novos (hes)

aparelhos, não sei bem como é o nome em português, esses patches que colam [na]- [na]- na  
 pele, que têm essas microagulhas, uma das vantagens é que eles (hes) não provocam dor0 na  
 pessoa que [está <to->]- está usando [esse]- esse patches.

O quinto parágrafo (hes) entra em detalhes como que funciona [esse]-0 esse patch e diz que0  
 ele é inteligente é um patch0 (hes) que detecta automaticamente (hes) a quantidade [de]-0  
 [de]- [de remédio]- de droga que a pessoa precisa e ele automaticamente0 injeta [esse]- essa

droga no organismo da pessoa.

O sexto parágrafo, ele0 tem [um]-0 um erro [de]- gramatical, em inglês0 (hes) o present  
 perfect aqui não está... (hes)0 A terceira pessoa0 é um errinho bem pequeno, mas a terceira  
 pessoa0 não está concordando aqui com o verbo. Deveria ser: "Robert Langer and MIT has  
 developed". E esse é um cientista que desenvolveu [um]- um chip0 que é uma forma mais eficaz  
 de, não sei se é mais eficaz, mas0 ele administra [o]- [o]- [o <re->]- a droga0 nas (hes)  
 parece que direto [no]- [no]- no alvo [nas]- [nas]- [no]- no tecido alvo onde tem que ser  
 administrado droga através [de um]- de um chip.

O último parágrafo0 (hes) é a respeito [de uma]- de um procedimento que [eles]- os cientistas  
 estão tentando aprimorar que é (hes) a respeito de um mecanismo que0 liberaria a quantidade  
 exata [de]- [de um]- [um raio]- de uma corrente elétrica pra que [o]- [o]- o organismo  
 assimilasse mais rápido0 a droga. [Só]- só que o problema com esse método é que  
 dependendo da corrente elétrica0 a eletricidade poderia danificar as células. <En-> então,  
 eles estão ainda aprimorando esse método pra0 (hes) saber ao certo0 a quantidade exata de  
 eletricidade0 que deve ser usada pra que não cause dano [e a]- [e a]- ao organismo, às células  
 e que a... pra que a droga seja (hes) assimilada0 com sucesso pelo organismo.

O texto, no geral, então, diz (hes) dessa0 evolução no [de <u->]- de uma futura evolução0 na  
 forma como os seres humanos (hes) [tomam0 drogas]-0 (hes) tomam remédios. Que  
 atualmente é ou por0 pílulas ou por injeções. O texto, então, diz que novas formas [de]- (hes)  
 de serem administradas essas drogas [no organismo do]- no organismo estão sendo0  
 desenvolvidas. Entre elas, [a]- [a]-0 a criação de um patch que vai ficar colado à pele e através  
 de0 microagulhas, insere a quantidade (hes) exata que o organismo precisa [da]- da substância  
 química. E outros métodos, [tem]- além desse tem outros métodos também. Um seria [um]- um  
 chip de <computa-> um chip que é inserido no organismo0 e também (hes) libera a quantidade  
 de droga que o organismo precisa. Esse chip é implantado [na]- (hes) no local que0 aonde a  
 droga [<deve->]- [deveria]- [deve]- deve <fa-> (hes) fazer efeito. (hes) Imagino, por exemplo,  
 [uma]-0 um remédio pro coração, se colocaria [um]- um chip desse em algum lugar perto do

coração e ele, ali, já liberaria [essa]- [essa]- (hes) essa droga0 [pro]-0 pro coração. E o último  
 método é esse [do]-0 [da]-0 da corrente elétrica, mas que ainda [está sendo]-0 tem que ser  
 melhor0 desenvolvido que é o método [da]- de uma corrente de energia elétrica que (hes) abre  
 (hes) consegue fazer com que [o]- o organismo assimile melhor a droga, mas (hes) <preci-> é  
 preciso que0 [a]- a quantidade [de]- de eletricidade seja0 (hes) bem administrada, caso  
 contrário ela pode0 danificar as células0 do organismo.

Subject 2 (October 01)

Text 1- L1

No primeiro parágrafo, eu fiz uma0 segunda leitura do primeiro parágrafo0 e0 [fala sobre é]-  
 geral é0 sobre as partículas0 de gás0 [que se]-0 que juntam umas às outras, né? e forma uma  
 estrela.

No segundo parágrafo, ele0 continua falando da estrela, como é que ela se forma0 e dá um  
 exemplo. (inint)

Terceiro parágrafo. Duas vezes eu li0 o terceiro parágrafo0 e a idéia principal é0 comentar o  
 brilho e o tamanho da estrela. Um exemplo é o Sol.

No quarto parágrafo, ele mostra o processo0 de expansão da estrela, depois que [o urânio]-  
 o hidrogênio já se transformou em hélio. E0 acho que é isso. A expansão da estrela, ela fica  
 enorme, gigante, tal. Não. Sem problemas aqui. Estou de novo, li duas vezes.

Agora, o quinto parágrafo. Mais uma vez eu li duas vezes o último parágrafo. Daí acho que a  
 idéia principal (inint) [mostrar0 a]- falar sobre a massa da estrela [e]-0 e que ela pode,  
 dependendo da contenção, da expansão, tornar-se0 um buraco negro, uma supernova0 e é  
 isso.

Eu acho que o texto todo, agora, o comentário do texto0 completo é0 [sobre]- sobre as  
 estrelas, a formação de estrelas0 ou quais são as reações que acontecem nas estrelas e tal.  
 (hes) Como elas se ("comportam"), se elas expandem, se elas contraem0 e, dependendo da  
 contração e expansão, que tipo de estrelas elas vão formar. E0 é isso. Não, assim [nessa]-  
 nessa leitura que eu fiz, não encontrei, assim, problemas com ("localizar"), acho que [está]-  
 está, não tem problemas de0 composição. Pelo menos eu não percebi nada, assim, de  
 problemático na escrita do texto0 e ele parece [bem]- [bem]-0 bem escrito nesse sentido.

Começa0 mostrando0 como está fazendo a pesquisa, não é? (hes) O pesquisador0 fala sobre  
 as reações que formam a estrela e depois vai explicando a expansão e contrações [até]-0 até  
 formar [as]- os tipos de estrelas, né? que transformam, ("tornassem"), acho que é isso.

## Text 2 – L2

Então, vamos para o inglês. Primeiro parágrafo. No primeiro parágrafo, fala da provável substituição das pílulas por outras coisas, né? não diz o que, mas é o início do trabalho. Injeções ou pílulas por outros tipos de drogas.

No segundo parágrafo, fala [da]- do uso da pele. "Nicotina e hormônios são absorvidos pela pele, insulina já não é."

Terceiro parágrafo. Um pesquisador desenvolveu um dispositivo [que]- [que]- [que] - que faz com que as drogas <abso-> sejam absorvidas pela pele.

Um, dois, três, quarto parágrafo. Testaram em ratos [esse]- [essa]- esse dispositivo e esse dispositivo é indolor.

Eu vou ler mais uma vez o quinto parágrafo. Um, dois, três, quatro. Segunda leitura do quinto parágrafo. Aqui no quinto parágrafo, ele está explicando como é que funciona, né? "As moléculas da droga" como um... "ligadas a um eletrodo, ("repele") suas moléculas e coloca-se na pele." O dispositivo abre buracos na pele para que [o]- o paciente (hes) consiga administrar a droga e isso, no futuro, vai ser feito automaticamente. Aqui está explicando como é que funciona o dispositivo, eu acho.

Pro sexto parágrafo... Um outro pesquisador (hes) desenvolveu um chip e o próprio chip é que (hes) coloca a droga no corpo.

O último parágrafo. Mais uma leitura do último parágrafo. Bom, o último parágrafo é sobre como usar a eletricidade pra [chegar]- abrir as membranas das células e um pesquisador criou um chip, biônico? que consegue fazer isso, mas é um método que ainda está muito longe de ser usado e tal, mas eles já estão no caminho. Pelo menos [em]- onde ("via") biológica (hes) conseguir. Bom, isto (hes) o texto todo fala [da]- [da]- do futuro das drogas, né? Deixaremos de usar pílulas e injeções pra usar (hes) patches, não é? e chips pra poder administrar as drogas aos pacientes. Diferentes pesquisadores, com diferentes métodos e ainda [se]- estão pesquisando mais métodos pra fazer esse tipo de administração. O texto, no geral, é um texto está tudo legal pra ler, não encontrei <ne-> maiores problemas. O um, dois, três, quatro, cinco, quinto parágrafo e último parágrafo eu li duas vezes. Eu tive problemas com palavras no ("contexto") e eu acho que é isso.



## Subject 3 (October 01)

## Text 1 – L1

[O]- esse primeiro parágrafo está bem claro, que fala sobre as partículas de gás. (hes) O astrônomo Roberto B., da Universidade de São Paulo, ele fala sobre essas partículas, que, devido às forças gravitacionais, [elas]- elas vão se concentrando. Ah, ok! Então, a estrela é formada por uma [gigantesca]- [gi-]- gigantesca nuvem de gás, que é formada pelas partículas de <ga-> gás, que elas vão se soltando no universo. Essa é a idéia principal, é a formação da estrela, segundo o astrônomo [Roberto da]- Roberto B., da Universidade de São Paulo, da USP. Então, (hes) esse primeiro parágrafo fala, basicamente, (hes) da formação da estrela, de uma estrela, né? Na minha concepção esse primeiro parágrafo [está bem]- está bem elaborado.

Nesse segundo parágrafo, fala que "Há uma fusão, uma reação atômica que transforma <hi->", ok! hidrogênio em hélio, mas não fala o nome dessa fusão. Por gerar uma "grande <quanti-> quantidade de calor e de luz", ok! isso se entende, está certo? Essa fusão gera calor e luz, bastante calor e luz. E o exemplo dela é a estrela jovem, ok! Então, a relação do primeiro texto com o segundo texto, o <prime-> do primeiro parágrafo do segundo, é que o primeiro fala-se da estrela, [da segunda]- o segundo parágrafo se fala que é uma fusão, mas é uma fusão de quê? Uma fusão das partículas de gás? Então, eu acho que deveria ser mencionado aqui. (hes) Então, (hes) o segundo [para]- parágrafo, basicamente, fala-se da estrela jovem, só que está mal elaborado. Que eu acho que deveria ser colocado: "Há uma fusão (hes) de partículas de gás soltas no universo, que forma a estrela jovem chamada <Ple-> Plêiades, na via Láctea." Ah, tá! O terceiro parágrafo, fala-se (hes) [da]- da existência que o <ca-> (hes) cerca de noventa por cento da sua existência... (hes) mas depois ele não continua: "Durante cerca de 90% da sua existência" o quê? Aí [o]- o caso do Sol, ok! O Sol é um exemplo de estrela, mas [não]- não tem relação com "[noventa]- noventa por cento da sua existência." Eu achei que [ficou meio]- faltou alguma coisa nessa parte do texto. Problema de estrutura. Bom, o Sol, [aí]- aí depois ele explica melhor: "se encontra na fase intermediária da sua existência, sofrendo mínima <condensa-> condensação." Que se relaciona com ligeira contração, mas [não]- não... o <te-> essa parte do texto não é muito claro. É terceiro parágrafo fala [sobre]- (hes) sobre a existência da estrela, o tempo de existência. Mas ela não... essa parte não é uma parte muito clara. É o primeiro sobre [estrela]- estrela jovem, o segundo e o terceiro é a existência, bom exemplo é o Sol. Mas não deixa... A estrutura dela não está muito boa. Pra introduzir o quarto parágrafo, faltou alguma coisa que ligue o terceiro ao quarto. O quarto parágrafo fala da transformação, né? [da]- da estrela. É, basicamente, são as transformações

6 : 6 : 6 : 6  
 dela. E também fala de um novo período em que há transformações. Então, [a]- a estrela  
 : 6 : :  
 começa jovem, aí depois ela passa por uma <con-> contração, uma condensação, depois  
 : 5 : : : 5  
 transformações e o último período0 é quando falta hidrogênio. E se a massa dessa estrela for  
 : 6 : 6  
 até duas vezes a do Sol, as transformará [num]- num pequeno corpo <morim-> moribundo.  
 : 6  
 (hes) Então, [essa]- essa parte do último parágrafo. Parágrafo um, dois, três, quatro, o quinto  
 parágrafo, <fa-> fala-se (hes) se eu tiver mais oxigênio, menos oxigênio. (hes) Dependendo,  
 : 6 : : :  
 né? da... (hes) [se for uma]- tiver <ma-> mais massa ou menos massa ela vai condensar. [Ela]-  
 : : : : 6 :  
 ela [vai ser]- vai virar uma supernova0 e assim as suas transformações. Muito parecido [com]-  
 : 5  
 com o parágrafo anterior.  
 6  
 Então, (hes) resumindo todo esse texto, fala-se da estrela0 (hes) que é uma reação atômica bá,  
 : : 6 : :  
 bá, bá. (hes) Que se transforma em0 [o]- a transformação da estrela0 e depois as suas fases.  
 : 6 : : 5 6  
 [É]-0 é isso [que]-0 que eu entendi do texto. A estrela, segundo0 esse astrônomo, e depois  
 5 : 5 6 : 6 :  
 [ele]- ele fala das fases0 que uma estrela passa. Ok!  
 5 6

## Text 2- L2

Bom, o primeiro parágrafo fala [que]-0 que apesar do diversos tipos de drogas e cada vez  
 : : 6 :  
 melhores0 (hes) no futuro0 (hes) pílulas [e]-0 e agulhas serão coisas do passado, ou seja,  
 : 6 6 : : 6 :  
 [vão]- nós não vamos0 (hes) utilizar mais. E nós vamos só utilizar0 (hes) "as pills or by  
 : 6 6 6  
 injection." "most of us still take medicines0 as pills or by <injec-> injection." Ok! Então, essa  
 6 5  
 primeira parte, assim, que (hes) [de]- de haver muitas novas e boas melhores drogas, no  
 :  
 futuro nós não... isso aí vai ser coisa do passado, ou seja, vai ser algo extinto, nós não vamos  
 mais utilizar. Essa é a idéia [dessa]- desse primeiro parágrafo.  
 6 : 6  
 [Esse segundo]- esse segundo parágrafo0 (hes) fala que <algu-> algumas drogas como0 a  
 6 :5  
 nicotina...0 Não está bem elaborado. [Ele]- ele não se <rela-> <re-> se relaciona com o  
 : 6 6  
 primeiro. Ele fala que é...0 (hes) Ele fala de0 algumas drogas, [depois]- depois ele fala sobre  
 : 6 6 :5  
 moléculas de insulina. Que você pode0 (hes) esfregar insulina na sua pele todo dia0 e ela não  
 : : 6 :5 : 5  
 entrará, mas ela não se relaciona0 muito. Que nicotina e hormônios podem ser entregues  
 6 5 : 6 : :  
 através da pele? Podem <se-> podem entrar através da pele, mas a insulina não. Ok! Agora,  
 : 6  
 eu entendi. (hes) Então, o segundo parágrafo se [ao]- ao primeiro0 é que pelo... <f-> se0 (hes)  
 6 : 6 :6  
 essas0 (hes) pílulas0 e agulhas serão coisas do passado, muitas coisas poderão ser (hes)  
 : 6 5 :

<intra-> intravenosas.

6  
 Então, (hes) você pode, através da pele, (hes) injetar [o]-0 o remédio, né? No caso de  
 : 5 : 6 6 : :  
 nicotina e hormônios, mas como as moléculas de insulina são muito grandes, [elas não

entrarão]- elas não penetrarão na pele. [Essa]- essa é a idéia [da]-0 do parágrafo dois.  
 Então, [e]- e no parágrafo três0 (hes) esse <Prau-> Prausnitz, ele desenvolveu0 umas agulhas  
 microscópicas0 (hes) [que]- [que <po->]- que possa0 (hes) injetar? (hes) remédios através da  
 pele. Então, isso seria, basicamente, uma solução pro problema de0 moléculas de insulina.  
 Apesar de esse texto não <ester-> ser bem escrito, porque [é]- uma coisa não está ligando a  
 outra. Dá pra entender [o que]-0 o que eles querem transmitir. Que no futuro [não vai]- não vai  
 haver mais pílulas e0 agulhas. (hes) Algumas drogas como nicotina e hormônios0 podem ser0  
 (hes) [injetados através, né?]- penetrados através [da]-0 da pele. No caso de insulina0 não,  
 porque é muito grande, mas (hes) esse pesquisador0 traz [uma]- uma solução. Que é um  
 dispositivo que você pode transportar drogas através [da]- da pele. Esse o parágrafo três.  
 O quarto...0 O quarto parágrafo fala que foi testado em ratos0 e os níveis [de]- [de]- [de]-  
 [de]- de glicose de sangue0 desceram significativamente.  
 E que0 esse método0 <intra-> de0 colocar esse dispositivo [de]- pra colocar as drogas através  
 da pele0 é sem dor. Então, dá pra entender (hes) [do que]- o que o texto fala. Que (hes)  
 esse... [essas needles]- essas agulhas, elas foram testadas0 em ratos0 e mais tarde [alguns  
 voluntários]- algumas pessoas0 (hes) [foi]- foi feito o teste em algumas pessoas e [esse teste]-0  
 (hes) esse método pareceu (hes) [que não]- que a pessoa não tem dor.  
 Uma, duas, três, quarto, quinto. [No]- no quinto parágrafo, trata0 (hes) de como, [os]- os  
 procedimentos, né? pra colocar0 [esse]-0 esse dispositivo. Aí pro caso de níveis [de]- [de]-  
 de glicose.  
 No sexto parágrafo, fala0 (hes) de Robert Langer, ele colocou um chip0 que dispensa as  
 drogas dentro do corpo. Mas [não]- não desenvolve o assunto, ele (hes) [é um]-0 ele0 solta  
 uma idéia, mas [essa]- essa idéia não é desenvolvida. Então, esse texto é muito vago0 [da]-  
 que dá pra ver entre um parágrafo e outro0 que [não tem]- não tem algo que ligue, né?  
 [não tem]- não tem ganchos, não há ganchos aqui.  
 No último parágrafo, fala [dos]-0 do problema pra abrir os poros, né? Só que não deixa claro  
 [que]- que isso [é um]- é um problema [que <po->]- se pode ter, né? nesse...0 colocando  
 esse <di-> dispositivo. Então, [a idéia]- a idéia0 geral do texto é que não haverá mais0 pílulas  
 [e]- e agulhas porque <ha-> haverá um dispositivo [que]-0 que possa0 (hes) passar (hes) [os]-  
 as drogas, né? através da pele. [Já o]- já0 tem <ca-> [em]- em algumas exceções como a  
 insulina, que é muito grande, [pode-se]- pode-se colocar um dispositivo específico0 [pra que  
 ela]-0 pra que isso não tenha problema. Que é no caso de...0 [pra]- pra medir [o <f->]- os  
 :

níveis de glicose, né? E, finalmente, tem alguns casos que0 (hes) os poros das células, elas0  
 não abrem, né? Então, [eles]-0 eles fazem...0 Aí [não há]- não há maneira para medir0 a  
 voltagem precisa0 desse trabalho. E a célula pode ser teimosamente fechada. Mas é [o]- a  
 idéia principal é esta, não haverá drogas no futuro porque vai haver0 [outra]-0 um dispositivo  
 específico que possa0 fazer esse papel [da]-0 [da]- dos remédios, né? injeção. É isto.  
 3

## Subject 4 (October 01)

## Text 1 – L1

(hes) O primeiro parágrafo está falando sobre0 (hes) como as forças gravitacionais0 (hes)  
 geram o surgimento de estrelas.  
 (hes) O segundo parágrafo fala [da]-0 como (hes) depois [da]-0 do aglutinamento das  
 partículas, (hes) como que uma <es-> uma <esse-> a (inint) vira estrela, ou seja, através de  
 uma reação0 <a-> atômica.  
 Eu tive que voltar no terceiro parágrafo pra reler a primeira linha. O0 terceiro parágrafo fala do  
 tempo de vida de uma estrela e0 o que acontece com o brilho e o tamanho.  
 O quarto parágrafo fala do processo de esgotamento que ("ocorre") na estrela [e como]-0  
 (hes) e como uma estrela vai perdendo a sua vida, vai chegando ao fim de existência.  
 Eu tive que voltar na segunda frase do último parágrafo. (hes) Muita informação intercalada.  
 O quarto parágrafo termina com o ciclo de vida das estrelas, (hes) quais são as últimas fases0  
 (hes) até que ela se esgote de vez. [O]- a idéia do texto0 (hes) como um todo é0 (hes) o ciclo  
 de vida das estrelas, como elas são formadas, toda a evolução delas até [o]-0 o seu  
 desaparecimento.  
 6

## Text 2 – L2

O primeiro parágrafo fala0 (hes) sobre drogas e como elas são (hes) atualmente medicadas  
 ainda.  
 O segundo parágrafo fala de como algumas drogas podem ser absorvidas0 pela pele e, (hes)  
 entretanto, algumas, como a insulina, ainda não pode ser, como são muito grandes, não podem  
 ser0 (hes) ministradas [desse <for->]- dessa forma.  
 O terceiro parágrafo fala da criação [de uma]-0 de agulhas [microscópicas]- (hes)  
 microscópicas para0 administrar drogas através da pele.  
 [Terceiro]- o quarto parágrafo fala [da]- [da]-0 do teste para se verificar a dor [dessas]-  
 [dessas]-0 (hes) dessa nova forma [de]- de administração [de]- de drogas.  
 O quinto parágrafo <fa-> dá mais detalhes dessas novas técnicas [de]- de administração de

:  
 drogas através da pele. Tive dificuldade com a <pala-> com o grupo nominal "zapping charged  
 : 6 : : : :  
 drug molecules." (hes) Não sei o sentido de "zapping" aqui.

6  
 O sexto parágrafo fala do desenvolvimento de uma nova técnica de implantação [de]-  
 : : :  
 [de um]-0 de um chip0 pra administrar as drogas já dentro do corpo, perto [dos]- dos locais  
 : 5 : 6 :  
 necessários.

6  
 O último parágrafo fala dos últimos desenvolvimentos pra0 ministração de drogas. (hes)

: 5 : 6  
 Através [de]-0 de mecanismos com eletricidade pra abertura das células e0 (hes) tive problema  
 : : 6 : 6  
 com a palavra "jolt", mas dá pra adivinhar pelo contexto. E o sentido geral do texto é0 sobre  
 : 6 : : 5 :  
 as... desenvolvimento científico sobre0 (hes) novas maneiras de se administrar drogas aos0  
 6 : 5  
 pacientes com doenças.

Subject 5 (October 02)

Text 1 – L1

Parei mais ou menos [na metade]- na metade do parágrafo, vou voltar pro início, eu não estava  
 concentrada. O parágrafo se refere0 às0 partículas de0 hidrogênio0 [que formam]- [que]- que  
 6 : 5 : 6 : 5 6 : :  
 se concentram devido a forças gravitacionais. Quando eu vou0 tentar fazer o resumo [do]- do  
 6 6  
 parágrafo, eu procuro0 (hes) identificar algumas palavras-chaves.

5 6  
 No segundo parágrafo, eu me direcionei logo à fusão0 e à quantidade de calor pra poder0  
 5 : 5 : 6  
 perceber [o]- o conteúdo do parágrafo. Que, no caso, é exatamente esse, né? Que [a]- a  
 : 5 5  
 fusão das partículas, ela gera uma grande quantidade de calor e luz.

6  
 Pausa0 no fim da sentença0 pra0 reler, pra tentar entender de novo. O parágrafo0 diz respeito  
 6 5 6 : 5 6 : 6  
 à pouca variação de tamanho e brilho da estrela, durante cerca de noventa por cento da sua  
 6  
 existência.

6  
 Pausa, retornar ao início do parágrafo. O parágrafo0 fala da0 morte da estrela. Quando0 o  
 5 6 : 5 : 6 : : 5  
 hidrogênio se esgota0 e0 ela passa por0 transformações muito drásticas.

5 : 6 : 6 6  
 O último parágrafo fala da0 das conseqüências0 dessa0 <trans-> [dessas]-0 (hes) desse  
 : 6 5 : 6 6  
 esgotamento ("drástico") do hidrogênio, das transformações que, de acordo com o tamanho0  
 : 6  
 [da]- da estrela, ela pode0 se transformar0 num astro0 que não consegue segurar os gases  
 : 6 : 5 5  
 da periferia, mas pode0 acabar [num]- num buraco negro, se a densidade for muito alta.  
 : 5 5 6  
 [O]-0 o texto fala... é como se fosse a0 biografia da estrela. (hes) Como ela nasce, as  
 : 5 : : : 6 : 5  
 transformações gasosas em seu interior0 e como isso pode levar0 a sua morte, a sua  
 : 5 : 5  
 transformação0 em outro corpo celeste.  
 5 6

Text 2 – L2

O primeiro parágrafo, ele...0 Na verdade eu vou ter que ler de novo pra poder0 dizer sobre o  
: 6 : 6 5  
que que ele é. Ah, tá! Ele está, de certa forma, determinando qual é o tema [do]- do texto.  
6 :6 : 6  
Exatamente, a superação do uso de pílulas e agulhas0 na aplicação de remédios.  
6 : 6  
Segundo parágrafo0 é sobre a0 possibilidade0 [de]- de uso0 de novas formas de absorção de  
5 :6 5 : 5  
remédios0 e ao mesmo tempo [algumas]-0 algumas impossibilidades. Porque0 a insulina, por  
: 5 : 6 :6  
exemplo, (hes) as partículas são grandes demais para serem0 (hes) aplicadas através da pele, o  
6 6  
que acontece com a nicotina e com os hormônios que já são usados dessa forma.  
:  
6  
Parei pra ver o significado de "shuttle", mas pelo contexto dá pra saber o que é. Que o  
: 5 6  
cientista, ele desenvolveu esse novo tipo de adesivo, com várias miniagulhas, que parece ser  
6 5 6  
mais um instrumento de tortura do que uma coisa0 médica.  
5 6  
<Vol-> voltei ao início da frase. Mais uma vez ao início da frase. Aqui ele fala que [o]-0 o  
6 6 6 : 5  
uso desse0 adesivo com essas miniagulhas0 tem sido bem sucedido em ratos e que, quanto ao  
: 5 5 :5  
fator dor, os voluntários0 humanos, eles0 <re-> resistiram bem, parece que não0 ofereciam  
6: 6 : 5 6  
[nenhum]-0 nenhum desconforto.  
: 6 6  
Voltei para a expressão "zapping charged", eu não estou conseguindo, pelo contexto, definir o  
5 : 5 5  
que é. Vou tentar ler de novo. (hes) Essa frase0 essa <pri-> "<A-> according to researchers"  
6 6  
até "pushing them into the skin" 0 é uma coisa que não está clara pra mim. Eu vou continuar  
6  
lendo pra ver se0 faz sentido. Agora eu vou voltar ao início do parágrafo pra ler0 todo, pra ver  
: 5 6 5 5  
se0 eu consigo entender. O parágrafo é sobre o funcionamento desse0 adesivo que o cara  
5 6 : :5  
inventou, mas0 pelo <vo-> vocabulário, as estruturas eu não estou conseguindo entender como  
6 : 6 :  
é o funcionamento, realmente, [da]-0 da coisinha, lá. Eu sei que de alguma forma0 (hes) a pele  
: 6 6 6  
vai sendo, microscópicamente, (hes) perfurada e que é possível0 autoaplicar insulina através  
:6 :6 : : 5  
desse mecanismo, mas0 qualquer outro detalhe não está muito claro pra mim.  
: 6 : 6 6  
E [um outro <ciem->]- um outro parágrafo, há um outro cientista que0 inventou0 [um]- um  
: :5 : 6 :  
chip que [permite0 a]- permite a injeção [de]- de drogas0 mais próximos [do]- do alvo.  
: :6 : 6 : 6  
(hes) Retornei e vou reler a frase. Vou ler de novo. De novo. Agora, eu estou lendo0 com mais  
6 6 6 5 :  
calma, com mais...0 bem mais devagar do que eu iniciei. O parágrafo trata [da]-0 das  
: : 6 6 : 6  
tentativas de definir uma voltagem necessária para que haja uma abertura na célula. O suficiente  
5  
para que haja0 (hes) a injeção [da]- da droga, mas0 sem0 destruir a célula ou, simplesmente,  
: 6 : 5 6 5 :5  
arranhá-la [e]- e não conseguir fazer com que a droga seja0 injetada nela.  
:  
6 6  
[O]- o texto todo0 (hes) é [sobre isso]- sobre [novos mecanismos]- novas invenções0 (hes)  
: 6 : 6  
que possam vir a substituir a pílula0 [e a]-0 e a injeção. De certa forma sejam mais0 eficientes0  
5 : 5 6 : 5 5  
<pa->0 para atingir0 o alvo mais precisamente. E não apenas uma coisa muito diluída dentro  
6 : 6 : 6

do organismo, mas algo mais específico. Então, <por-> já estão <desenvolven-> em desenvolvimento vários mecanismos0 pra que isso possa acontecer.  
6

Subject 6 (October 02)

Text 1 – L1

O primeiro parágrafo fala sobre nuvens de gás que se transformam em estrela. Eu não entendo muito bem sobre o assunto, “soltas no Universo, vão se concentrando devido às forças gravitacionais que puxam umas contra as outras,” isso termina0 ficando complicado. “Partículas de gás”0 é o tipo de texto que eu não costumo ler, então, fica confuso.  
6

O segundo parágrafo fala sobre [a <f->]- a reação atômica, da fusão do hidrogênio com o hélio, conhecida como...0 Ele dá um exemplo de estrela jovem. [A]-0 a fusão do hidrogênio e do hélio0 criam0 (hes) luz e calor0 e geram essas estrelas novas.  
6 : 5 6

Praticamente, durante toda a sua existência uma estrela não sofre grandes variações, como é o caso do sol, que permanece constante. Quando o hélio se acaba numa estrela, no terceiro parágrafo, ele... Quando o hélio0 se acaba...0 Não, na verdade quando o hidrogênio se converteu em hélio, ele... a estrela vai aumentar umas cinquenta0 vezes de tamanho0 e0 isso é o que vai acontecer com o Sol daqui a quatro <zi-> quase cinco bilhões e anos.  
6 : 6 : 5 6 6 : 5 : 6 : 6

No último parágrafo. No último parágrafo ele fala sobre0 (hes) o salto de hidrogênio, os resultados0 (hes) que vai <se-> depender do tamanho da estrela, se vai ser <ti-> duas ou três vezes maior ou menor do que o sol. (hes)  
6 : :6 : 6 : 6

E o texto, no geral, fala sobre0 como surge uma estrela, o que acontece com...0 quando o hidrogênio se transforma em hélio e também quando [há]-0 há falta0 de hidrogênio, dependendo do <tama-> e os resultados, dependendo do tamanho da estrela. Pra mim seria, basicamente, isso.  
6 :6 : 6 : 6 : 6 : 6 5

Text 2 – L2

Primeiro <pará-> parágrafo eu tenho que ler duas ou três vezes0 pra realmente conseguir entender o que que está querendo dizer. E fala sobre...0 Não consigo entender direito: “An endless stream”. Bom, (hes) [novos tipos de]- melhores tipos de droga0 (hes) fazem com que...0 (inint) tomamos muitos0 (hes) pílulas e injeções, mas que no futuro tanto pílulas, quanto injeções, elas0 [vão <se->]- vão ser antiquadas. Isso me lembra que0 na verdade, no Brasil, especialmente, no Brasil, a  
6 : 5 : : 6 : 6 : 5 6 : 6 : 6 : 6 : 5 : 5

gente costuma tomar muito0 pílulas e injeções por conta própria.  
 Segundo parágrafo fala que0 nicotina e hormônios <po-> já podem ser0 (hes) colocados  
 no corpo através da pele, mas não é o caso da insulina que0 as moléculas0 são muito  
 grandes e não tem como penetrar.  
 Terceiro parágrafo fala sobre a invenção0 de (hes) “tiny patch” que eu [não sei  
 exatamente o que que é]- sei0 o que que é, mas não sei0 como expressar isso em  
 português. Imagino que seja algo tipo aqueles “Band aids”0 (hes) com quatrocentas0  
 (hes) agulhas microscópicas que vão0 (hes) injetar0 drogas através da pele.  
 O quarto parágrafo fala sobre testes com animais que parece ter reduzido [o]-0 o nível  
 de glicose0 e que em adultos foi testado e o método se0 mostrou0 (hes) indolor. Os  
 testes foram0 desenvolvidos em ratos e isso me lembrou0 aquele ratinho que  
 <desenvol-> (hes) de laboratório que [desenvolveram]-0 fizeram o implante de uma  
 orelha0 [e <fi->]- nas costas.  
 Eu tenho que ler [o]-0 o quinto parágrafo, eu tenho que ir voltando porque existem  
 algumas palavras que eu conheço, mas que devido ao contexto0 ficam mais  
 complicadas. Algumas têm uma seqüência de dois ou três adjetivos antes0 e que  
 também complica. Quinto parágrafo fala sobre0 (hes) métodos que outros  
 pesquisadores estão desenvolvendo0 (hes) pra colocar insulina0 através da pele. (hes)  
 Métodos0 esses patches, eles têm0 (hes) <pe-> pequenas lâminas de titânio que abrem0  
 (hes) buracos <micros-> microscópicos na pele0 e que vão ajudar0 (hes) na inserção da  
 insulina0 através da pele.  
 O penúltimo parágrafo0 (hes) <fa-> fala sobre a invenção de um chip0 que0 dispensa  
 [o]- a inserção de drogas0 no corpo. Não entendi bem0 como ele vai fazer isso ou como  
 é que é isso, né? Não consigo visualizar0 exatamente o que que é.  
 O último parágrafo fala sobre a tentativa de usar0 (hes) choques elétricos pra abrir  
 membranas0 da célula, mas eles têm dificuldade0 que eles não sabem0 (hes) porque [se  
 usar]-0 se o choque for muito forte isso pode <des-> destruir0 a célula0 e se for muito  
 fraco, isso vai fazer com que ela se feche, impossibilitando a inserção de0 drogas.  
 Então, eles ainda estão testando.  
 E o texto, de um modo geral, fala sobre as possibilidades de, no futuro, nós não0  
 utilizarmos mais pílulas e agulhas, mas0 termos esses adesivos0 que vão colocar droga  
 através da pele, ou chips0 (hes) que na verdade [vão estar]- [vão ser]- podem ser  
 controlados pela pessoa0 <o-> ou podem ser, automaticamente, controlados [na medida  
 exata]-0 uma dose certa.



5

6

Subject 7 (October 10)

Text 1 – L1

Primeiro parágrafo, a idéia principal é: moléculas de hidrogênio são atraídas por uma  
 : 5 :  
 força gravitacional e formam [uma]-0 um tipo de estrela.

Segundo parágrafo: [fusão]- fusão nuclear, moléculas de hidrogênio que formam em  
 6 6  
 5  
 hélio.

O terceiro parágrafo eu não entendi direito. Fala sobre a <conse-> condensação0 e eu sei  
 6 6  
 que é um processo que pode ocorrer numa estrela. No caso, seja falta de conhecimento  
 :

prévio do assunto.

Ah, tá! Já li alguma coisa sobre o assunto. Quando a estrela está perto da sua destruição,  
 :

[ela dobra seu]-0 praticamente, dobra o seu tamanho0 e ela se expande no espaço.

Ah, o último parágrafo é sobre o buraco negro. Eu já li alguma coisa a respeito, quando  
 6 : 6 : 6  
 6 :

a estrela se expande, ela causa tipo [uma]- uma ruga no espaço0 e já que [a <mole->]- a  
 : : : 6 : :

massa da0 estrela, ela diminui, consideravelmente, abre tipo uma onda0 pra uma outra  
 : : 5 : 5 5  
 dimensão.

E a idéia principal desse texto [é sobre]-0 é sobre física, eu já estudei, né? No caso, eu  
 5 6  
 fazia Engenharia Civil, mas eu desisti. Mas [é]-0 é um assunto curioso sobre a vida útil  
 6 : 5  
 de uma estrela. Seria isso.

Text 2 – L2

Ah, já li alguma coisa sobre esse texto. Fala sobre...0 (hes) Primeiro parágrafo fala  
 : : 6  
 sobre0 formas de <inge-> ingestão [de]-0 de remédios, no caso, atualmente, são as pílulas  
 5 : 6 : 6

e injeções, mas isso0 (hes) o uso [de]-0 de agulhas pode ser uma coisa do passado.

: 6 6 : 6 : 6  
 Mas isso depende muito [do]- do tamanho da molécula, por exemplo, existem esses

: 5  
 dermo-patch0 que são agregados na pele0 [e <fa->]- e que a própria pele [se]-0 (hes) se  
 5 : 6 : 6  
 responsabiliza em absorver.

E um cientista fala que esses dermo-patch são compostos de agulhas0 microscópicas0  
 : 6 : 6  
 que fazem com que0 as drogas entrem através da pele.

: 6 : 6  
 E eles estão testando alguma forma0 indolor0 de absorção [de]-0 de...0 no caso, seria de  
 : 6 5 : 6 : 5  
 insulina. Deve ser tratamento de pessoas com diabete.

: 6 : 6  
 E aqui ele descreve o método. É um pouco complicado, porque ele usa eletrodos pra  
 : 6 :  
 repelir as moléculas, empurrando-as [na]-0 na pele. E as agulhas aqui iriam forçar uma  
 : : 5 6

abertura microscópica pra essas moléculas de insulina entrarem.

E outro0 cientista, (hes) Robert Langer, ele está pensando [num]- um implante. No caso, seria0 subcutâneo ou0 dentro do corpo, [que]-0 que iria dispensar esse dermo-patch ou seria uma outra forma.

Bem, aqui ele está falando que a maior dificuldade encontrada foi ver a voltagem dos

eletrodos. [Porque muitos <ele->- porque dependendo da [voltagem]- [<vol->-

voltagem0 as células podem morrer0 ou, então, seria obstruir, né? ao invés de abrir, o caminho <se-> seria, no caso, de obstrução, mas0 eu acho que eu sei disso, porque a

família do meu pai é diabética, eu já li muita coisa a respeito, muitos tratamentos0 sobre

diabete, mas esse, particularmente...0 Eu já ouvi falar [de]-0 não sobre eletrodos ou

sobre dermo-patches, mas sobre0 (hes) métodos ultra-sônicos que, no caso, usariam0

uma0 ondas0 curtas suficientes para penetrar na pele, [mas]-0 mas é interessante a

solução. Acho que é só.

Subject 8 (October 3)

Text 1 – L1

De acordo. (hes) As partículas [de gás]- hidrogênios. De acordo com pesquisa feita na

Universidade de São Paulo, partículas de gás, ou seja, [o]- o hidrogênio, [elas]-0 [elas]-0

as partículas de gás soltas no universo, de modo geral, a medida [que os]- [o]- as

partículas de gás, o hidrogênio, se concentram0 devido às forças gravitacionais, eles

formam0 o que chamamos de estrela "uma gigantesca nuvem de gás". [Como a estrela

se forma]-0 como a estrela se forma.

[Por exemplo]-0 aqui já é um exemplo. Uma reação entre o hidrogênio em hélio

[transforma]-0 gera0 uma quantidade de calor e de luz e um exemplo disso são as

Plêiades, na via Láctea. [Que é o exemplo]-0 o segundo exemplo. Que que acontece,

aqui cita o exemplo.

"O brilho e o tamanho da estrela variam pouco, ocorrendo apenas uma ligeira

contração." [descreve]-0 [descrição da estrela]-0 descrição...0

O que acontece com a estrela em relação ao brilho e ao seu tamanho. Ocorre mínima

contração. O brilho e o tamanho da estrela <va-> varia pouco0 e isso faz com que

ocorra uma ligeira contração. "É o caso do Sol", é outro exemplo. (sussurros)

[Quando esse hidrogênio]-0 [quando há escassez de hidrogênio]-0 quando essa

("substância") se esgota na estrela, ocorrem transformações. Que transformações são

essas? Então esse parágrafo está falando sobre0 o que ocorre com a estrela0 quando0

uma boa parte do hidrogênio se esgota. [Quais são essas consequências]-0  
[quais são as consequências]- quais são as transformações disso. O hidrogênio é  
("transformado") em hélio, diminui a fusão. "A quantidade de calor gerados é tão  
grande". O astro se expande, o raio aumenta e o calor se dilui. E "a estrela vira uma  
gigante vermelha", ou seja, quais são as transformações da estrela quando o hidrogênio  
se esgota. Tudo bem.  
Mas o que acontece quando falta hidrogênio. Aqui é quando o hidrogênio se esgota. Na  
maior parte0 o hidrogênio se esgota. Aqui quando falta hidrogênio...0  
ou seja, quando falta hidrogênio0 a situação se torna mais crítica. O que acontece?  
Quando falta... 0 (inint) quando falta o hidrogênio [na estrela]-0 na estrela, por exemplo,  
o Sol. "Sua contração transformará o corpo" terrestre...0 se a massa... Não, espera aí.  
Dependendo da massa...0 "Se a massa da estrela for..."0 sua contração vai se  
transformar no corpo terrestre. "Se a massa for de duas a três vezes a do Sol, a  
contração será muito mais forte." "Quando a massa é maior, a condensação" é mais  
violenta0 e a sua densidade0 [é tão]- [fica]- torna-se (hes) (sussurros) 0 por  
consequência os gases0 dessa camada periférica [se <tor->]- se transforma em uma  
supernova. (sussurros)  
Ou seja, esse texto técnico0 fala sobre o que compõe a estrela, certo? E a estrela se  
compõe de hidrogênios. As estrelas, por exemplo, as Plêiades, na via Láctea. E que o  
hidrogênio0 permite com que essa estrela se esgote. Quando uma parte dos hidrogênios  
se esgota0 <dimi-> (hes) há uma diminuição na fusão, nas moléculas de gás, na  
quantidade de calor. E luz0 aumenta, o seu raio aumenta. No entanto, [quando <iss->]-  
quando a falta de hidrogênio0 acontece, a fusão entre os gases0 diminui0 [e a massa]-  
[e se]- dependendo do tipo da massa da estrela, [a estrela]-0 a sua contração  
transformará o corpo celeste em um pequeno astro moribundo, a contração final [vai  
ser]- pode ser muito forte. Se a massa dela for maior0 a sua densidade vai ser mais alta0  
e diante disso, simultaneamente, os gases da camada periférica se transformam em uma  
super0nova estrela, eu acho. É, esse texto aqui fala0 sobre o que se compõe a estrela:  
hidrogênio. Partículas de gás, geralmente, hidrogênio. [De que se compõem as  
estrelas]-0 de que se compõem as estrelas0 e de como a falta0 dessas partículas de gás0  
transformam0 essas estrelas? É isso? Como uma nuvem de gás0 se transforma0 em  
estrela. Deve ser isso.

## Text 2 – L2

Drugs. O assunto daqui é drugs. ("Por exemplo") " medicines as pills or by injection ."  
 [Exemplos]-0 exemplos de drogas0 em nosso corpo?  
 "Nicotine and hormones..."0 O que esse homem fez...0 (sussurros) "Tiny patch"  
 (sussurros) (hes) isso0 (inint) "tiny patch", "needles." "Shuttle drugs through skin."  
 Primeiro experimento0 foi feito com ratos. O experimento [("realizado") com <ra->]-  
 feito com ratos0 mostrou que há [o nível]-0 os níveis de glicose0 [aumentaram]- não,  
 caíram. Os níveis de glicose caíram, no entanto, [um <experi->]- um outro experimento  
 com seres humanos0 voluntários...0 Houve dois tipos [de <a->]- [de]- de experimento:  
 com rato0 e ("voluntários humanos"). (inint) os níveis de glicose <aumen->0 cair0 e um  
 outro método foi0 o sem dor.  
 Zapping...0 não é isso. Como eles fizeram isso daqui? "charged drug <mole-> molecules  
 with a matched charge from an electrode repel the molecules, pushing them into the  
 skin." (hes) pra ajudá-los, eles colocaram0 (inint) "into the skin". ("This") patches0  
 permitiu que...0 [foi que]- (hes) Deus, que confusão. (inint) Mecanismos que  
 monitoram0 os níveis de glicose podem0 devolver a insulina?  
 É isso? Isso aqui foi a conclusão que eles tiraram, não é? Mecanismos feedback0 que  
 monitoram, continuamente, os níveis de glicose, ("the even"). Isso aqui é [uma  
 hipótese]-0 a hipótese deles.  
 Aqui já não utiliza0 remédios dentro do corpo. E esse senhor aqui desenvolveu [um  
 chip]- um chip implantado. Eles pensam que não utilizam0 as drogas0 dentro do corpo.  
 Bem, pode-se concluir o seguinte: esse texto0 [fala como]- fala sobre0 o uso de0  
 drogas0 e remédios. Ou através de pílulas ou através de injeção0 [podem]-0 podem0  
 diminuir? [É diminuir, é?]- [vai diminuir?]- vai diminuir o quê?  
 (hes) podem abrir as membranas das células. Está bom, então esse texto trata de  
 remédios, como por exemplo, as0 pílulas ou injeção. Como utilizar pílulas e injeção, por  
 exemplo, no corpo0 para (inint) abrir as membranas das células. Só que esse camarada  
 aqui0 desenvolveu0 [agulhas]-0 injeções microscópicas. Enquanto este0 desenvolveu  
 patches, como é que é mesmo em português? Não sei, esqueci. Enquanto...0  
 Ah, está aqui. Então, esse texto trata0 do uso de remédios, tal como0 pílulas ou através  
 de injeção0 para0 monitorar0 os níveis de glicose0 e de insulina. Enquanto uns, como  
 Mark Prausnitz, alega0 que as moléculas de insulina são muito grandes0 e, portanto, o  
 melhor que deve ser feito é através de0 injeção? Outros, como os pesquisadores da Alza  
 Corp, alegam0 que o melhor é injetar0 dentro da pele "titanium-foil blades", pedaços de

titânio. E outro, como Robert Langer alega ter desenvolvido uma placa [que dispensa o uso [de <me->- de drogas, mas]-0 que dispensa o uso de drogas0 e tem utilizado0 eletricidade para tornar ("tornar as células normais"). Então, o aviso [tanto]- nem...0 E outro camarada aqui0 criou o0 "bionic chip"0 o que permite aos (inint)0 medir a voltagem necessária para os poros das células. [É isso]-0 [é isso?]- eu acho que é isso.

Subject 9 (October 4)

Text 1 – L1

Primeiro parágrafo está bem claro, bem escrito e só trata de como as estrelas são formadas. Com a concentração de hidrogênio e substâncias. O segundo parágrafo, ele exemplifica um exemplo de estrela e continua falando [da]- [do]- do processo [de]- de transformação da estrela. Também está bem claro, li0 tranqüilamente, bem <li-> linearmente. Esse parágrafo também está bem claro e falou do sol, mas eu achei legal reler de novo o começo, porque durante cerca de noventa por cento da sua existência... [está]- está falando do brilho e as características da estrela. Então, eu achei0 dar uma relida antes de fazer algum comentário. O quarto parágrafo já trata [de]-0 do que pode acontecer no futuro0 [com]-0 com relação [a transformações de]- (hes) as transformações que esses elementos químicos podem gerar. Também está bem escrito e eu li sem problemas nenhum, eu não tive que parar em nenhum lugar, tranqüilo. Esse parágrafo também li linearmente, só que eu0 reli porque como acabou a fita eu0 perdi0 momentaneamente o raciocínio, mas também fala de uma parte muito interessante0 [que do]- do buraco negro0 que é a falta de luz. (hes) Quer dizer que ele não reflete mais a luz0 e são termos muito técnicos que eu, realmente, não conheço nada disso e0 acho que a idéia principal0 está sendo falado0 (hes) é acerca dessa transformação [das]- das substâncias, (hes) principalmente, tudo relacionado com hidrogênio0 e0 ah, não é, assim, a coisa mais difícil do mundo, mas também não é a coisa que eu mais gosto de ler. Então, achei interessante como uma leitura rápida, mas0 nada me marcou, assim, que eu vá, talvez, me lembrar mais pra frente. Seria isso. Mas (hes) estou fazendo certo?

Text 2 – L2

Esse é um tema que já me agrada um pouquinho mais<sup>0</sup> e também foi fácil de leitura. Só  
 : 6 : 5  
 parei no "needles" porque primeiro eu tinha lido "needs", aí eu vi que é "needles"<sup>0</sup> e [fala  
 5 :  
 [da]-<sup>0</sup> da existência da]-<sup>0</sup> fala das drogas e do futuro delas.  
 : 6 : 6 : 6  
 O segundo parágrafo também não tem nenhuma palavra complicada. Fala sobre a  
 5  
 insulina.  
 6  
 E o terceiro eu achei superinteressante, porque [tem]- está sendo desenvolvido (hes)  
 :  
 <mini-> <micros-> agulhas microscópicas, mas eu ainda quero entender [pra que]-<sup>0</sup> pra  
 : 5 5  
 que isso. (hes) Porque aqui está dizendo que<sup>0</sup> isso<sup>0</sup> [colocaria]-<sup>0</sup> faria as drogas (hes)  
 5 : 5 6 5  
 <en-> penetrarem pela pele, mas agora eu quero ver o que vem depois.  
 5 6  
 O quarto parágrafo também reli, porque<sup>0</sup> eles estão falando de um experimento que já  
 6 :6  
 foi feito com ratos, estão falando [da]- que [não]- não será<sup>0</sup> nada dolorido<sup>0</sup> esse  
 5 : 5 6  
 experimento ou a<sup>0</sup> futuramente o que vai ser feito nos humanos. Ah, e também (hes) reli  
 6 6  
 de novo a primeira parte até<sup>0</sup> [a]- a parte da glicose isso. Não conheço a palavra. E pra  
 : 5 6 :  
 entender [o]- de novo a idéia do parágrafo.  
 :  
 Que<sup>0</sup> está sendo falado sobre <gri-> glicose e depois<sup>0</sup> a sua... Ah, agora faz sentido a  
 : 6 6 :  
 parte das agulhas, porque<sup>0</sup> isso vai ser, provavelmente, pra pessoas [que]-<sup>0</sup> que têm  
 :5 6  
 diabetes. É a idéia que imagino que vem em seguida.  
 5 6  
 Ah, que interessante. O <terce-> o outro está [bem]- bem...<sup>0</sup> claro bastante termos  
 5  
 técnicos, mas é facinho de entender, porque<sup>0</sup> está falando da facilidade que o usuário vai  
 : 5  
 ter, depois, de administrar [a <dro->]- a droga e sem dor. Também não tive problema, li  
 6  
 ele, continuamente, não parei em nenhum lugar. (riso) No outro parágrafo, eu tive que  
 5 6 5  
 reler "tissues", porque eu tinha lido como "issues"<sup>0</sup> e<sup>0</sup> agora eu vou ler mais uma vez.  
 6 5 6  
 E [esse <pará->]- esse é muito importante pro futuro do MIT. (inint) No MIT eles estão  
 :  
 desenvolvendo [uma]- uma maneira de implantar as drogas perto [do]- [do]- dos  
 lugares<sup>0</sup> "closer to their [target tissues]-<sup>0</sup> target tissues." Eu achei que fosse<sup>0</sup> perto  
 6 6 6 5  
 [do]-<sup>0</sup> [do lugar onde se quer]- do objetivo onde quer se injetar<sup>0</sup> a glicose, mas  
 6 : 5 :  
 eu acho que eu<sup>0</sup> não entendi.  
 5 6  
 (risos) Eu ri porque<sup>0</sup> (hes) achei engraçada a parte [do]-<sup>0</sup> da medida da voltagem, que  
 : 5 : 6  
 eu já associei o cara morrer eletrocutado. Muito legal. Conforme o artigo, o último  
 : : 6 6  
 parágrafo tem as previsões<sup>0</sup> do que vai fazer quando eles conseguirem<sup>0</sup> <e-> essa parte  
 : 5 5  
 [do]-<sup>0</sup> da voltagem, uma espécie de um choque pra abrir [as]- os poros das células (hes)  
 : 6 6  
 será muito mais fácil o trabalho [de implantação]- (hes) da injeção<sup>0</sup> da insulina, acredito  
 5  
 eu. Também li linearmente e o texto inteiro está falando sobre<sup>0</sup> [a]-<sup>0</sup> os medicamentos

6 : 5 : 5  
que, no caso, primeiro eu tinha achado quealaria sobre0 (hes) drogas como cocaína ou  
6 5 : :  
heroína, mas na verdade [é uma]-0 está falando de algo positivo pra ajudar as pessoas,  
: : : 6 :  
<na-> não pra0 prejudicar. É isso.  
5 6 6  
A idéia geral [do]- do texto um (hes) era sobre [a]-0 as modificações com hidrogênio, a  
: 6 :  
formação de estrelas, a formação de buraco negro, que eu esqueci de falar. Que eu me  
: : 6  
lembre, superficialmente, a idéia principal é essa.

Subject 10 (October 04)

Text 1 – L1

Eu vou reler que0 acho que eu não estou muito concentrada. (hes) Esse parágrafo fala  
: 5 6 :  
[da]- de como [se]- [se <fo->]- se forma a estrela, acredito. (hes) Que seria devido às  
: 6 :  
partículas de gás que [se condensam]- se juntam. E isso (hes) segundo um professor  
6  
[da]-0 da USP.  
: 5 6  
Ele dá exemplos [de]- de [estrela]-0 (toss) uma estrela que chamam de estrela jovem,  
6 6  
que é formada a partir [da]- de uma reação atômica.  
: 6  
(hes) Aqui fala que0 as estrelas sofrem pouca alteração [de]- de tamanho e de brilho0  
:5 : 5  
durante a sua existência.  
6  
Eu li, mas eu vou reler, porque [essas]- as informações ficam soltas. [Eu preciso]-0 pra  
5 5  
verbalizar o que eu estou entendendo eu preciso ler novamente. [O terceiro]- o quarto  
6  
parágrafo. Hum! interessante. (hes) O processo [de]- [de]- de condensação, né? Que [é  
6 : 5  
<ge->]- é gerado pela (hes) o hidrogênio, na verdade, depois, ele vai [se]- se reverter,  
: 5  
[vai <vo->]- vai se tornar [um]- um processo de expansão. Porque0 isso vai aumentar  
: : : 6 : :6  
[o]- [o raio]- o tamanho da estrela, né? o calor e luz [são]- são aumentados. Isso é o  
6  
que aconteceria com o sol, [entre <ou->]- as outras estrelas também.  
6 6  
Acho que tem um errinho aqui: "e se a massa da estrela for até duas vezes a do Sol, sua  
6  
contração transformará o corpo celeste e0 em um pequeno..." Tem0 uma coisinha  
6 6  
sobrando aqui. É esse parágrafo fala da diferença entre [uma]-0 (hes) [um]- um buraco  
6 : 6  
negro, uma supernova. (hes) Acho que é isso, né? Tudo tem relação [com]- com0 a  
: : 6 6  
quantidade de hidrogênio que ainda resta no astro.  
6

Bom, [o]- o texto fala, basicamente, [de]- das estrelas, né? [de]- de como se forma a  
:  
estrela. (hes) No caso [o]-0 se fala bastante da função do hidrogênio na formação [da]-  
6 : 6  
[da]-0 das estrelas, porque, na verdade, a ausência ou a presença do hidrogênio, em  
5  
maior ou menor quantidade, que vai fazer com que elas se expandam ou se contraíam,

enfim. E essas estrelas podem vir a se tornar0 buraco negros ou supernovas. É um texto  
 6 : : : 5 : 6  
 sobre a formação e evolução das estrelas.  
 : :

## Text 2 – L2

Fala que0 (hes) a gente ainda (hes) recorre bastante [a]- a medicamentos, digamos, assim,  
 :6 : :  
 tradicionais como0 (hes) comprimidos e injeção, apesar [de]- de o avanço já trazer novas  
 6 : 6  
 formas [de]- [de]-0 de a gente se medicar, né?  
 : 6 6  
 Aqui fala [que]- que uma das formas, né? digamos, assim, alternativas da gente0 (hes)  
 6  
 ingerir outras0 substâncias seria pela pele, aí dá o exemplo [da]- da nicotina e de outros  
 ::5 :  
 hormônios. No entanto, fala que em outros casos como é o da insulina isso não seria viável,  
 6 :  
 porque as moléculas são0 muito grandes, as moléculas de insulina. Isso é (hes) segundo  
 6 6  
 [uma]-0 um engenheiro químico0 da Universidade de...0 acho que do Instituto de  
 6 : 6 6  
 Tecnologia.  
 6  
 Essa mesma pessoa desenvolveu [um]- [um]- (hes) um “patch” de0 [pequenas agulhas]-  
 : 6  
 minúsculas agulhas que seriam capazes [de]- de <mo->0 lançar substâncias [no nosso]-0 [no  
 6 6  
 nosso]- no nosso organismo através da pele.  
 6  
 E alguns testes já têm mostrado que o nível de glicose no sangue diminui. Os experimentos  
 6  
 são feitos em ratos0 e0 [havia uma vantagem disso aqui]- (hes) [outra vantagem desse  
 6 :6  
 método seria que]-0 seria uma das vantagens, não seria que (hes) indolor.  
 : 6 : 6  
 (hes) Esse parágrafo explica um pouco [o]- o processo, né? como é que a pele consegue  
 absorver essas substâncias, né? desses “patches”. (hes) Esses “patches” [seriam]- eles teriam  
 6 : :  
 uns mecanismos que permitiriam ao usuário0 administrar, né? (hes) se automedicar,  
 5  
 digamos, assim, de acordo [com]- com a necessidade, usando [uns]- alguns mecanismos do  
 6 : :  
 próprio “patch”. Tudo muito pequeno, acredito.  
 6  
 (hes) O professor ou pesquisador do MIT (inint), nesse parágrafo fala que ele desenvolveu0  
 : 6  
 um “chip” que pode permitir que você0 coloque as drogas no seu corpo, né? da forma,  
 : : :6 : :  
 assim, mais precisa possível, né? muito próximo dos pontos do seu corpo que você  
 :  
 precisaria atingir.  
 6  
 Aqui fala de que os pesquisadores têm enfrentado um problema, que é descobrir qual seria a  
 :  
 voltagem ideal pra fazer com que a célula se abra pra receber esse medicamento.  
 6  
 (hes) [Um dos problemas]- o problema central que ele fala aqui é que0 uma voltagem muito  
 5  
 alta seria capaz de destruir a célula, enquanto que uma muito baixa [não]- não seria capaz de  
 abri-la, né? para [que]- que o medicamento fosse inserido. Então, é o0 Boris Rubinsky, na  
 6 : : 6 :5  
 Califórnia, criou [um “chip” biônico]- um “bionic chip”0 de silicone, que0 ele, acredita-se,



será capaz, né? [de]- [de]-0 de levar a célula a se abrir (hes) na medida certa, digamos,  
 assim, pra receber0 o medicamento, mas isso ainda [é]-0 é0 pesquisa em andamento.  
 Bom, o texto fala de formas, acho que posso falar, assim, alternativas [de]- de0 ingerir  
 medicamentos [na]- no organismo humano. Não só através de pílulas e de0 injeções, mas  
 também os patches e [de]- de [coisas]-0 (hes) substâncias que seriam absorvidas, diretamente,  
 pela pele, né? Acredita-se que trariam, acho que um resultado [mais eficiente]- mais rápido,  
 talvez. E problemas que eles, os pesquisadores na área têm enfrentado são0 esses que eu  
 [falei]- falei [no último <pa->]- no último parágrafo. Como lidar com a célula de forma que  
 ela seja0 receptiva0 a esses medicamentos. É isso.

Subject 11 (October 05)

Text 1 – L1

Eu li uma vez [o]-0 o parágrafo, mas pra conseguir a idéia central eu tenho que voltar  
 novamente0 ao início. O que me chama a atenção aqui, a idéia é0 que0 partículas de  
 <ga-> gás se concentram...0 que estão soltas no universo... eu preciso0 falar o texto em  
 voz alta [pra]-0 [pra]-0 [pra]-0 pra entendê-lo melhor0 e eu acho que essa é uma das  
 estratégias que eu estou usando. “Partículas de gás, elas estão soltas no universo, elas  
 vão se concentrando devido às forças gravitacionais0 que puxam umas contra as outras.  
 E assim elas formam uma gigantesca nuvem de fumaça que se transforma em estrela.”  
 Então, aqui está explicando0 a formação da estrela. Que são partículas de gás0 que estão  
 soltas no universo e elas [se condensam]- [se concentram]-0 se condensam e assim0  
 [formam]-0 formam0-se as estrelas.  
 Segundo parágrafo. Há [uma fusão]- uma reação atômica que transforma o  
 hidrogênio...0 No segundo parágrafo, a explicação0 de como acontece,  
 necessariamente, [essa]-0 essa formação0 da estrela. É [a fusão]-0 “há uma fusão, uma  
 reação atômica que transforma hidrogênio em hélio, gerando grande quantidade de calor  
 e luz. Um exemplo de estrelas jovens são as Plêiades, na via <Lá->0 Láctea. Está  
 explicando...0 “uma reação atômica que transforma <hige-> hidrogênio em hélio.”  
 Estou retornando às sentenças0 [pra que haja]-0 pra que eu <co-> possa constituir a  
 idéia. “Uma reação atômica que transforma hidrogênio em hélio, geralmente...” Então,  
 [a]- [a]- a estrela, ela é formada de uma grande quantidade de calor e luz, que é a  
 junção0 [de]-0 [de]-0 de duas substâncias, hidrogênio e hélio. Essa é a idéia principal,  
 <co-> [como]- como a estrela0 é formada, né? Pela quantidade de calor e luz, a partir da

junção de hidrogênio e hélio. Mas pra isso eu tive que retornar várias vezes às  
 sentenças pra conseguir constituir a idéia principal.  
 Terceiro parágrafo. Terceiro parágrafo, [a]-0 a palavra que me chama a atenção é  
 [tamanho]-0 brilho e tamanho. Então, ele está falando sobre o tamanho [do]-0 da  
 estrela, que elas variam e dá [o <exe->]- o exemplo, exemplifica com o Sol [que]-0  
 que tem quatro vírgula cinco bilhões [de ano]-0 de anos e se encontra ainda em fase  
 intermediária [de <su->]- de sua existência. O que ele comenta, voltando ao início da  
 sentença, que cerca de noventa por cento [da sua existência]- da existência da estrela  
 que a estrela varia muito pouco em tamanho e brilho. E exemplifica, então, no caso,  
 que o Sol com quatro vírgula cinco bilhões de ano, ele ainda está numa fase  
 intermediária e sofreu <mu-> muito pouca alteração e mudança. Essa é a idéia principal.  
 Quarto parágrafo. Como a estrela é composta de hidrogênio e hélio, [voltando]-0  
 voltando ao segundo parágrafo em que ele comenta isso, que é a junção de hidrogênio  
 e hélio.  
 No quarto parágrafo, ele comenta que quando parte desse hidrogênio, do qual é  
 formada a estrela se esgota... pra isso eu retornei ao segundo parágrafo, só [pra]-0 pra  
 [ligar]- fazer a conexão [com]-0 com a formação da estrela, hidrogênio e hélio, os dois  
 elementos [que]- que a formam. (hes) Quando isso se esgota, inicia-se um novo período  
 em que há drásticas transformações. Ele vai explicar as transformações [que]- (hes) que  
 [seria]-0 (hes) sofrem devido ao esgotamento [do]- do hidrogênio. Pra entender  
 esse parágrafo, estou voltando várias vezes. “Praticamente todo o hidrogênio já  
 se converteu em hélio. Com isso, diminui a fusão entre as moléculas de gás  
 e começa um período de contração e aquecimentos violentos no  
 corpo celeste.” Eu preciso voltar, ler em voz alta, porque o assunto não é [do meu]-0  
 [da]- da minha esfera [de]- [de]- de leituras habituais, então... Então, o que acontece  
 com a estrela, esgotou-se o hidrogênio, esse hidrogênio se converteu em hélio, com isso  
 há [um supra-aquecimento]-0 um aquecimento violento, como é dito aqui, né? um  
 supra-aquecimento da estrela. Com isso, “a quantidade de calor e luz gerados é tão  
 grande que o movimento se inverte: o astro passa a se expandir” e com isso há o  
 crescimento da estrela. “Seu raio chega a aumentar cinquenta vezes e o calor <che-> se  
 dilui. A estrela vira [uma gigante]-0 uma gigante vermelha – uma amostra de como o  
 Sol ficará daqui a <do-> quatro vírgula cinco bilhões de anos.” (hes) Então, aqui (hes)  
 o parágrafo fala das transformações da estrela. A partir [da]- do esgotamento do

hidrogênio0 [ela se converte]- [ela fica]-0 [ela se converte em]-0 todo o hidrogênio do  
 núcleo se converte em hélio, como é falado aqui. Então, há um superaquecimento da  
 estrela, com isso, há o aumento dessa estrela0 [e]- e ele exemplifica, né? que ela vai  
 ficar uma estrela gigante0 [e]- e exemplifica0 (hes) [ou indica]-0 faz uma  
 referência a como o Sol ficará daqui a0 tantos milhões de anos. (hes) E fala  
 sobre o raio da estrela também, que “[chega a aumentar cinqüenta vezes]-0  
 [chega a aumentar cinqüenta vezes e o calor se dilui]- seu raio chega  
 a aumentar cinqüenta vezes e o calor se dilui.” (sussurros) “a estrela vira  
 uma gigante vermelha.” Tá, acho que basicamente... voltei várias vezes ao  
 parágrafo (hes) a várias sentenças pra conseguir ligar as idéias, mas acredito que a idéia  
 principal é essa, é a conversão0 da estrela, é o esgotamento do hidrogênio e acúmulo de  
 hélio como... e a transformação que essa estrela (hes) a transformação que ocorre nessa  
 estrela.  
 Li uma vez o primeiro parágrafo, mas tenho que retornar. “Em um outro período,  
 quando a falta de hidrogênio torna-se crítica, apesar da rápida expansão, a fusão dos  
 gases diminui <conti-> continuamente. Se a massa da estrela for até duas vezes a do  
 Sol, sua contração transformará o astro celeste em um pequeno astro moribundo, cuja  
 gravidade já não consegue segurar os [gases]- gases da periferia.” Aqui fala da...0  
 “Em outro período, quando a falta de hidrogênio [torna-se <crí->]- [torna]- torna-se  
 crítica, apesar da rápida expansão, a fusão dos gases... se a massa...” Aqui fala dessa  
 transformação [que]-0 [que]-0 que foi mencionada no parágrafo anterior0 [e [das]-  
 diferentes]-0 das diferentes conseqüências pra estrela. [Se]-0 [se essa <ra->]- [se essa  
 expansão]-0 se nessa expansão0 a massa da estrela for até duas vezes0 a do Sol, o que  
 acontecerá com essa estrela, ela vai se transformar num “pequeno astro moribundo, cuja  
 gravidade já não consegue segurar os gases da periferia.” Agora, “se a massa for de  
 duas vezes a três vezes [a do Sol]- comparado a do Sol, a contração [ficará]- será0  
 muito forte, criando um corpo celeste denso0 chamado pulsar ou estrela de nêutrons.  
 Huhum, então, aqui, voltando, [se a estrela0 for até duas vezes]- se a massa da estrela  
 for até duas vezes a do Sol, [ela se]- essa estrela se [transformará]- (hes) ela se  
 transformará [em]- em um pequeno astro moribundo, como é falado aqui. Mas, (hes)  
 contudo, se essa massa for de duas a três vezes a do Sol, equiparado a do Sol, acontece  
 que essa estrela0 não será mais um astro moribundo, ao contrário, ela0 será um corpo  
 celeste denso0 chamado pulsar ou [estrela]- estrela de nêutrons. “Quando a massa é

maior, a condensação final é mais violenta0 ainda0 e o núcleo do antigo astro vira um buraco negro.” Em relação [a essa]- a0 essa segundo aspecto, quando a massa [é]-0 igual ou [três]- duas a três vezes a do Sol, equiparado a do Sol, as...0 “essa condensação final é mais violenta...0 e o núcleo do antigo astro vira um buraco negro – a sua densidade é tão alta que ele não deixa a luz escapar. Simultaneamente, os gases...”

Hum, tá! Tenho que retornar0 às sentenças anteriores. Então, há duas colocações aqui: uma0 que [a <sente->] [a]- a estrela pode se tornar um astro moribundo0 e outra [que a]-0 que a estrela pode se tornar [um]-0 um corpo celeste denso. São as duas questões aí. (hes) E explica que [quando a massa é maior]-0 se a massa0 que compõe a estrela é maior, [a condensação dela0 é mais violenta]-0 [a condensação]-0 a transformação dela é mais violenta, talvez. E o núcleo do antigo astro vira um buraco negro. “Sua densidade é tão alta que não deixa a luz escapar.” Consequentemente, [se a]-0 se a massa é maior e [a condensação]-0 a transformação é violenta, [vai acontecer]-0 vai acontecer esse buraco negro, [vai acontecer essa]-0 vai acontecer, digamos, assim, a morte da estrela, o buraco <ne-> negro e consequentemente, [a estrela]-0 os gases [que estão0 na camada periférica]- que estão ao redor da estrela0 “se transformam numa supernova – massa de gás que brilha por pouco tempo .” E aí [ela se]-0 ela se dissipa...0 (hes) O que eu entendi, [fazendo]-0 fazendo o retorno ao texto, [a]- a várias sentenças0 é que essa contração de luz, no segundo momento, [essa]-0 [é]- é forte, que ela acaba [exterminando]- dissipando a estrela. Então, [voltando]-0 voltando [ao parágrafo]- ao último parágrafo. Essa falta de hidrogênio torna-se crítica, apesar da rápida expansão. Então, se0 o que pode acontecer nessa expansão é que0 a estrela pode se transformar num0 corpo celeste, [vai]- vai se transformar em um astro [moribundo]-0 moribundo0 ou ela [se <tor->]- se transforma em um corpo celeste denso chamado pulsar. [Nessa]-0 nessa expansão que pode ocorrer se ela for muito violenta, é que pode acontecer esse0 buraco negro, ou seja, a dissipação [da]-0 da estrela. E assim...0 Acho que é isso.

## Text 2 – L2

Eu fiz uma leitura do primeiro parágrafo, agora [eu]- eu retorno. Foi uma leitura muito rápida, estou retornando. Que ele quer comentar aqui0 que0 remédios, né? comprimidos0 e agulhas serão uma coisa do passado, né? que0 as [pessoas]-0 as pessoas normalmente tomam remédios...0 (hes) foi desatenção, agora, deixa eu voltar. Desliguei um momento. O que ele fala [que]-0 que agulhas e comprimidos será uma coisa do

passado, né? [que]-0 que [de]-0 de0 um número grande de drogas novas  
: 5 : 6 : 6 : :6 : :  
que entram no mercado, muitos de nós ainda, né? tomamos remédios, né? <o->0 <o->0  
: 6 : 5 6 : 6 : 6  
ou injeções. “In the future, [pills]- pills and needles may be a thing of the past.” Mas  
6 6  
ele acredita que no futuro essa coisas0 como agulhas e <com-> comprimidos será uma  
5 : :  
coisa [do]- do passado.  
: : 6  
Estou lendo o segundo parágrafo, vou retornar. E diz que0 drogas como a nicotina e  
: : 6 :5  
hormônios são, geralmente, absorvidas através da pele, né? ou [são enviados através da  
: : :6 6 :  
pele]- eles são injetados através da pele, né? você pode até0 (hes) passar insulina sobre  
: 6 :6  
sua pele o dia todo que [ela não vai]- ela não vai0 entrar na pele, né? Ainda a introdução  
: : :5 6  
do texto e eu não estou conseguindo ainda0 encaminhar meu pensamento. Eu acredito  
: : :6 : 6  
que tenho que ler mais alguns parágrafos pra voltar a esses.  
: 6  
Ah, sim. No terceiro parágrafo, ele fala que [foi]-0 foi criado [um]-0 um adesivo0  
: : 6 : 5 : 6 : 6  
microscópico, né? E esse adesivo, ele é usado pra0 transmissão de drogas ou  
: 6 : 6 : 5 : :  
medicamentos através da pele, tá? Tá! voltando ao0 primeiro parágrafo, eu estou  
: 6 6 : : 5 : 6  
tentando fazer as conexões. O primeiro parágrafo, então, a idéia0 onde o autor quer  
: 6 : 6 :  
levar é [que]-0 que nós <usa->0 (hes) consumimos (hes) medicamentos0 <injeço->  
: 6 6 : : : 6  
(hes) todo tipo de medicamentos ou0 através[de]-0 do uso da injeção, né? pela  
: 5 : 6 : 5 : 5 : 5  
aplicação0 [do]-0 do remédio0 [e]-0 e ele diz [que]-0 (hes) que pela aplicação. Então, o  
: 5 : 6 : 6 : 6 : :  
ponto que ele quer fazer aqui é que0 não necessariamente vai ser preciso0 [essa0  
: : :5 : : :5 : : 6  
agulhas]- essa aplicação, né? que já existe esse adesivo microscópico que você pode  
: : 6 : : : :  
<gru-> aderir à pele e com isso0 você0 (hes) você...0 usufruir o teu remédio sem  
: 5 :6 6 : :  
necessariamente ser picado, [ter agulha]-0 passar por essa aplicação. (hes) Toda essa  
: : : 5 6  
questão que ele está levantando. Mas pra isso, no primeiro parágrafo, eu li, me senti um  
: : :6  
pouco perdida, segundo também. Eu precisei ir até o terceiro parágrafo [pra fazer]-0 pra  
: 5 : 6 : 5  
fazer as conexões. Pra ver: Ah, tá! Então, ele quer falar [sobre]-0 sobre as “needles”  
: : : 6  
que não... [as]-0 as0 agulhas e... aplicações com agulhas que já não <sã-> serão  
: 6 : 6 : : : :  
necessárias (hes) <den-> [no]- [no futuro]- dentro dum tempo próximo, um tempo...0  
: : : : : 6  
E é no <co-> [no]- no0 quarto parágrafo, ele comenta sobre testes que foram feitos0  
: : 6 : 5  
com o uso desses adesivos, que0 [os adesivos]- [eles são indolores]-0 sugere-se que eles  
: 6 :6 : : 6  
são indolores.  
: :  
E testes com animais demonstraram [de <gli->]- de glicose sangüínea, usando [esses]-0  
: : : : : 6 : 5  
esses adesivos em experiências feitas com ratos, caiu significativamente. E outro fator é  
: : : 6 6 : :  
que0 [a]-0 esse método é indolor. Então aqui ele está <fazen-> falando [no quarto  
:5 : 6 : : 6 :  
<perí->- no quarto parágrafo0 dos benefícios0 (hes) advindos desse uso de adesivos,

né? que [a taxa sangüínea]-0 (hes) o nível de taxa0 sangüínea0 baixa, tá? Só que aí eu  
 não consigo entender bem o porquê desse0 “blood glucose levels”0 quer dizer, a razão0  
 no texto eu entendo, mas eu acho que precisa ter [um]-0 [um]-0 uma informação  
 anterior aí que eu não tenho0 [sobre]-0 sobre essa questão0 (hes) é uma informação  
 mais na área de medicina ou0 um contexto maior, uma explicação sobre esses níveis de  
 glicose0 sangüínea. Essa informação aqui pra mim [está]-0 ficou a desejar porque [eu  
 <prec->- eu preciso fazer relação com outras coisas [e não]-0 e [não tenho]-0 não  
 tenho esse conhecimento, tá! Mas0 ele comenta que é indolor, tá? É um método  
 indolor, ele está querendo mostrar os benefícios.  
 Ele vai explicar sobre esses níveis de glicose agora. Que de acordo com pesquisas...0  
 (sussurros) A palavra insulina aqui me chamou atenção, porque0 me passou  
 despercebida no segundo parágrafo. Agora, como ele está falando [sobre]-0 sobre [o]- o  
 consumo de insulina ou a aplicação de insulina0 no corpo, eu voltei0 ao segundo  
 parágrafo onde é mencionada essa palavra. Eu <vol-> fiz [esse]-0 [esse]-0 esse  
 processo, onde ele comenta [que]-0 que você pode até esfregar insulina na sua pele todo  
 dia que ela não vai penetrar. Então, que...0 (hes) a ligação que eu faço é que [esse]-0  
 [esse]-0 esse0 adesivo0 ele vai ajudar [pras <perso->- as pessoas [que]-0 que tem que  
 [fazer]- tomar insulina periodicamente0 e que esse adesivo, ele tem um0 mecanismo0  
 que vai ajudar a pessoa a se autoadministrar essa droga. Então, voltando, [esses  
 animais]-0 (hes) foi testado nesses animais0 [esse]-0 esse adesivo. Então, esse adesivo,  
 [ele é]- ele é específico pra pessoas que precisam0 (hes) [de]-0 [do]-0 do consumo  
 diário, mensal ou semanal de insulina.  
 E essas pesquisas...0 por isso0 [que]- que [ele]- ele comenta em: “show ablood glucose  
 levels”. Tá, porque o experimento é realmente0 (hes) destinado ou veiculado [pra]-0  
 pra pessoas que precisam receber insulina. Mas eu <prec-> quero0 confirmar essa  
 informação, vou [voltar ao]-0 voltar ao parágrafo0 primeiro, segundo, terceiro, quarto,  
 quinto parágrafo0 [pra]- [pra]-0 eu quero0 realmente me certificar que é  
 especificamente pra pessoas que precisam0 de insulina. Huhum, provavelmente pela  
 última sentença que ele fala: que monitora os níveis [de]- (hes) [de]- que esse  
 mecanismo, [ele]- ele ajuda a monitorar os níveis de <gli-> insulina0 [que]-0 [que a]-  
 [que a <prec->- [que a pessoa precisa]-0 que [o]- o organismo da pessoa precisa.  
 Primeiro, segundo, terceiro, quarto, quinto, sexto. No sexto parágrafo, ele comenta  
 [que]-0 que há [um]-0 um mecanismo que foi desenvolvido0 que [dispensa o uso]-0

[dispensa “drugs”]- que dispensa o uso [de]-0 de medicamentos e drogas dentro do  
: : 6 :  
corpo. (sussurros) Tá, essa informação [preciso]-0 (sussurro) preciso ler novamente.  
: 6 : : 6 : : 6 : : 6 :  
Sei que essa informação do0 quinto parágrafo tem relação, mas está me faltando mais  
6 : : 6 : :  
ainda0 [mais]-0 [mais complemento]- [mais]-0 mais idéias. É um chip que foi  
: 6 6 : : 5 : :  
desenvolvido0 e que dispensa o uso da droga, tá! (sussurros)  
: 6 : : : 6 6

Tá. No último parágrafo, está explicando [esse mecanismo]- [esse]-0 esse chip, no caso,  
5 : : : : 6 : :  
que dispensa o uso [de]-0 de droga no corpo. Que você pode0 usar esse mecanismo, só  
5 : : : 6 : :  
que0 aqui eles estão0 colocando [que]-0 que não há maneira de medir0 [a]-0 a voltagem  
6 : 5 : : 6 : 6 : 6  
precisa, [o]- [o]- [a]-0 [a]-0 a eficácia [desse]-0 desse mecanismo. Por isso [que  
: : : : 6 : 6 : : : 6 : : 6  
<mu->]- que demais destrói as células e de menos0 faz com que as células se0 fechem.  
: : : : 6 : : 6 : 6 : 6

E diz que [agora]- no momento, em Berkley, foi criado0 um chip0 que é biônico, que é  
: : 5 : 6 : : 5 : : 6  
construído [de]-0 de produtos de silicone0 com uma célula viva0 no centro do seu  
: 6 : : 6 : : 6 :  
circuito, [que]-0 que permite [que]-0 com que os pesquisadores0 tenham uma precisão  
: 6 : 5 5 : : 6 :  
da voltagem <necessida-> (hes) necessária0 [pra]- [pra]- pra ser colocada [na]- na  
: : : : 5 : : : : :  
pele [pra que0 os]- pra que os poros não se fechem ou pra que os poros [não se]-0 não  
: 5 : : : : : 5  
se destruam. Mas, contudo, esse método ainda está em desenvolvimento. [Eles <em->]-  
6 : : : : 6  
eles têm, como eles dizem, apenas ainda uma chave pra...0 O que eles têm agora é  
: : : 6 : :  
apenas [uma chave]- uma pequena chave [pra]-0 pra descobrir esses mecanismos da  
: : : 6 : : :  
célula. Tá, então, aqui o que eu fiz foi uma leitura mais ou menos0 traduzindo o que0  
6 : : : 6 : 5  
eu estava lendo, pra eu conseguir0 entender0 e tentar fazer todas as ligações com o que  
: : 6 : 6 : :  
eu li anteriormente, pra ver se eu consigo fazer agora [todo]-0 todo o conjunto da idéia  
6 : : : 6 : :  
do texto, [o que que o texto quis dizer]-0 o que que ele está falando, tá? que colocações  
: 5 : : 6 :  
que eles fazem. Eu preciso voltar agora a várias partes do texto pra tentar0 fazer todas  
: 6 : : 5  
as conexões.  
6

Então, voltando, foi criado um mecanismos, mas esse mecanismo ainda não é viável. É  
: 6 6 : : : 6 : : : 6  
o que o quarto parágrafo diz e eles estão em descoberta de um mecanismo que se (hes)  
: : : : :  
que seja adequado [ao uso das]- pra o uso0 (hes) [que seja adequado à]-0 que seja  
: : : : 6 : : 6  
adequado pra0 aderir, pra colocar na pele da pessoa0 que precisa [da]- da  
: : 5 : : 6 :  
insulina [e que]-0 e que isso [não]-0 não acarrete [em]- em problemas, né? Então,  
: 6 : : 5 6  
estudos estão em desenvolvimento em relação a esse0 chip. Tá, [deixa eu voltar aqui]-0  
5 : 6 : : 6  
deixa eu colocar todas0 as idéias em ordem.  
: : 6 : 6

Então, no primeiro parágrafo, ele está introduzindo, [querendo]- (hes) fazendo uma  
: : : : 5  
introdução, dizendo [que]-0 [que]-0 tentando levar [ao]-0 [ao]-0 ao objetivo dele é  
: : 6 : 6 : : 6  
claro. (hes) Dizer que0 que injeções e aplicações de injeções [serão uma coisa do

<pa->-0 [podem ser uma <co->]- podem se uma coisa do passado e daí, com isso,  
 nessa introdução ele coloca [que o]-0 que, por exemplo, a insulina você pode esfregar  
 sobre a pele que ela [não vai]- não vai penetrar. Então, com isso, ele começa a falar das  
 coisas [que foram]- [que]- que estão sendo desenvolvidas. (hes) Que foi desenvolvido  
 [um]-0 [um]-0 um adesivo, né? que ele tem <peque-> (hes) microscópicos0  
 buraquinhos, como se fossem agulhas, pra que [a]- [a]-0 a droga (hes) possa penetrar0  
 pela pele. Então, [ele fala0 nisso]-0 ele faz essa colocação. Em seguida0 ele fala que  
 isso foi testado em animais e [que houve]-0 que houve uma eficácia considerável.  
 Então, aí ele está querendo falar dos benefícios0 [dessa descoberta]-0 [do que foi  
 desenvolvido]- desses adesivos. (hes)

E daí [no <se->]- no próximo parágrafo [ele fala0 que esse adesivo]-0 ele fala [como]-  
 como esse adesivo, (hes) como que é? funciona, né? Os componentes desse adesivo, ele  
 fala [em]-0 [em]- fala em lâminas de titânio.

Tá! Ele [fala em]-0 fala dos benefícios [desse]- desse adesivo0 e0 que ele pode  
 ser automonitorado, mas fala que no futuro esse adesivo pode0 monitorar também  
 níveis0 de sangue. Que esses níveis de sangue podem0 ser distribuídos [de]- [de]-0 não  
 [que]-0 que o mecanismo0 pode ser desenvolvido, [que]-0 que monitore os níveis de  
 glicose [que são]-0 [que são]-0 (hes) (inint) que são0 enviados0 automaticamente pelo  
 organismo.

Tá! E daí ele vem falar de uma outra pesquisa. Ele fala, então, da qualidade, dos  
 benefícios desse adesivo e depois ele fala dos chips0 [que]-0 que tem sido desenvolvido,  
 né? [que dispensam [o uso de]- o uso de <do-> drogas]- [que dispensam]- esses chips  
 dispensam o uso [da]- [da injeção]- da aplicação de injeção, né? Mas, contudo, esses  
 chips ainda0 (hes) não são totalmente desenvolvidos0 [ainda tem]-0 ainda tem0 (hes)  
 limitações. Porque eles podem ou destruir as células do organismo, devido [à]- à  
 voltagem, tem que ser uma voltagem0 regulada, senão ela pode destruir as células do  
 organismo ou elas podem fechá-las0 e isso ainda está em estudo.  
 Há pesquisadores0 fazendo esse estudo da precisa voltagem0 desses chips [pra]-0 [pra  
 serem usados na]-0 [pra serem usados]- pra que não danifiquem as células, mas  
 [esses]-0 [esses <méto->]- esse método ainda está em estudo.

Tá! Então, deixe-me ver. Eu quero fazer uma leitura de todo o texto agora. Tá! Eu tive  
 que fazer uma leitura de todo o texto pra0 ver se consigo0 fechar.  
 Então, a idéia foi: falar que0 agulhas são coisas do passado, né? que0 nicotina e



hormônios já são enviados através [de]- da pele de diversas maneiras, mas, contudo, a insulina, ela é muito difícil de [ser]-0 [ser] (hes) feita]- seguir o mesmo processo. Então, há estudos, né? Um dos estudos é [a]- os adesivos que são colocados sobre a pele pra que0 essa insulina seja enviada [ao]- ao organismo. [São]-0 eles são automonitoráveis, o texto fala dos benefícios, né? e0 em seguida0 também é colocado0 que além [da]-0 [da]-0 dos adesivos, que existe o desenvolvimento desses chips, mas, contudo, esses chips0 (hes) também ainda estão em desenvolvimento, tal qual os adesivos, (hes) porque [ainda não foi] (hes) estudado0 o]-0 ainda está em desenvolvimento0 a, [como é]- como é dito aqui, a voltagem precisa0 desses chips pra serem0 colocados [no]-0 no corpo, porque eles podem destruir [a]- a célula [ou]-0 [ou]-0 ou fechá-la, né? Esses chips, no caso, ainda estão em desenvolvimento (hes). Esses chips, na verdade, (hes) [eles estão]-0 eles0 estão relacionados com os adesivos, só que são partículas [que]-0 que vão dentro do adesivo, digamos, assim, imagino eu, pelas minhas <rela-> (hes) inferências, né? Então, são estudos que estão desenvolvendo em relação a esses0 adesivos, nos quais tem [esses]-0 esses mecanismos aí pra que a droga possa ser passada [pra]-0 pra dentro do sangue [pra quem deseja ou precisa]-0 pra quem precisa receber doses de insulina no sangue. É isso. Se eu entendi o texto, é isso.

Subject 12 (October 05)

Text 1 – L1

Eu termino o parágrafo e normalmente eu volto pra ler quando tem algumas palavras (hes) que não são comuns no meu vocabulário cotidiano, como, por exemplo, <gave-> gravitacionais, (hes) hidrogênio, partículas de gás. (hes) Está falando a respeito de um0 (hes) astrônomo que comenta como que as estrelas são formadas. Então, que elas seriam formadas a partir [de]-0 de partículas de gás, né? [que <ju->]- que estão soltas no universo e que vão se juntando aos poucos (hes) através da força gravitacional. No segundo parágrafo já fala0 (hes) da transformação0 que ocorre nos tipos de gases, no hidrogênio pro hélio0 [e]- e como isso gera calor e luz e também fala de uma estrela jovem. O terceiro parágrafo fala sobre a idade0 das estrelas, né? (hes) e fala também sobre o Sol como sendo uma estrela [na sua]- (hes) na metade, vamos dizer assim, da sua vida. O terceiro parágrafo, por ser um pouco mais longo, eu tenho tendência de querer ler o começo de novo, porque parece que eu já perdi a informação. É que ele está falando0

que uma vez que [o <pala->]- [o parágrafo anterior ia comentando]-0 o anterior não, o  
 : : 6  
 segundo parágrafo ia comentando de como o hidrogênio se transforma em hélio pra  
 :  
 formar a estrela. Então, nesse parágrafo já fala de que uma vez que todo o hidrogênio  
 : 5  
 se esgota, [a]- a vida da estrela...0 (hes) A estrela começa [a]- a, vamos dizer assim,  
 : 6 : : 6 : :  
 morrer, né? Então, acaba [se <expan->]- começa a expandir em tamanho0 e perder o  
 5 : : : 5 :  
 calor.  
 6  
 O último parágrafo, (hes) ele0 fala0 a respeito de0 o que que pode acontecer a  
 : : : 5 : 6 :6 : : :  
 uma estrela, dependendo0 (hes) [da]- (hes) quando o hidrogênio [se]- se esgota (hes)  
 : 6 : 6 : : : :  
 quase que totalmente e também, dependendo0 da massa que a estrela possui. Então,  
 : : 5 : : 5  
 quanto maior a massa, (hes) maior, vamos dizer assim, o estrago, maior [a]- [a]- [a]-  
 : 6 : : : : : :  
 o...0 de maior dimensão é o que pode acontecer com a estrela e com o que está a sua  
 : 6 : : : : : :  
 volta, né? Então, uma estrela menor, ela simplesmente desaparece, vamos dizer assim,  
 : : : : : : 5  
 e se for uma estrela muito grande ela pode virar um buraco negro. Acho que é isso.  
 : : 6 6  
 Bom, acho que, do texto como um todo, a idéia principal, ele fala das estrelas de uma  
 : : : : : :  
 forma geral. (hes) O que que são as estrelas [e]- e como elas são constituídas0 e dá um  
 : 6 : : : 6 : : :  
 histórico das estrelas [do]- do começo [da sua]- da sua criação [até]- até a sua suposta  
 : : : : : :  
 morte.

## Text 2 – L2

O primeiro parágrafo está falando a respeito0 de que [no]- no presente é muito comum  
 : : : 6 : : : : :  
 (hes) <in-> injeção, remédios, enfim, né? (hes) mas que no futuro isso [pode]-0 [pode  
 : : : 5 : 5  
 deixar de existir]- pode ser algo não mais utilizado.  
 6  
 Já no segundo parágrafo fala0 (hes) de como [algum]- [alguns remédios]- algumas  
 : : : 6 : : : : : : :  
 drogas0 já podem ser (hes) absorvidas pela pele, né? mas que outros, como a insulina,  
 : 5 : : : 6 : : :  
 por exemplo, são muito grandes0 pra isto.  
 6 6  
 O terceiro parágrafo fala...0 penso que seja uma pessoa, Prausnitz, é a mesma pessoa do  
 : 6 : 5 6 :  
 segundo parágrafo, que desenvolveu (hes) agulhas microscópicas que serviriam0 (hes)  
 : 6 : : : : : : 5  
 [pra <i-> <inse-> inserir]- pra injetar0 [a]- os remédios (hes) pela pele. O terceiro  
 : : : : 6 : : : : : :  
 parágrafo [eu]- eu li duas vezes [a <me->]- a primeira sentença e agora estou lendo  
 : : 6 : : : : : : :  
 pela terceira vez. (hes) Está falando [como]- (hes) como esses adesivos fizeram com que  
 : 6 : : : : : : :  
 a taxa de glicose0 diminuísse [em]- em0 (hes) ratos de <labora-> (hes) é ratazanas, né?  
 : 6 : : : 6 : : : :  
 [E]- e também que o fator0 (hes) [que]- que não existe dor nesse método, segundo  
 : : : 6 : : : : : : :  
 alguns humanos que serviram de voluntários para testes.  
 6  
 O próximo parágrafo, novamente a primeira sentença eu estou lendo de novo. (hes)  
 : 6

Algumas palavras (hes) me soam estranhas como “zapping”<sup>0</sup> (hes) e mesmo outras  
palavras, apesar de serem <pa-> palavras (hes) semelhantes com o português, são  
palavras que normalmente não estão<sup>0</sup> no meu vocabulário cotidiano [e]- e dificultam  
como, por exemplo, “electrode”, (hes) “molecules”. (hes) Parece que esse parágrafo está  
falando de mais ou menos como funcionaria esse adesivo num humano, né? (hes) De  
que<sup>0</sup> (hes) ele funcionaria<sup>0</sup> controlado por um eletrodos<sup>0</sup> e eles seriam  
automaticamente repelidos ou<sup>0</sup> (hes) da pele, quando não necessários, e [eles]- eles  
<au-> automaticamente <se-> ou<sup>0</sup> seriam utilizados quando necessário. Por um outro  
lado (hes) fala também [de]-<sup>0</sup> [da <o->]- da possibilidade de que a pessoa que está  
usando [o]-<sup>0</sup> o adesivo, enfim, que ele pudesse se autoadministrar [a]- a droga através  
de<sup>0</sup> (hes) um pequeno botão. E que no futuro, então, [essa]- [essa]- essa possibilidade  
da automaticidade seria uma coisa mais pro futuro.

O próximo parágrafo (hes) fala sobre [Roger]- (hes) Robert Langer, (hes) um cientista,  
talvez, do MIT, que desenvolveu<sup>0</sup> uma forma<sup>0</sup> de injetar [a]-<sup>0</sup> [a]-<sup>0</sup> o chip [de]- de  
polímero, deve ser a palavra em português, (hes) que coloca o remédio diretamente  
dentro do corpo, próximo [do]- do tecido [do]- do local (hes) [atingido]- a ser tratado.

O último parágrafo fala<sup>0</sup> (hes) [de um <pesquisa->]- de um pesquisador que<sup>0</sup> está  
desenvolvendo um método pra, (hes) através de voltagem [de]- de aplicações [de]- de<sup>0</sup>  
eletricidade<sup>0</sup> pra que se abra os poros da célula, mas que isso ainda é algo<sup>0</sup> a ser mais  
pesquisado. A idéia como um todo...<sup>0</sup> (hes) Esse está mais difícil pra mim, não sei se é  
porque só em inglês<sup>0</sup> ou também por causa desses<sup>0</sup> termos<sup>0</sup> médicos e tudo mais, mas<sup>0</sup>  
(hes) parece que eles estão falando, de uma forma geral, de possibilidades futuras<sup>0</sup>  
para<sup>0</sup> (hes) tratamento de doença através [de]-<sup>0</sup> [de]- com remédios (hes) que não<sup>0</sup> o  
habitual hoje em dia [de pílulas]- de se ingerir pílulas ou injeções, mas sim de novas  
possibilidades que poderiam ser utilizadas. Acho que é isso.

Subject 13 (October 05)

Text 1 – L1

Como será que se pronuncia esse sobrenome desse astrônomo? Deve ser polonês, hum.  
É [a]- a idéia principal desse primeiro parágrafo é, em linhas bem simples, a formação<sup>0</sup>  
de uma estrela através [de]-<sup>0</sup> de forças gravitacionais de átomos, principalmente de  
hidrogênio que atraem, formam uma nuvem e se transformam numa estrela.  
Aí, a idéia do segundo parágrafo é aprofundar um pouco a idéia principal do primeiro,  
(hes) como<sup>0</sup> [o]-<sup>0</sup> as partículas de hidrogênio se transformam [em]-<sup>0</sup> em uma estrela.

6 : 6 6 5  
 Que primeiro, na verdade, há uma fusão que transforma o hidrogênio em hélio [e  
 : : 6  
 gera]-0 e dessa fusão além da transformação do hidrogênio em hélio, gera também  
 : : 5 6  
 [calor e luz]-0 uma grande quantidade de calor e luz. E dá um exemplo de estrela jovem.  
 : 6 6 : 6  
 Opa! Tem uma frase mal feita aqui. (inint) existe um aposto explicativo, mas não tem  
 6 :  
 continuação. “Durante cerca de 90% da sua existência – o brilho e o tamanho variam  
 pouco, ocorrendo apenas uma ligeira contração.” Ponto. Está faltando coisa nessa frase.  
 6  
 (sussurro) (hes) A idéia desse (hes) parágrafo é que0 tanto o brilho quanto o tamanho  
 : : 6  
 das estrelas variam pouco durante sua existência, apesar de que [essa primeira frase  
 : 6 :  
 aqui]- esse tópico frasal está0 mal estruturado. Esse quarto parágrafo trata  
 6 : 6  
 principalmente da velhice, digamos, assim, [da]- de uma estrela, onde0 (hes) já quase  
 : 6 6  
 não existe mais hidrogênio no núcleo, [já está]- existe [a <clo->]- a transformação quase  
 total do núcleo em hélio0 e ao invés [de]- de contrair-se, a estrela começa a se  
 : 6 :  
 expandir0 e o calor se dilui, ou seja, ela cresce e esfria. (hes) E aí passa a (inint).  
 : 6 : : 6  
 (hes) E esse parágrafo final fala0 de outras <deno->, continuando a questão da velhice  
 : : 6  
 das estrelas, outras denominações que elas podem0 tomar, dependendo do tamanho [e]-  
 : 6 : :  
 e0 (hes) massa. (hes) [Que ela pode se]- ela pode se transformar num pulsar0 ou num  
 :6 : :6 : : 6  
 buraco negro0 ou ainda numa supernova, dependendo de0 como é a massa.  
 : 6 : 6 : 6  
 É, a idéia geral do texto, basicamente, é0 falar da vida útil de uma estrela, né? Desde o  
 6 : 5  
 nascimento0 até a, digamos, assim, a morte dela. Quais as transformações químicas e  
 : 6 :5  
 tem <denomina-> <deno-> denominações que ela0 sofre através de sua existência. É,  
 5 : 6 : : 6  
 acho que é isso. Desse texto, acho que é isso.  
 5

## Text 2 – L2

Esse primeiro parágrafo já nos diz [que]-0 (hes) que os métodos [de]-0 [de]-0, me fugiu  
 : 6 : 6 : 6  
 a palavra agora, (“vinculação”) (sussurros) Ah, enfim, [que a gente vai tomar  
 : 6 :  
 remédio]-0 que [a gente]- a gente é acostumado a tomar comprimidos e ou injeções, né?  
 5 : :  
 mas que no futuro isso vai ser coisa do passado. Bom, no futuro tudo vai ser coisa do  
 :  
 passado, mas, enfim. (hes) Algumas drogas...0  
 6 6  
 Segundo parágrafo já fala que existem remédios que podem ser administrados através  
 da pele, [via <subcuta->]- via cutânea, como nicotina e hormônios. Mas que [a]- [a]- a  
 : 6 : 6 : :  
 insulina já não0 poderia ser administrada por essa via, porque as moléculas são grandes  
 6 : 5  
 demais, né? e não ultrapassam os poros e aí tem0 um cientista que confirma isso, Mark  
 : 6 : 6 : 6  
 Prausnitz. Que foi [o]- [esse]- [esse cara]-, no terceiro parágrafo, esse cara desenvolveu

: :6  
 [um]-0 [um patch]- um adesivo de quatrocentos (inint) agulhas microscópicas, né? e é  
 6 : : 6  
 por elas que as drogas atravessam. Ah, como o caso [o]-0 a insulina. E esse método é  
 : : 6 6 6  
 indolor0 e funciona, pelo menos, com ratos. Essa é a idéia do0 quarto parágrafo.  
 : 6 5 6 : 6 5 :6  
 O quinto parágrafo fala [da]- [da]- [da <fu->]- [da]-0 das características físicas [do]- de  
 6 :  
 como é administrado isso através de...0 fala [que]-0 (hes) que dentro desse patch existe  
 6 : 5  
 [um <ele->]- um eletrodo [que]- que empurra as moléculas, forçando elas a entrarem na  
 : : 6  
 pele0 e também existem0 minúsculas lâminas de titânio que fazem0 furos  
 6 : 6 : : 5  
 microscópicos na pele. Então, fala [da]- mais de como fisicamente ocorre o0 fenômeno  
 : 6 6  
 de absorção.  
 5 6  
 Já um outro cientista, do MIT, desenvolveu0 chip0 que faz o mesmo serviço. (sussurro).  
 : 6 : 6 : 6 6

(hes) E o último parágrafo fala0 [do uso]- do possível uso da eletricidade pra abrir as  
 6  
 membranas celulares, mas que até então, era0 impossível0 se medir a quantidade exata,  
 : 6 5 : : 6 : :  
 já que0 [tem]- tem que ser uma quantidade certa [pra não]- pra não destruir nem0 causar  
 : : 5  
 o0 fechamento das membranas (inint) o cientista (inint). É, basicamente a idéia <ce->  
 6 : 6 6 :  
 central0 do texto todo, <a->0 <a-> ao contrário do que0 poderia parecer pelo primeiro  
 6 : 6 : 5  
 parágrafo, não é, simplesmente, uma coisa que...0 É, [eu]- eu esperaria mais. A  
 6 : : : 5  
 princípio, eu poderia prever que o texto falaria [de outras maneiras]- de novas maneiras  
 : :  
 de administração [de]- de medicamentos, mas ele se baseia0 principalmente na questão  
 : 5  
 dos patches, deixando outras0 de fora, né? Acho que é isso.  
 : 6 : 6 : 6 5

Subject 14 (October 06)

Text 1 – L1

Bem, no final do primeiro <pa-> parágrafo eles estão falando das0 (hes) [do gás]- das  
 : : 6 :  
 partículas de gás, principalmente, (hes) o hidrogênio, ficam suspensas no ar0 por causa  
 : : 5 6  
 das forças gravitacionais.  
 6

O segundo parágrafo está falando0 dessa0 produção de calor e luz, por causa da  
 : : 6 : :5 :  
 transformação do hidrogênio em hélio. E [o]-0 esse nome, Plêiades, é um nome0 novo  
 : 6 : 6 : : : :5  
 pra mim, tem haver com astronomia. Eu não tinha visto isso antes, tinha ouvido falar,  
 : 5 :6 : :  
 mas não entendia direito o que que era Plêiade.  
 : : 6

O terceiro parágrafo está falando, então, das estrelas, um caso é o Sol, e do tamanho  
 : : : : 6 : :  
 delas0 e porque que ela está em fase intermediária, como é que a gente sabe que está em  
 : 6 : : : : 6  
 fase intermediária: por causa [<d->] do seu]-0 [da]- da contrção0 dessa estrela, agente  
 : 5 : 6 :  
 consegue detectar a idade dela.

Bom, [o terceiro parágrafo]- no quarto parágrafo, desculpe, está falando sobre, então, a  
 vida da estrela, como é que se dá, já que todo o hidrogênio se converteu em hélio.  
 Então, ela vai expandir, (hes) há um aquecimento grande e assim é como vai ser o sol  
 daqui a quatro bilhões de anos. (hes) Uma informação que eu também desconhecia, é  
 nova pra mim.  
 Bom, e no último parágrafo está se falando do final da vida de uma estrela, né? Como  
 ela pode, dependendo do tamanho, se transformar num buraco negro, por causa da sua  
 massa. (hes) Na condensação final fica uma massa bem maior e também ela pode  
 gerar uma supernova que seria o brilho, a estrela que vai se perder [até se <su->]- até  
 .  
 Acho que [ele está]- o texto todo está falando de toda a vida das estrelas. Como é  
 que começa a vida de uma estrela e como é que termina uma vida do estrela. Ele está  
 falando sobre (hes) como se dá a vida [de uma]- [de um]- de uma estrela.

## Text 2 – L2

O primeiro parágrafo está falando do uso [de <me->]- de medicamentos, né? que [nós  
 fazemos]- nós utilizamos, é grande esse uso. E no futuro isso pode não mais acontecer.  
 Bom, eu vou voltar ali pra o segundo parágrafo. Eu me perdi e vou voltar a ler. Bom, o  
 segundo parágrafo está falando das drogas (hes) [como]- (hes) como nicotina e  
 hormônios que também já estão [na nossa]-0 na nossa pele [e]-0 e que moléculas de  
 <insu-> insulina são bem grandes e que a gente pode, na verdade, (hes) esfregar [essa]-  
 [essa]-0 essas moléculas de <insu-> insulina na pele, né? e elas não [vão se]- [vão  
 terminar]- elas não vão passar. (hes) Isso de acordo com o engenheiro químico Mark.  
 (hes) O próximo parágrafo está falando que [esse <cien->]- (hes) esse engenheiro  
 químico, o Prausnitz, desenvolveu [um]-0 [uma forma, né?]- uma agulha  
 microscópica, né? Pra poder transportar a drogas através da pele.  
 Vou voltar ali a0 esse parágrafo, que é o quarto parágrafo. Não conheço essa palavra  
 [“ouch”]- “ouch factor”. Não me lembro de tê-la visto. Eu vou ter que procurar [num]-  
 no dicionário, provavelmente. Bom, esse quarto parágrafo, então, está falando do uso  
 de adesivos, né? em ratos. Mostraram, né? a diminuição de glicose no sangue e que  
 esse teste [pode]-0 foi demonstrado também não ter dor nenhuma em voluntários  
 humanos. Agora esse “ouch factor” eu não sei que tipo de fator é esse.  
 Bom, eu vou voltar ali, então, um, dois, três, quatro o quinto parágrafo, pra entender  
 melhor. Bom, (hes) esse parágrafo está falando [de]- de alguns pesquisadores, na

6 5 : 5 : :6  
 Califórnia, que encontraram uma maneira de0 quebrar essas moléculas, né? ou empurrar  
 : :6 : :5  
 essas moléculas0 [pra pele]-0 pra dentro da pele. Na verdade, (hes) uma forma de0  
 5 : 6 : 6 6 :5  
 aplicação [de]0 de drogas, um exemplo seria a insulina. No futuro, então, poderia-se  
 : 5 5 6  
 aplicar insulina, automaticamente, (hes) através de um adesivo.  
 : : 6 : : : 6  
 Bom, [no]- no parágrafo seguinte, um, dois, três, quatro, cinco, no sexto parágrafo, uma  
 : : : : : :  
 frase falando de outra pessoa, Robert Langer, que desenvolveu0 um tipo [de]- de chip0  
 : 5 :6 : 5  
 que0 poderia ser implantado e dispensaria0 (hes) não, [que]- que jogaria, então, (hes) [a  
 :6 : : : 6 6 :  
 droga]- que colocaria a droga no corpo0 <po-> perto do tecido alvo, né? Então, na  
 : : 6 : : 6 : :  
 verdade, seria uma outra forma de, na verdade, já implantada e não0 com0 [um]-0 um  
 : :5 : 5 6  
 adesivo.  
 : 6  
 “Jolt”, eu não conheço essa palavra. “Jolt of <ec-> electricity”. Tem que ser alguma  
 :  
 coisa0 como carga de eletricidade ou um tipo de0 instrumento. É ele deve ser um  
 5 : 5 6  
 instrumento, porque eles estão falando que não conhecem ainda0 a voltagem exata0 pra  
 6 : : 5  
 se fazer isso, pra0 abrir as membranas. Ou uma rajada de eletricidade, algo assim. Bom,  
 :5 6 : : 6  
 vou voltar a ler o último parágrafo, que ele é maior, pra entender melhor o que eles  
 :  
 estão querendo dizer. Bom, então eles falam que os pesquisadores, eles0 sabem que essa  
 6 : 6 : :6  
 carga de eletricidade poderia abrir [uma]- a <me-> membrana da célula, mas eles não  
 :  
 sabem, precisamente, a voltagem. (hes) De repente, muito trabalho pode ser (“feito”  
 : 6 :  
 pra se destruir a célula [e <mui->]- em muito pouco tempo a célula0 se fecharia. (hes)  
 : : 6 6  
 Existe uma outra pessoa, Boris Rubinsky, na Universidade da Califórnia, que criou um  
 : : : 5 :  
 tipo de chip0 biônico. É feito de silicônio0 (hes) e com camadas, na verdade, de células  
 : 5 : 6 : : 6 :  
 vivas0 no centro do seu circuito0 e que permitiria a esses pesquisadores medirem a  
 : 6 6  
 voltagem necessária para abrir os poros da célula. Mas, na verdade, esse método ainda  
 6  
 está longe de ser alcançado. Pelo menos [há]- há uma chave0 na engenharia pra se  
 : : 6 : 5 :  
 abrir0 a célula, disse0 Rubinsky. Então, na verdade, eles estão falando uma forma0 de  
 6 5 : :5 6 5  
 aplicar drogas através0 não só de adesivos, mas também de algum chip. A idéia  
 : : 5 : 5  
 principal do texto, de algum chip que eles possam colocar0 na pessoa na necessidade de  
 6  
 aplicar uma droga, continuamente, e não precisando-se mais de injeções ou agulhas. Eu  
 : 6 : : : 5  
 acho que0 esse é o0 que o texto está falando sobre o desenvolvimento de uma aplicação  
 5 :6  
 através de um chip implantado0 no corpo humano.  
 : 5 6

Subject 15 (October 08)

Text 1 – L1

Bom, eu tenho que ler mais uma vez esse primeiro parágrafo, pra tentar visualizar [o que que]-0 exatamente o que que ele...0 As partículas vão [se <co->]- se concentrando0 devido às forças gravitacionais que puxam umas contra as outras. Então, seria a formação0 a idéia principal. A formação de nuvens de gás. Isso, a formação de nuvens de gás. Isso de acordo com Roberto Boczko. Hélio, que gás é esse? O hidrogênio transformado em hélio. Espera aí, (hes) essa formação de nuvens de gás0 se condensam na estrela. Minha preocupação aqui é entender0 o conteúdo.

A idéia do segundo parágrafo pode ser0 o procedimento0 de transformação0 da nuvem de gás em estrela. E aí é o exemplo0 (hes) o <procemento-> procedimento de transformação0 da nuvem de gás0 [em<es->]- em estrela.

<Seg-> terceiro parágrafo0 mostra que [essa formação]-0 a formação0 das estrelas. Tem [uma variedade]- [uma variação mínima]-0 pouca variação. A chuva me chamou a atenção agora, eu me desviei um pouco do texto.

O quarto parágrafo faz [uma]-0 uma previsão0 de como0 o Sol ficará daqui quatro0 <milho-> bilhões e meio de anos. Ele0 coloca0 (hes) na transformação0 [da<es->]- da estrela após a (inint) Devido à perda0 ou à transformação0 do hidrogênio0 em hélio0 e as conseqüências disso é o aquecimento0 muito grande no corpo celeste. [“Astro moribundo”]-0 astro0 decadente. (hes) Comecei a pensar que seria sobre (hes) o efeito estufa, mas0 estou confusa, não sei. (“De novo esse”) quinto parágrafo. Acho que não é, vou voltar ao início pra procurar entender0 melhor (“desde”) o primeiro parágrafo.

Então, a formação de uma estrela, primeiro parágrafo. Uma fusão. Eu estou tentando visualizar. Fusão, reação atômica0 transforma hidrogênio em hélio. Gera0 calor e luz. (hes) Importante aqui, o Sol se encontra na fase intermediária0 dessa transformação0 de hidrogênio em hélio. Primeiro período, são dois períodos dessa transformação. Primeiro período: todo hidrogênio se converteu em hélio, aí começa0 o [aquecimento]-0 aquecimento muito grande. Um outro período0 é o inverso. Ao invés do aquecimento, essa fusão do...0 mas não quer dizer [que vai]-0 que vai0 diminuir0 o calor. O segundo momento: sem mais hidrogênio0 [aí não tem]- portanto não tem mais a fusão dos gases, hidrogênio e hélio. Diminui, então, [essa]-0 essa fusão. (hes) No primeiro momento, então, tem [uma]-0 uma quantidade de calor e luz gerados0 é muito grande, então, é muita luminosidade. Já no segundo momento, a falta de hidrogênio, não tem mais [a]- a fusão dos gases0 [esse]-0 essa estrela0 se torna0 moribunda, como diz aqui, decadente0



e aí0 (hes) o efeito é inverso. Vai diminuindo a luminosidade até0 .  
 Voltando ao quarto parágrafo, tentar achar a idéia principal. Acho que seria0 a  
 [transformação]-0 transformação [da]- [da]- [da]- [da]- da estrela através da fusão  
 [dos]-0 dos gases0 [e o]- e a geração [de]-0 de aquecimento no corpo celeste.  
 E [no segundo]-0 [no]- no quinto parágrafo, então, a0 [não há mais fusão dos  
 gases]-0 não há mais a fusão dos gases, (hes) prevalece0 uma nova massa de gás  
 (sussurros)0 Eu acho que é essa a idéia principal0 do texto é [a transformação de uma  
 estrela]- a formação de uma estrela0 através dos gases que estão0 soltos no universo.  
 (hes) as dificuldades de entender esse texto, extrair a idéia principal, [são]- eu acho que  
 são devidos a minha0 falta de leitura sobre esse assunto0 e mesmo0 conhecimento  
 sobre o assunto. Quer dizer, o texto [não é]- não me é familiar. Eu tentei0 visualizar0  
 [essas <situ->- a situação que o texto0 traz, [mas o]- mas0 encontrei dificuldade  
 justamente por não conhecer0 sobre o assunto mais profundamente.

## Text 2 – L2

O texto vai falar sobre0 pílulas e agulhas0 que podem ser coisa do passado. O que será  
 que vem [pela]-0 pela frente, então? A idéia aqui é que0 o fim [das]-0 [da]- [da]- do uso  
 de pílulas e agulhas, enfim, do uso [de]- de pílulas0 e agulhas0 para0 combater [uma]-  
 a doença ou coisa assim. A primeira frase já explica pelo uso [da]-0 [de]-0 através da  
 pele, não é mais necessário a ingestão de pílulas e agulhas.  
 Daí no segundo parágrafo fala sobre [essa]-0 esse uso de medicamentos através da pele0  
 [e]-0 e ele cita exemplos como0 hormônios, moléculas de insulina, huhum! E o uso da  
 acupuntura como é que fica? (sussurros)  
 Terceiro parágrafo. O desenvolvimento de um pacote. (hes) Quatrocentos tipos0 de  
 agulhas microscópicas0 para ingerir0 medicamentos através da pele. A palavra “patch”0  
 estou tentando descobrir através do contexto: “patch-wearing rats”. Ah! Através de  
 experiências com animais0 (inint) com animais. Esse método é0 indolor.  
 Vou voltar aqui0 ao início do parágrafo. “Charged drug molecules with a matched  
 charge from an electrode repels the molecules, pushing them into the skin.” (hes) No  
 parágrafo <ante-> anterior ele...0 o (“texto”)0 fala das experiências com animais já.  
 [Que os]- está dizendo que os [níveis [de <gli->]-0 de0 glicose no sangue]-0 dos níveis  
 de glicose no sangue, no primeiro parágrafo seguinte. Aqui fala [da]-0 a insulina0 e  
 como que0 a insulina será0 [retraída0 pela pele]-0 recebida pela pele. (sussurros)

[Esse parágrafo]- essas duas frases aqui: “Robert Langer0 desenvolveu0 [um  
implante]-0 um chip0 que dispensa0 as drogas0 dentro do corpo.  
(hes) Último parágrafo. “A jolt of eletricity”. (hes) Através [de]-0 (“diz”) de laser,  
talvez. Último parágrafo. Pode (“abrir-se”)0 membranas nas células, [que não]-0 mas  
ainda não há uma medida precisa0 pra saber qual a voltagem que deve ser usada  
[nessa]- nessa tarefa. Muito destruirá a célula, pouco0 a célula ficará fechada. Aí,  
então, o novo cientista, Boris Rubinsky, criou0 um chip biônico, construído [de <si->]-0  
de silicone, com uma célula viva no centro do seu circuito, que permite aos  
pesquisadores0 medir precisamente a voltagem0 precisa para abrir0 [os]- [os]- os poros.  
Aí ele acrescenta que agora tem0 [um]-0 um instrumento0 pra trabalhar as0 biologia de  
uma célula. Estou tentando traduzir [pra]-0 pra entender melhor0 o último parágrafo.  
Dificuldade com o vocabulário0 (sussurros) e também com o conteúdo do texto. Ah,  
uma correção no segundo parágrafo. Aqui diz que você pode0 esfregar insulina na sua  
pele todo dia e ela não entrará. (hes)  
O texto trata do fim [das]-0 do uso de agulhas e pílulas para0 a cura de0 doenças, dá  
alguns exemplos0 e depois0 [dá]- [dá]-0 dá alguns exemplos de como isso pode ser feito  
[através da pele]- da ingestão de medicamentos através da pele0 e, por último,  
pesquisadores0 (hes) como0 Boris Rubinsky, da Califórnia, [descobrem]- criam um chip  
biônico0 e0 capaz de abrir as células e ingerir0 o medicamento necessário.

Subject 16 (October 09)

Text 1 – L1

Então, aqui0 (hes) o assunto é maio ou menos o mesmo, mas é um assunto que eu0  
desconheço, eu não sei muito sobre isso, mas de acordo com o astrônomo0 da  
Universidade de São Paulo, da USP, (hes) existem0 partículas [de]- de gás soltas no  
universo0 [e]-0 e que uma0 vai puxando a outra [e <fo->]- [e <fo->]- e formando uma  
nuvem0 de gás gigantesca que se transforma em estrela.  
(hes) E0 existe uma fusão, né? (hes) Que é uma reação atômica que acontece, que  
transforma0 o hidrogênio em hélio0 e que gera uma grande quantidade de calor e luz0  
no nosso planeta.  
(hes) [Eu]- eu já estou no terceiro parágrafo, mas eu esqueci de citar no segundo [que]-0  
(hes) que um dos0 exemplos dessa0 fusão é [que]- que gera0 calor e luz, seria um  
exemplo de uma estrela jovem0 (hes) que tem na via Láctea. E, voltando ao terceiro  
parágrafo, durante0 (hes) por volta de noventa por cento da existência dessa0 estrela,



: 5                    6 : 6  
 E0 que algumas drogas como a nicotina, né? que contém no cigarro0 e alguns  
 : 5                    :                    : 5                    : 6 :  
 hormônios, (hes) elas [são]-0 (hes) são absorvidas pela pele. Então, (hes) as pessoas  
 : 6                    : 6                    : 5                    : 6  
 [que]-0 (hes) [que]- [que]-0 que usam esse tipo de droga, elas têm uma dependência0  
 : 6                    : 6                    :                    :                    : 6  
 ainda maior. E elas podem ser0 (hes) testadas também0 pela pele da pessoa0 que usa  
 : : 6                    : 6                    :                    6                    :                    6  
 esse tipo de droga.  
 : 6  
 (hes) Tem [um]-0 um estudioso0 (hes) desenvolveu0 [um]-0 um microscópio [pra]-0  
 : 5                    : 6                    : 6 : 5                    : 6  
 (hes) pra não sei se medir ou pra0 (hes) testar a0 (hes) quantidade ou tipo de droga que  
 :                    : 6                    : 6                    :                    :  
 tem no organismo da pessoa através da pele. Talvez, até pra0 testar a quantidade [que]-0  
 :                    : 6                    : 6                    :                    : 6  
 que ela tem.  
 : 6  
 (hes) E alguns testes foram feitos [em]- em animais, quase sempre eles são feitos [em  
 : 6                    :                    :  
 animais]- [em]- especialmente em ratos0 antes de serem feitos0 em seres humanos0  
 : 5                    6 :                    : 6  
 [e]- 0 e eles mostram um nível de glicose no sangue. Seria um método [pra]-0 que eles  
 : 6                    :                    :                    : 6                    : 6 :  
 usam pra ver0 o nível [de]-0 de glicose no sangue. E depois continua0 (hes) e0 é como  
 : 6                    : 6 :                    : 6                    : 6 : 6 : 6  
 eu falei antes, é um assunto que0 eu não domino, mas0 tudo bem.  
 :                    : 6                    : : 5                    6  
 (hes) Estão falando0 (hes) que de acordo com alguns pesquisadores, né? (hes) que  
 : 6                    : 6 6  
 [algumas drogas são utilizadas pra]-0 algumas são utilizadas pra, pelo que eu entendi,  
 :                    :                    : 6                    :                    : 6  
 algumas com algum objetivo, assim, pra0 cura de alguma coisa e algumas pra0 medir a  
 :                    : 5                    6 :                    : 6 : :  
 quantidade [de]-0 de <gli-> o nível de glicose0 que a pessoa precisa, por exemplo,  
 : 6                    :                    : 6 :  
 pessoas que precisam tomar a insulina, né? porque são diabéticas, talvez, ou0 não. (hes)  
 6 6                    : :                    : 6 : 6  
 Então, elas precisam ser aplicadas através da pele, né? (inint) as moéculas0 na pele. E  
 : 6                    : 6 6                    5                    6  
 que, talvez, no futuro0 esse mecanismo de0 essa aplicação será0 bem mais fácil de ser  
 :                    : 5                    : 6                    : 6 :  
 aplicada, terá formas automáticas e mais fáceis.  
 : 6                    :                    : 6  
 (hes) E daí tem [a]-0 (hes) uma outra pessoa [da]- da MIT, [que]-0 (hes) que aqui está  
 : : 6                    : :                    6 : 6  
 mostrando [que]-0 [que <desen->]- que [a]- [a]- [a tecnologia]- a tecnologia vem se  
 : 5                    : : :  
 desenvolvendo0 bastante e que daqui uns tempos0 (hes) as pessoas não vão mais  
 : 6                    : :                    6  
 precisar ingerir drogas pra tomar, através de pílulas ou injeções, mas que0 elas vão  
 :                    : 6                    : : :                    : 6  
 poder0 (hes) usar [um]-0 [um]-0 algum adesivo0 ou [algum]-0 algum tipo [de]-0 (hes)  
 : 6                    : : 5 : 6                    : : 5                    : 6 :                    : 6  
 de chip0 ou alguma coisa assim ou...0 (hes) de uma forma mais fácil, né? buscando a  
 : 5                    : 6                    : 6 6  
 cura0 que elas precisam.  
 : 5                    6  
 Bem, no último parágrafo ainda continua falando de0 (hes) de pesquisadores [que  
 :                    :                    : : 6                    :  
 vêm]-0 (hes) que vêm [pesquisando]-0 (hes) pesquisando...0 (hes) não sei o que seria  
 6                    : : 6                    : : 6                    : :  
 “jolt”0 “a jolt of electricity”0 (hes) provavelmente, (hes) uma maneira0 de conseguir  
 : 5                    6                    : 6                    6 :  
 abrir as membranas [da]- das células através [de]-0 da algum aparelho de eletricidade,  
 :                    :                    :                    : 6 :                    :                    :

alguma coisa0 pra poder medir0 a voltagem precisa0 pra poder fazer, (hes) através desse  
 : 6 : : :6 6 :6  
 aparelho, pra poder0 (hes) descobrir alguma coisa através [da]- [das células]- das  
 : : 6 : : : :  
 membranas das células. (hes) Que na verdade muitos acabam destruindo a célula0 e0  
 : 6 : : : 6 :6  
 que <a-> <a-> agora [no momento]-0 no presente, (hes) um pesquisador0 da  
 : : 5 : 6 5  
 Universidade da Califórnia criou0 [um chip]- um "bionic chip"0 que [é]- é  
 : 6 :: 6 : :  
 [construído]- feito [de]-0 de silicone, [que]- que é... acaba permitindo que esses0  
 : 5 : : : 5  
 pesquisadores possam medir (hes) com precisão, né? a voltagem que é necessária para  
 : 6 : : 6 : :  
 abrir [os]- os poros0 da célula. Só que, (hes) agora, estava pensando, não sei, (hes) se  
 : 5 6 : 6  
 seria pra0 detectar alguma coisa0 ou, talvez, [pra]-0 (hes) pra fazer [algum]- [alguma  
 :6 : : : 6:6 : : 6 :  
 dessas]-0 algum desses medicamentos0 [que são absorvidos]- que são0 (hes) colocados  
 5 : : 6 : :6  
 na pele0 e são absorvidos por ela, né? provavelmente, acho que essa é a segunda opção.  
 : 6 : : : 6 : 6  
 É que <po-> por enquanto, (hes) eles vão fazendo0 esse procedimento na medida do  
 : : 6 : 6 :  
 possível, mas que ainda, (hes) eles continuam [estudando]- pesquisando [pra]-0 até  
 : 6 : : : 6 : : : 6 :  
 [que]- que consigam um método melhor, mas que no pondo de vista deles ainda está um  
 : : 6 ::  
 pouco longe, mas não impossível de se descobrir. Que, por enquanto, eles [vão]-0 (hes)  
 : 6 : : 5  
 vão usando0 (hes) o que eles têm0 no momento e tentando adequar da melhor forma  
 : :6 : 5 : :  
 possível.

Subject 17 (October 10)

Text 1 – L1

(hes) A idéia principal é [do]-0 do primeiro parágrafo0 é, basicamente, explicando como  
 : 6 : : 6 :  
 se forma uma estrela. Que ela se forma a partir das partículas de gás que, geralmente,  
 6  
 são hidrogênio, que se concentram devido às forças gravitacionais.  
 : 5 6  
 E essa estrela ainda é formada0 a partir de uma fusão, segundo parágrafo, uma reação  
 : : : :5 6  
 atômica que transforma hidrogênio em hélio. E um exemplo disso seria a estrela jovem0  
 6 : : : 6  
 Plêiades, na via Láctea.  
 5 6  
 Aqui falta...0 O brilho e tamanho das estrelas variam0 pouco. Faltam as estrelas. (hes)  
 : : : 6 : 5 6 : : :  
 Também fala que0 [a variação das estrelas]- a variação do brilho e tamanho0 é muito  
 : : :6 : : 6  
 pouca, né? [noventa por cento]- duram noventa por cento da sua existência0 e que o Sol  
 6 6  
 se encontra nessa fase intermediária.  
 6  
 Esse parágrafo está muito grande. Pode riscar? Eu não entendi aqui a palavra astro como  
 6 6 :  
 sinônimo de estrela. "E0 esse movimento se inverte." Ah, tá! Tá, no início era a  
 : 6 :6 6 6 : :  
 contração [e a]- e a estrela se forma a partir da concentração dessas moléculas de gás0 e  
 : 6  
 agora, ao contrário, há uma0 expansão, isso, certo. Ok! (hes) O parágrafo, no geral, fala  
 6 : : 6 6 6 6 : : 5

da, digamos, assim, do período de amadurecimento da estrela que, geralmente, acontece quando a parte de hidrogênio se perde e o que fica mais é hélio e com isso há um processo inverso de expansão, que chega a ter aumentos em seu raio até cinquenta vezes. Seria mais ou menos isso. Terceiro parágrafo, aliás quarto parágrafo. Quinto parágrafo. Esse parágrafo está [muito grande]- [muito]- muito grande. Bom, aqui em cima, voltando um pouco ao primeiro parágrafo, com a falta de oxigênio diminui a fusão e aumenta a expansão. Certo. Então, em um outro período, quando a falta se torna-se crítica, quando o hidrogênio quase acaba, deveria ter uma expansão e continua ainda... "Em um outro período, quando a falta torna-se crítica, apesar da rápida expansão, a fusão entre os gases diminui continuamente." Claro, se ele está expandindo, há fusão. Aí o que que acontece: "se a estrela for até duas vezes o tamanho do Sol, sua contração transformará o corpo celeste." Porque ela <es->. Espera aí, a fusão diminui, mas ela está expandindo, eu não entendi a palavra contração aqui. "Se a massa da estrela for até duas vezes a do Sol, sua contração transformará o corpo celeste em um pequeno astro moribundo." Mas se [o]- o hidrogênio diminui, não deveria continuar aqui. (hes) Ah, tá! Está certo! Está aqui: contração. O gás começa um período de contração, está certo! Até (hes) "cuja gravidade não consegue segurar os gases da periferia. Mas se a massa for duas vezes a do Sol, a contração final será muito forte, criando um corpo denso chamado estrela de nêutrons." Que a condensação... quanto maior a contração violenta e o núcleo, eu acho, vira um buraco negro. A sua densidade é tão alta que ele não deixa escapar. E o que que acontece com os gases da periferia? Transformam uma supernova massa de gás, que brilha por pouco tempo. Bom, então vejamos aqui, tentando resumir o último parágrafo é o seguinte: (hes) o hidrogênio, cada vez fica menos, né? [aumenta a expansão]- (hes) aumenta a sua expansão. Agora eu não entendi, porque [está em rápida expansão]- quando ele está faltando, está em rápida expansão e a fusão diminui. Ah, claro. (hes) Claro que diminui, porque fica menos [a]- a força entre as moléculas e a tendência é dar (inint). Agora, se a massa for até duas vezes o tamanho do Sol, essa contração vai transformar a estrela em um astro moribundo, porque a gravidade está ("sem"), isso. Mas se a massa for de duas a três vezes a do Sol (inint) muito forte até se transformar numa estrela de nêutrons. (sussurros) (hes) Noutras palavras, o parágrafo está mais ou menos (hes) dando o sumário do texto, né? e dizendo o destino das estrelas, né? Ele começa com como é que elas são formadas: por partículas de gás, geralmente, são hidrogênio. Aí depois vai dando algumas características e depois vai dizer o que que a

estrela pode se tornar, né? [Com a]-0 com0 o passar do tempo e com a perda0 [do  
 <al.-]- do hidrogênio, a estrela pode se tornar apenas ou um astro moribundo, né? se a  
 massa for até duas vezes a do Sol, se for mais tem, deixe-me ver aqui, tem duas  
 possibilidades. Uma é de a contração ser muito forte e se transformar em uma estrela de  
 nêutrons0 ou, então, se ainda continuar a condensação final for ainda mais violenta,  
 vira-se num buraco negro0 e os gases [que sobram]-0 que ficam na periferia0 vira uma  
 supernova. Está aqui, isso aqui é, basicamente, no final do texto está0 (hes) morte e vida  
 das estrelas. Seria isso.  
 E o assunto geral do texto é: morte (hes) não. Nascimento, vida0 e morte0 das estrelas.

## Text 2 – L2

(hes) O primeiro parágrafo0 (hes) abre o texto, dizendo que0 (hes) pílulas e...0 (hes) que  
 as pílulas e as agulhas serão coisas do futuro.  
 (hes) O segundo parágrafo fala que0 já se pode0 tomar nicotina e alguns hormônios  
 através da pele, mas a moléculas de insulina são muito grande0 e por mais que você0  
 (hes) passe na pele, ela não vai0 entrar, né? Quem fala é Mark Prausnitz, engenheiro  
 [da]- do instituto de tecnologia [de Geórgia, né?]- de Geórgia.  
 O parágrafo seguinte diz que ele desenvolveu quatrocentos0 (hes) agulhas  
 microscópicas0 que vão fazer com que [as]- a droga atinja a pele.  
 Que0 (hes) a <glu-> [glicose]-0 glucose? [já foi]-0 já foi testada em ratos. (hes) Já foi  
 testada em ratos0 e que um pequeno teste em voluntários humanos [<su->]- [<su->]-  
 tem sugerido0 que esse0 fenômeno é0 sem dor.  
 (inint) Não conheço esse (inint)0  
 Bom, "patch-wearing rats"0 também não entendo que tipo de rato é esse, mas tudo bem.  
 "Patch-wearing (inint) ("in rats") (inint)", mas deu pra entender0 tranquilo. "According  
 to researchers0 at..."0 Esse0 parágrafo um, dois, três, quatro. Esse quinto parágrafo  
 aqui está muito complexo. Mas, no geral, ele quer dizer que0 (hes) se você associar0  
 (hes) moléculas da droga, né? com a... Se você combinar essas <modé-> moléculas da  
 droga0 com eletro, que repele essa molécula, vai puxar para dentro da pele. E para0  
 ajudar essas moléculas, [vai ter que]-0 você vai ter que0 ter0 "tiny titanium-foil blades,  
 slice microscopic holes into the skin." É, algumas lâminas de titânio, né? microscópicas0  
 vão0 (hes) vão colocar dentro da pele, através [de]- de poros microscópicos, digamos,  
 assim. (hes) [Um botão [na]- na]-0 um botão [na]-0 no colete, digamos, [no]-

no...0 vai permitir [que o usuário]-0 que o próprio usuário0 (hes) administre a droga.  
 : 6 : : 6 6 6  
 No futuro0 (hes) um [mecanismo]-0 mecanismo que monitore [o]- [o]- (hes) [os <nu->]-  
 : :6 : 6 : : : :  
 os níveis de glicose [podem estar]-0 (hes) podem receber0 a insulina automaticamente.  
 : : 6 5  
 Bom, em resumo, complicou aqui o meio de campo, mas no geral [é]-0 é esse parágrafo  
 5 6 6 : : :  
 um, dois, três, quatro, quinto parágrafo seria mais ou menos assim: se você pegar0 essas  
 : 5 6  
 moléculas da droga0 e se você associar0 com uma carga de ("elétrido"), vai repelir essa  
 6 6 6 5  
 carga0 e vai acabar, (hes) digamos, assim, aí a pele vai puxar essa carga0 como se fosse,  
 6 :6 : 6  
 assim, um choque. E a partir daí umas lâminas vão se responsabilizar para0 colocar essa  
 6 : : : : 6  
 molécula dentro da pele. E isso vai poder ser controlado0 por um botão, certo? no,  
 6 : 5 5  
 digamos, assim, um colete0 que o usuário vai usar que vai poder controlar. E que os  
 6 6  
 níveis de glicose, eles mesmos [podem]-0 (hes) podem requerer a insulina, que vai ser  
 : : : 6 : :  
 automático, né? porque vai ser uma ligação automática.  
 6 6  
 Bom, o próximo parágrafo, o sexto parágrafo0 (hes) fala0 de um ship, né? implantado de  
 6 : 6 : :6 6 : :  
 polímero, implantado0 porque ele dispensa a droga dentro do corpo, que dispensa, né?  
 5 6 : : : :6 6  
 (hes) E que esse pesquisador, Robert Langer, trabalha no0 (hes) Massachusetts Institute  
 : : : 5 6 : :  
 of Technology, MIT, acho que é isso.  
 5 5 6  
 Bom, (hes) o último parágrafo aqui aponta primeiro0 [o <q->]- o que que se está  
 6 : 6 :  
 fazendo realmente pra0 conseguir0 (hes) que se tome drogas0 [sem, né?]- [sem]- sem  
 :6 :6 : : 5  
 precisar [de]-0 dessas (hes) agulhas, né? tão, que cause tanta dor. Mas tem um problema  
 : : 6 : : : 5 5 6  
 sério, porque0 não se sabe a voltagem precisa pra se fazer isso. Porque se a voltagem for  
 :5 : : 6  
 grande, destrói a célula, se for pequena, ela se fecha, né? E0 o que é que tem se criado  
 : 6 : 6 :6  
 aqui? (hes) [O que <fo->]- (hes) o que se criou na Universidade da Califórnia, Berkley,  
 6 : 6 5  
 foi um ship biônico, construído de camadas de silicone0 com a célula viva no centro do  
 5 5  
 circuito, que faz com que os pesquisadores0 meçam a voltagem necessária para abrir a  
 6 6 : :  
 célula. Só que isso ainda está muito distante de se <conse->0 concretizar, mas pelo  
 6 : : 5 6  
 menos os engenheiros, agora, [têm uma]-0 têm pelo menos uma chave pra0 começar a  
 : : 6 : : : :6  
 fazer isso. Em resumo, (hes) o texto inteiro, em termos bem gerais, fala de novos  
 6 6 6 : 6 :  
 métodos0 (hes) de se tomar remédios. Que no futuro0 nós não mais usaremos nem  
 : 6 : :5  
 pílulas, nem muito menos as dolorosas0 agulhas0 de injeção.  
 : 5 6 5

Subject 18 (October 10)

Text 1 – L1

O primeiro parágrafo...0 na verdade [eu]- eu não identifiquei tanto a pausa. A única  
 : 5 : :  
 coisa [que]-0 que me chamou atenção, na verdade, é que tem muita informação, assim,  
 5



né? e não sendo dessa área científica, fica complicado [de]- de conseguir0 resumir o  
 texto, lembrar do nome da pessoa da Universidade de São Paulo0 [que]- que falou  
 (inint) a compactuação [da]- [da]-0 dos gases [vai]- vai formar uma nuvem que se  
 transforma numa estrela, né? Na verdade, assim, acho que tem que ler, acho que, umas  
 duas vezes pra conseguir, por exemplo, (hes) resumir esse primeiro parágrafo.  
 No segundo parágrafo também a mesma coisa, porque0 quando a gente não está muito  
 habituado ao vocabulário, o jargão, né? na verdade, [fica]-0 a gente tem que pensar,  
 acho que, <ma-> pelo menos duas vezes mais, assim, né? Ele está falando aqui0 que  
 uma reação atômica, uma fusão0 transforma o hidrogênio [<de-> dessas]-0 [<de->  
 dessa]-0 dessa <rea-> reação atômica em hélio e que gera0 calor e luz, depois ele vai  
 dizer o exemplo de uma estrela jovem, ele vai falar que são as Plêiades.  
 Terceiro parágrafo, de novo a mesma coisa. (hes) [A dificuldade]- [num]- num tenho  
 dificuldade quanto ao texto, parece que0 ele está bem escrito [o]-, parece, está coerente,  
 coeso, o único problema também são os dados, eu acho. É, e terceiro parágrafo fala  
 que0 [grande]- grande parte da existência de uma estrela0 o brilho e o tamanho0 variam  
 pouco e fala que0 o Sol [está]- está numa fase intermediária [da]- da existência e que0  
 ele [se <con->]- se condensa pouco. Aí, [nesse]- nesse parágrafo0 (hes) é interessante  
 que <enquan-> enquanto a gente está lendo, assim, tem bem aquela sensação [de]- de  
 começar a lembrar [do]- do que a gente aprendeu na escola ou, então, o que a gente está  
 lendo, na verdade, aí começa a lembrar já [da]- [da]- da supernova, [da]- das estrelas  
 azuis, [da cor]- da variação das cores das estrelas de acordo com a idade0 e tal, né?  
 O quarto parágrafo. [Esse que]- esse é o mais difícil, assim, a gente já olha, [porque]-  
 que ele é o mais longo [do]- [do]- dos três, que a gente viu até agora, ele é o mais longo  
 sim. Então, a gente já começa a olhar oxa, mas tem tanta coisa [pra]-0 pra gravar, assim,  
 né? Aqui, de novo, no começo do parágrafo, ele está falando0 do hidrogênio [que]-0  
 que vai se transformar0 e aí também [já]- [já]- já causa um desconforto, né? Porque a  
 gente quer saber o que que é0 essa transformação [e]- [e]- e como é que funciona,  
 assim, sem ler o resto, né? já. Ainda continua a leitura: “Com isso, diminui a fusão entre  
 as moléculas de gás e começa um período de contração”, aí já [é]-0 [é]- causa mais  
 desconforto ainda. [Pra]-0 pra resumir esse parágrafo, eu acho que, (inint) até0 muito  
 mais tempo [que o]- que os outros, porque tem [mais]-0 maior número de informações,  
 [porque o]-0 [porque é mais]-0 porque é mais complexo um pouco, né? Tá, esse quarto  
 parágrafo0 fala que quando [o]- o hidrogênio de uma estrela se esgota ele [vai]- vai

começar a se transformar, ele já tinha se convertido em hélio, aí, depois, o que vai  
acontecer? As partículas vão começar a se contrair e o astro vai começar a expandir.  
(hes) Aqui o texto não fala, mas daí a gente começa também a imaginar de textos  
anteriores que tem explosões [no]-0 no centro [do]- do astro e0 fala também que a  
estrela vira uma gigante vermelha e [é]- é como o Sol vai ficar daqui a quatro vírgula  
cinco <mi-> bilhões de anos.  
O quinto parágrafo. Aí, mais uma pausa (hes) depois da primeira frase. (hes) “Em um  
outro período, [quando falta hidrogênio]- quando a falta de hidrogênio torna-se crítica,  
apesar de rápida expansão, a fusão entre os gases diminui continuamente”, (toss) aí  
[vem]-0 remonta a idéia de fusão e a gente tenta <imagi-> voltar pra química, pra física,  
lembrar o que que é fusão, o que que é estado de ebulição, o que que o processo e tudo.  
Aí, [já]- já tem que ler mais uma vez. Eu li duas vezes, o problema já0 foi resolvido.  
Mais uma pausa0 na segunda0 frase do0 quinto parágrafo: “Se a massa da estrela for até  
duas vezes a do Sol, sua contração transformará o corpo celeste em um pequeno astro  
moribundo,” aí também pela quantidade de informação, <pri-> principalmente, depois  
do0 “se a estrela for até duas vezes [ao]- a do Sol”, depois dessa informação0 sua  
<contro-> contração transformará o corpo celeste0 e0 em0 aqui acho que deve ter um  
erro [de <gr->]- de grafia, não sei. “Em um pequeno astro moribundo, cuja gravidade já  
não consegue segurar os gases da periferia.” Aí, já tem que ler, acho que, umas cinco  
vezes, porque0 tem que tentar entender de novo. Aí, pra pausa, como ele fala do corpo  
celeste0 chamado pulsar0 ou estrela de nêutrons. (hes) Mais uma vez, a gente vai  
lembrar de toda0 a química e0 física [e]- (toss) que desaprendi. Tem que lembrar e ler  
mais uma vez. Aqui ele fala [do]-0 como ele está falando do astro, [fala que]- (toss) fala  
do buraco negro que não deixa a luz escapar. Imediatamente, quando ele fala de luz  
escapar, eu já fiz uma associação [com]-0 com o texto anterior, do calor, que na verdade  
(hes) não tem nenhuma, aparentemente, não tem nenhuma relação, mas já começo a  
pensar no outro texto. (toss) Aqui ele vai falar da supernova e é uma coisa que quando  
eu estava lendo o primeiro parágrafo, eu estava lembrando já da supernova, quer dizer,  
eu já estava meio que adiantando, né? Esse [parágrafo aqui]- [parágrafo]- parágrafo,  
acho que, também por ser mais longo e por conter mais informações, ele vai demorar  
com certeza mais tempo pra ser resumido. Fala [que quando]-0 que quando0 o  
hidrogênio começa a ficar rarefeito (hes) os gases vão demorar mais pra se fundir e  
que [se a]- se a estrela for duas vezes0 o tamanho do Sol, [ele vai se transformar]- [a

estrela vai se transformar]- o astro vai se transformar [num]-0 num pequeno astro que  
 ele fala que é moribundo. Mas se não, se ele for [três]- duas ou três vezes maior, ele vai  
 criar um corpo celeste chamado pulsar. Quando é ainda maior0 a condensação (inint)  
 mais violenta0 e o núcleo desse astro vai virar [um]- um buraco negro. Os gases (hes)  
 de fora dessa camada0 nuclear vão se transformar numa supernova, que é [uma]- uma  
 estrela que brilha [por]-0 por pouco tempo até -0 desaparecer.  
 A idéia geral do texto é: está falando que as partículas de gás, geralmente, hidrogênio,  
 [ela vão se]- elas [vão se formar]- vão se transformar numa estrela. Depois ele começa a  
 falar [da]- das reações que acontecem <den-> dentro dessa estrela0 e0 fala [do]- da  
 duração [do]- da luz ou não, do tamanho das estrelas e0 de que tipo [de]- [de]- de  
 estrela, dependendo [do]- do tamanho ou da idade (hes) acho que idade ele não fala.  
 (hes) Pode-se formar, daí ele explica que0 quando o hidrogênio que é o gás [que a  
 maioria [das]- das estrelas]- de qual a maioria das estrelas é composto0 começa a ficar  
 rarefeito, aí, o que acontece [são]- são várias0 reações0 [que podem]-0 e que podem0  
 transformar esse astro em três tipos: um astro que ele chama de moribundo, um pulsar0  
 ou uma supernova. Acabou.

## Text 2 - L2

Esse segundo texto, apesar de ser em inglês, pela própria <fal-> (hes) pelo próprio fato  
 [de]- [de ser]-0 (toss) de ser de uma área deferente e que já0 é de mais interesse já0 fica  
 mais fácil. Quanto0 a pausa0 por enquanto, no primeiro parágrafo não tem nenhuma  
 pausa, porque (hes) foi fácil. Aqui ele está falando que, [apesar de]-0 apesar [do]- dos  
 avanços0 [na]-0 [na]- na medicina em termos [de droga]- de medicamento, a gente  
 ainda usa0 pílulas e injeções e que no futuro isso [não vai mais ser <pre->]- não vai se  
 mais preciso.  
 O segundo parágrafo, em termos de vocabulário, [de]- de compreensão, (hes) não tem  
 nenhum problema, aparentemente. Ele fala que [algum tipo de]- alguns tipos [de]- de  
 droga como a nicotina e os hormônios, eles já são liberados na pele, (toss) mas que0 as  
 moléculas [de]- de insulina0 você pode esfregar [o]-0 o dia inteiro que como elas são  
 muito grandes, segundo um engenheiro químico [da]-0 [da <Geo->]- da Georgia  
 Institute of <Tecnolo-> (inint) Technology, (hes) não é possível a absorção pela pele.  
 O terceiro parágrafo também [não]-0 não apresenta grandes dificuldades. Ele fala que0  
 [este]- esse mesmo0 médico, não, engenheiro químico0 (hes) que chama-se Prausnitz,  
 ele desenvolveu0 um adesivo [com]- com quatrocentas minúsculas agulhas [que]-0 que

vão liberar0 drogas através da pele. Sem problemas0 [nesse]- nesse [terceiro parágrafo]-  
quarto parágrafo.

Ah, e [o terceiro]- o quarto parágrafo já, quando ele começa a falar de0 “early animal  
tests show blood glucose”, aí, <come-> (hes) a palavra “glucose”, a gente [já]- já tem  
que parar pra pensar no que que é glucose (hes) e etc. Pra tentar resolver esse problema  
[da]- [da]-0 da palavra glucose e [a <ge->]- eu, pelo menos, fiz uma associação de todas  
[as]-0 [os]-0 as substâncias [e]-0 e níveis que são vistos, por exemplo, num exame de  
sangue: glicose, colesterol, etc. Esse [terceiro <pará->] o quarto parágrafo0 (hes) fala  
[que]- que ratos que0 <usa-> 0 usavam [esse]- esse adesivo o nível de glicose diminuiu  
[significamente] e]- significativamente e que0 é um processo [que não é]-0 que não  
é dolorido [no]- [no caso [de]-0 de <al->]- (hes) no caso [de]- da existência de algum0  
voluntário0 humano pra esse tipo de0 experiência.

Quinto parágrafo. A primeira (“parte”) do quinto parágrafo0 (hes) vem com a palavra  
[“zapping”]- zapping, porque0 é como se (hes) tivesse lendo essa palavra, de novo,  
causa um certo desconforto, tem que...0 [é como]- ela é uma key word aqui, tem [que]-  
que prestar mais atenção [no]- na leitura, né? Novamente, quando ele começa a  
descrever o processo0 [com]- com <info-> informações variadas [e]- e desconhecidas0  
[de um]- de um leigo, por exemplo, ela se torna mais complicada [e]- e exige bem mais  
atenção, né? (inint) Exatamente [depois dessa]- [antes]-0 o que vem antes e depois dessa  
 (“parte”) (inint) você vai precisar mais uma leitura. Quando ele começa a falar do (hes)  
mais outra pausa quando [na]- na segunda frase [dessa]- desse quinto parágrafo ele fala  
de0 “titanium-foil blades” aí, já começa a pensar no que que esses (hes) “titanium-foil  
blades slice microscopic holes into the skin.” Aí, eu [já]-0 já fica uma confusão  
completa, né? Pronto, depois de, acho que, uma segunda leitura, sem problema. Ele está  
explicando no quinto parágrafo como que funciona o0 mecanismo [de]-0 <de-> [desse]-  
[desse patch]- desse adesivo na pele. [O que]- como que acontece [pra que ele possa]-0  
(hes) [pra que ele possa] colocar0 (hes) a insulina]- pra que a insulina possa chegar,  
automaticamente [no]-0 no corpo, quer dizer, (hes) na circulação e...0 que fala [que]-0  
[que nesse]-0 que nesse adesivo [tem]-0 tem [um]- [um botãozinho]- um botão, na  
verdade, que a pessoa [que]-0 [que]- [que sofre]- (hes) que sofre de diabetes, ele não  
fala da pessoa que sofre de diabetes, mas a gente0 (“infern”), ela pode controlar [o]-0 e  
monitorar o nível de glicose0 no sangue.

Quinto <pará-> (sussurros) sexto parágrafo. (hes) [Primeira]- a primeira pausa <co->

com a palavra polímero, “polymer chip”, aí a gente (hes) também [não]- não sei o que  
que... Tem que lembrar e fazer uma associação com a química pra ver o que que é o  
polímero. E [esse <pa->]- nesse parágrafo aqui fala que0 [um <pes->]- um pesquisador  
chamado Roger Langer desenvolveu [esses polímeros]- (hes) polímero, né? esse chip0  
polímero0 [que]- que [dispensa]-0 (hes) dispensa [droga]- (hes) droga injetável ou0 essa  
que a gente toma, pra que [ela seja]- essa droga seja liberada [com]-0 diretamente [no]-0  
[mais]- [mais]- mais próximo [do]- [do]- [do tecido que]-0 o tecido alvo, né? na  
verdade.  
[A primeira <pa->]- a primeira pausa [da]- do sétimo parágrafo, na verdade foi quando  
[a]-0 a primeira frase termina, né? Ah, outra pausa quando ele fala de “silicon wafers”.  
A gente tem que fazer uma associação também do que que é o0 silicone, do que que são  
esses wafers. (hes) [Sem]- sem mais problemas (hes) nesse sétimo parágrafo, [ele fala  
que]-0 os pesquisadores falam que0 (hes) é necessário uma quantidade de eletricidade  
pra que [possa]-0 as membranas da célula possam ser abertas. Só que ele fala que muito  
pode destruir a célula e (hes) muito pouco [no]- não causa nenhum efeito. Um  
pesquisador da Universidade [de]- (hes) de Berkley, né? na Califórnia, [ele]- (hes)  
chamado Boris Rubinsky, disse que0 ele criou um chip biônico construído de0 wafers  
de silicone0 [que]-0 que permite com que os pesquisadores saibam <ne->0 (hes)  
precisamente a voltagem que é <preci-> necessária [pra]- pra abrir os poros da célula.  
[Enquanto isso não se realiza]- enquanto não se sabe ainda, porque é só uma idéia, pelo  
menos [o]- esse pesquisador, né? que eles [já sabem]-0 já tem pelo menos <u-> uma  
idéia [que pode]-0 do que pode0 surtir efeito [no]-0 na célula, né? enquanto0 trabalho  
biológico entre aspas. [O]-0 o resumo desse texto, na verdade, (“ele”) está falando que0  
[não]- não necessariamente a gente vai precisar mais tomar drogas injetáveis ou (inint)  
(hes) né? injetáveis ou tomar medicamento (hes) remédio com pílulas0 que no futuro  
pílulas e agulhas vão ser uma coisa do passado e que0 [alguma <dro->]- algumas drogas  
como a nicotina e hormônios [já são]- [já]- já são colocadas [na]-0 através de adesivos e  
que0 (hes) pesquisadores [já]- já estão utilizando [esse adesivo]- essa forma [como]-0  
como mecanismo de cura [de]- de várias doenças e0 entre elas uma que possa diminuir  
o nível de glicose [do]-0 do sangue, que já foi testada com ratos0 e que0 pode vir a ser  
testada em humanos e que [não]- não causa nenhum tipo de dor. E (inint) [esse]-0 esse  
(hes) um dos0 pesquisadores, ele desenvolveu [um]-0 um adesivo com [quatrocentos]-  
quatrocentas pequenas agulhas e que0 pode liberar0 (hes) diversas drogas através da

pele, só que por enquanto não se sabe, porque (inint) não se sabe o quanto de, por  
 : 6 : :  
 exemplo, (hes) eletricidade. Segundo um outro pesquisador (inint) nível de0 eletricidade  
 6 : : 5 : :  
 xis [pode0 liberar]-0 pode abrir as membranas [da]- da célula do corpo humano. Não se  
 6 5 :  
 sabe ainda, apesar [de]- de ter feito uma pesquisa, o quanto [de]-0 de eletricidade você  
 : : : : 6  
 <nece-> é necessário [pra que]-0 pra que (hes) a operação saia de acordo, né? <Out->  
 : 6 : 6  
 vários outros pesquisadores0 [fizeram]-0 um outro pesquisador, chamado Robert  
 : 6 : 5  
 Langer, fez [um]-0 primeiro um chip polímero [que]- (hes) que evita a necessidade [de]-  
 : : 5 : :  
 de drogas injetáveis, mas [ao mesmo tempo]-0 (hes) ao mesmo tempo que não se sabe  
 : 6 : 5  
 quanto [que]-0 que precisa [desse]-0 de eletricidade [pra que]-0 pra que isso possa ser  
 : : 6 : 6 : 6 :  
 bem sucedido. [Outros <pe-> um outro pesquisador0 desenvolveu um projeto piloto  
 : 6 6 : :  
 [de]-0 de wafer de silicone [que possa]- [que]- que saiba exatamente o quanto [de]- de  
 : 6 : : :  
 eletricidade é necessário pra que esse processo seja bem sucedido. Enquanto isso [não]-  
 : 5 : :  
 não ocorre, pelo menos já se sabe mais ou menos como funciona0 o processo, na  
 : 6 : : 6 : :  
 verdade, [o processo]-0 o <engen->0 como fala. Se sabe mais ou menos como é que  
 : 6 5 6  
 funciona tecnicamente [pra que]-0 como [que]- que possa (inint) se pode fazer com que  
 6 : : :  
 uma célula...0 Ah, como é que vou explicar isso? Bom, pelo menos agora já se tem  
 : 6 : 6  
 mecanismos necessários que se possam0 fazer com que (inint) respostas positivas em  
 : 6 : :  
 termos0 biológicos.  
 : 5 :

APPENDIX B: GENERAL INSTRUCTIONS ON THE READING ABILITY  
MEASURES

You will take part in an experiment on reading comprehension. You will be asked to read two texts and comment on your reading. Initially you will practice the procedure of this experiment. Secondly, the actual experiment will take place, and you will read the two texts.

Reading Instructions

You will be reading two different texts: the first in Portuguese and the second, in English. While you read these texts, you should follow the procedure I describe below.

1. You will read a text silently. Your purpose is to formulate the main idea of each paragraph and the main idea of the text.

2. You should read the text SILENTLY, but your silent reading should be interrupted whenever you:

2.1. Detect a pause\* (no matter how short it is) or problem while you are reading.

PAUSE\* - moment when the reading activity is interrupted and you find yourself, for instance, thinking about a problem encountered, or about something that might have caught your attention (Tomitch, 1995, p.194).

2.1.1. Whenever you interrupt your reading because you have detected a pause, you are asked to:

a) point the pause in the text, that is, read aloud the word, expression or sentence that has caused the pause;

b) comment on the reason for the pause, that is, if the pause was caused by something that caught your attention, or by some kind of difficulty or problem that you have found;

c) if the pause requires solving a problem before you start reading again, try to think aloud while working towards a solution.

2.2. Finish reading each paragraph (a small square has been placed at the end of each paragraph as a reminder).

2.2.1. When you get to the end of each paragraph, you are asked to:

a) comment on what you have just read, that is, about the content of the paragraph;

- b) comment on what you have just been thinking about while you were reading the paragraph;
  - c) try to formulate the main idea for each paragraph;
  - d) as soon as you get to the end of the text, try to formulate the main idea for the whole text.
- 3) Keep on reading the text and talking about it until you reach the end of the text.
  - 4) Make an effort to read as if you were on your own.
  - 5) If you want, you may use a pencil to underline the text.
  - 6) Your comments will be tape-recorded.
  - 7) You will practice the procedure before the real experiment takes place.



## APPENDIX C: INSTRUCTIONS ON THE READING SPAN TESTS

You will read 42 sentences. The sentences are divided into 12 sets. The number of sentences per set will start from 2 extending to 5. (3 sets of 2 sentences, 3 sets of 3 sentences, 3 sets of 4 sentences, 3 sets of 5 sentences).

There will be grammatical and ungrammatical sentences. First, you will read the sentences, which will be presented on a computer screen one at a time. As each sentence is presented, you will judge whether the sentence is grammatically possible or not. In addition, you will try to keep the last word in each sentence. Having read the last sentence in each set, you will read the prompt "RECALL WORDS" on the screen.

You will receive a response booklet, containing 24 pages. With two pages corresponding to each set. After rating each sentence in a set (grammatical or ungrammatical), you will read the prompt "RECALL WORDS", and will turn the next page in the booklet and will try to write down the last word of each sentence in the set.

This procedure will take place twice: first, you will read 42 sentences in Portuguese. Second, you will read 42 sentences in English.

Before starting the experiment, you will train the procedure. You will read 15 sentences in Portuguese, these sentences are divided into 6 sets. The number of sentences per set will start from 2 extending to 3 (3 sets of 2 sentences, 3 sets of 3 sentences).

## APPENDIX D: TEXTS USED FOR THE READING ABILITY MEASURES

Original Text (L1/ Portuguese)

Existência Tumultuada: Como Nascem, Vivem e Morrem as Estrelas?

A existência de um astro, que dura de 100 milhões a 1 trilhão de anos passa por três fases: nascimento, meia-idade e maturidade. “Todas as estrelas nascem da mesma forma: pela união de gases”, diz o astrônomo Roberto Boczko, da Universidade de São Paulo (USP). Partículas de gás (geralmente hidrogênio) soltas no Universo vão se concentrando devido às forças gravitacionais que puxam umas contra as outras. Formam, assim, uma gigantesca nuvem de gás que se transforma em estrela – isto é, um corpo celeste que emite luz.

A gravidade espreme essa massa gasosa a tal ponto que funde os átomos em seu interior. Essa fusão é uma reação atômica que transforma hidrogênio em hélio, gerando grande quantidade de calor e de luz. Um exemplo de estrela jovem são as Plêiades, na via Láctea, resultado de fusões que começaram há poucos milhões de anos.

Durante a meia-idade – cerca de 90% da sua existência – a estrela permanece em estado de equilíbrio. Seu brilho e tamanho variam pouco, ocorrendo apenas uma ligeira contração. É o caso do Sol, que, com 4,5 bilhões de anos, se encontra nessa fase intermediária de sua existência, sofrendo mínima condensação.

Quando a maior parte do hidrogênio que a compõe se esgota, a estrela entra na maturidade – este sim, um período de drásticas transformações. Praticamente todo o hidrogênio do núcleo já se converteu em hélio. Com isso, diminui a fusão entre as moléculas de gás e começa um período de contração e aquecimentos violentos no corpo celeste. A quantidade de calor e luz gerados é tão grande que o movimento se inverte: o astro passa a se expandir rapidamente. Seu raio chega a aumentar 50 vezes e o calor se dilui. A estrela vira uma gigante vermelha. Um exemplo é Antares, na constelação de Escorpião – uma amostra de como ficará o Sol daqui a 4,5 bilhões de anos, engolindo todo o sistema solar.

Já na maturidade a falta de hidrogênio torna-se crítica. Apesar da rápida expansão, a fusão entre os gases diminui continuamente: o astro caminha para o seu fim. O modo como ele morrerá depende de sua massa. Se ela for até duas vezes a do Sol, sua contração transformará o corpo celeste em um pequeno astro moribundo, cuja gravidade já não consegue segurar os gases da periferia. Mas se a massa for de duas a três vezes a do Sol, a contração final será muito forte, criando um corpo celeste extremamente denso chamado pulsar, ou estrela de nêutrons. Quando a massa é maior, a condensação final é mais violenta ainda e o núcleo do antigo astro vira um buraco negro – a sua densidade é tão alta que ele não deixa nem a luz escapar. Simultaneamente, os gases da camada periférica dessa estrela se transformam em uma supernova – massa de gás que brilha por pouco tempo até sumir de uma vez por todas. (483 words)

## Reference

Existência tumultuada: Como nascem, vivem e morrem as estrelas? (2001, August)  
Superinteressante Especial: O Melhor de Superintrigante, Mundo Estranho, 16-7.

Experimental Text (L1/ Portuguese)  
Existência Tumultuada: Como Nascem, Vivem e Morrem as Estrelas?

De acordo com o astrônomo Roberto Boczko, da Universidade de São Paulo (USP), partículas de gás (geralmente hidrogênio) soltas no Universo vão se concentrando devido às forças gravitacionais que puxam umas contra as outras. Uma gigantesca nuvem de gás se transforma em estrela.

Há uma fusão, reação atômica que transforma hidrogênio em hélio, gerando grande quantidade de calor e de luz. Um exemplo de estrela jovem são as Plêiades, na via Láctea.

Cerca de 90% da sua existência – o brilho e tamanho da estrela variam pouco, ocorrendo uma ligeira contração. O Sol, que, com 4,5 bilhões de anos, se encontra nessa fase intermediária de sua existência

Praticamente todo o hidrogênio do núcleo já se converteu em hélio, diminuindo a fusão entre as moléculas de gás, um período de contração e aquecimentos violentos no corpo celeste. A quantidade de calor e luz gerados é grande. O raio do astro chega a aumentar 50 vezes e o calor se dilui. A estrela vira uma gigante vermelha – uma amostra de como o sol ficará daqui a 4,5 bilhões de anos.

Se massa do astro for até duas vezes a do Sol, sua contração transformará o corpo celeste em um pequeno astro moribundo, cuja gravidade já não consegue segurar os gases da periferia. Se massa for de duas a três vezes a do Sol, a contração final será muito forte, criando um corpo celeste denso chamado pulsar, ou estrela de nêutrons. Quando massa é maior, a condensação final é mais violenta ainda e o núcleo do antigo astro vira um buraco negro – a sua densidade é tão alta que ele não deixa a luz escapar. Simultaneamente, os gases da camada periférica dessa estrela se transformam em uma supernova – massa de gás que brilha por pouco tempo. (303 words)

Original Text (L2/ English)  
Drug Delivery: Getting Under the Skin

Despite an endless stream of new and better drugs, most of us still take medicines as pills or by injection. In the future, pills and needles may be a thing of the past, as researchers develop new ways to sneak drugs past the body's defences – squeezing them through micropores in the skin, or pushing drugs into cells deep in the body via implanted microchips.

Some drugs such as nicotine and hormones are already delivered through the skin. But the skin patches aren't very effective for such large molecules of insulin. "You can rub insulin on your skin all day long and it won't go in", says Mark Prausnitz, a chemical engineer at Georgia Institute of Technology.

To break the skin barrier, Prausnitz, along with electrical engineer Mark Allen, has developed a tiny patch of 400 hollow microscopic needles. The device, about the size of a ladybug, would shuttle drugs through skin.

Early animal tests show blood glucose levels in patch-wearing rats dropped significantly, indicating that the insulin was at work. As for the ouch factor, a small test on human volunteers suggests the method is painless, says Prausnitz.

Researchers at Alza Corp. in Mountain View, California, outfitted a similar patch with an electronic circuit. Zapping charged drug molecules with a matched charge from an electrode repels the molecules, pushing them into the skin. To help them along, tiny titanium-foil blades slice microscopic holes into the skin. A button on the patch allows the wearer to self-administer the drug. In the future, a feedback mechanism that continuously monitors glucose levels might deliver insulin automatically. Alza researchers are hoping the microblade patch can also be used to administer the vaccines.

For very large molecules that can't be forced through the skin, Robert Langer and colleagues at MIT have developed an implantable polymer chip that dispenses drugs inside the body, closer to their target tissues.

But the ultimate goal is to push drugs directly into cells. Researchers have long known that a jolt of electricity would open cell membranes, but until now there was no way to measure the precise voltage to do the job. Too much destroys the cell, too little and the cell is stubbornly shut. Now, Boris Rubinsky at the University of California, Berkley, has created a "bionic chip", constructed of silicon wafers with a living cell at the center of its circuitry, that allows researchers to measure precisely the voltage needed to open a cell's pores. While the method is years away, "We at least now have an engineer's key to open the biological workings of a cell," Rubinsky adds. (378 words)

Reference

Heist, A. (2001, Summer) Drug delivery: Getting under the skin. Popular Science: Flash Forward. 65.

Experimental Text (L2/ English)  
Drug Delivery: Getting Under the Skin

There is an endless stream of new and better drugs, most of us still take medicines as pills or by injection. In the future, pills and needles may be a thing of the past.

Some drugs such as nicotine and hormones are delivered through the skin by means of patches. Molecules of insulin are too large. “You can rub insulin on your skin all day long and it won’t go in”, says Mark Prausnitz, a chemical engineer at Georgia Institute of Technology.

Prausnitz has developed a tiny patch of 400 hollow microscopic needles. This device would shuttle drugs through skin.

Early animal tests show blood glucose levels in patch-wearing rats dropped significantly. As for the ouch factor, a small test on human volunteers suggests the method is painless.

According to researchers at Alza Corp. in Mountain View, California, zapping charged drug molecules with a matched charge from an electrode repels the molecules, pushing them into the skin. To help them along, tiny titanium-foil blades slice microscopic holes into the skin. A button on the patch allows the wearer to self-administer the drug. In the future, a feedback mechanism that continuously monitors glucose levels might deliver insulin automatically.

Robert Langer at MIT have developed an implantable polymer chip that dispenses drugs inside the body, closer to their target tissues.

Researchers have long known that a jolt of electricity would open cell membranes, Too much electricity destroys the cell, too little and the cell is stubbornly shut. Now, Boris Rubinsky at the University of California, Berkley, has created a “bionic chip”, constructed of silicon wafers with a living cell at the center of its circuitry, that allows researchers to measure the voltage needed to open a cell’s pores. While the method is years away, “We at least now have an engineer’s key to open the biological workings of a cell,” Rubinsky adds.

(317 words)

Text Used For Training The Verbal Protocol Procedure  
Sol pra Contrariar: Esfriamento Global / Original Text

Muito se discute no mundo todo sobre o efeito estufa, causado por gases que produzem uma camada na atmosfera que não deixa o calor da Terra sair. Mas poucos lembram uma coisa: fazer com que o calor saia ajuda, mas é mais importante evitar que ele entre. Isso porque, desde a Revolução Industrial – quando entramos na era dos motores e do fumacê generalizado – o planeta ficou mais escuro. Cores escuras absorvem o calor do Sol, enquanto as claras o refletem de volta ao espaço. Portanto, haveria um jeito de lutar contra os efeitos nocivos do aquecimento global que ninguém está considerando: tornar o planeta mais claro! Bastaria, para isso, pintar estradas, cidades e aeroportos de branco. Russel Seitz, do Centro Olin de Estudos Estratégicos da Universidade de Harvard, Estados Unidos, fez uma conta curiosa para tentar descobrir as reais implicações do calor emitido pelo Sol sobre a Terra. Segundo ele, se fosse possível “branquear” cerca de 520 000 quilômetros quadrados da superfície terrestre – pouco menos que o estado da Bahia – reverteríamos de uma vez só todo o aquecimento provocado por nós desde a revolução industrial. (185 words)

Reference

Griffith, M. (2001, July) Sol pra contrariar: Esfriamento global. Superinteressante, 19.

Text Used For Training

Gases produzem uma camada na atmosfera que não deixa o calor da Terra sair. Mas poucos pessoas lembram uma coisa: é importante evitar que o calor entre. Desde a Revolução Industrial – quando entramos na era dos motores e do fumacê generalizado – o planeta ficou mais escuro. As cores claras refletem o calor do sol de volta ao espaço. Podemos tornar o planeta mais claro, pintando estradas, cidades e aeroportos de branco. De acordo com Russel Seitz, do Centro Olin de Estudos Estratégicos da Universidade de Harvard, Estados Unidos, se isso fosse possível – reverteríamos de uma vez só todo o aquecimento provocado por nós desde a revolução industrial. (107 words)

## APPENDIX E: SENTENCES OF THE READING SPAN TEST L1 -

## PORTUGUESE

- 1- Tornou-se cada vez mais comum ver adultos usando aparelhos nos dentes.
- 2- Em quase cinquenta anos de política ACM acumulou fortuna e poder.
- 3- A crise de energia de falta só é não brasileira chuvas.
- 4- Cientistas analisam imagens das galáxias para traçar o mapa evolutivo do cosmo.
- 5- O maior símbolo da resistência uma foi colonização a contra africana mulher.
- 6- Ao chegar ao campo de batalha, os soldados da Grécia antiga bebiam vinho.
- 7- Os bebês nascem programados a com emocional vínculo um formar para mãe.
- 8- Acreditava-se que a função biológica e natural da mulher era ter filhos.
- 9- Em vários países, é autorização sem pessoais informações arquivar crime.
- 10- Diz a ancestral sabedoria que quem controla a respiração controla a mente.
- 11- A ciência está comprovando a eficácia de base à populares receitas de ervas.
- 12- Algumas soluções para nossos problemas nossos de diante bem florescendo estar podem olhos.
- 13- A ciência e a tecnologia tornaram-se o aspecto dominante da guerra.
- 14- Um estudo indica que do dependentes são americanos médicos dos 20% ópio.
- 15- Os medicamentos passaram a para chave a como vistos ser cura.
- 16- O leite materno em leite o que do melhor sendo continua pó.
- 17- Mais importante do que entender é sentir a palavra de Deus.
- 18- Mobilização social deve de subida contra sociedade da luta incluir preços.
- 19- Os títulos das reportagens estão dentre os elementos mais importantes do jornal.
- 20- Galileu foi o primeiro a apontar o telescópio para os céus.

- 21- Segundo Aristóteles, a Lua, os de feitos seriam estrelas as e planetas éter.
- 22- A humanidade só venceu e descobriu coisas novas pelo aperto e por crises.
- 23- A política monetária tem sido do alta a conter para eficaz pouco dólar.
- 24- Deus criou o universo, mas são os designers que estão repaginando o mundo.
- 25- Funcionários que fumam apresentam baixa produtividade porque perdem tempo com o vício.
- 26- A construção de grandes obras cinco a quatro de leva geração de anos.
- 27- O desmantelamento da na cubana economia a jogou Soviética União Iona.
- 28- Não há dúvida de que mais prisões devem ser construídas em todo país.
- 29- Os óleos de peixe podem evitar o cancer de mama e pulmão.
- 30- O alho ajuda a evitar os altos níveis de colesterol no sangue.
- 31- Em qualquer empresa há apenas a e cultura a importantes coisas duas marca.
- 32- Ao longo da história as pessoas foram segregadas por castas e classes.
- 33- Nos motores de carros, o do oxigênio o com se combina hidrogênio ar.
- 34- Covas mostra que, com honestidade, a valer pode política fazer caráter e pena.
- 35- Mário Covas cumpriu seu trabalho, e agora pode descansar em paz.
- 36- A função dos a para fartura a garantir é pajés tribo.
- 37- Na área energética, está faltando uma visão estratégica de longo prazo.
- 38- Os homens a sobre comida botar para escritório em trabalham mesa.
- 39- E provável que o nossas mudará que existência uma traga progresso vidas.
- 40- O yoga trata da relação entre a mente e o corpo.
- 41- O estresse, a ansiedade ou os desencadear podem fortes muito emoções mesmo tiques.
- 42- Pesquisas centradas na genética procuram a causa da agressividade em características dos genes.



## APPENDIX F: SENTENCES OF THE READING SPAN TEST L2 – ENGLISH

- 1- He played baseball all day at the park and got a sore arm.
- 2- I saw a child and her father near the river playing ball.
- 3- His younger brother roll and rock a in guitar played band.
- 4- Suddenly the taxi opened its door in front of the bank.
- 5- The last thing he hot nice a take to was did take bath.
- 6- Her best memory of England was the Tower of London bell.
- 7- At the very top of the tall tree sat a small bird.
- 8- She took rusty the into reached and breath deep a box.
- 9- The state of Wisconsin is famous for its butter and cheese.
- 10- He overslept economics morning the of all missed and class.
- 11- The first thing golf a swing is morning every does he club.
- 12- Popular foods in the summer are water melon and sweet corn.
- 13- The boy was surprised to know that milk came from a cow.
- 14- The only thing left broken a was cupboard kitchen the in cup.
- 15- The birthday party began in the morning and lasted all day.
- 16- The young woman a saw they thought boyfriend her and dog.
- 17- There was nothing left to do except leave and lock the door.
- 18- In order to attend the dinner she needed to buy a dress.
- 19- The woman screamed the in man old the slapped and face.
- 20- She leaned over the candle and her hair caught on fire.
- 21- The drinks were all the was remained that all and gone food.
- 22- He quickly drank some the washed then and milk the of glass.
- 23- He looked across the room and saw a person holding a gun.

- 24- The hunting knife was so sharp that it cut his right hand.
- 25- She soon realized that the man forgot to leave the room key.
- 26- The saw that he the for enough strong not was brought lock.
- 27- The first driver out in the up picks always morning the mail.
- 28- All that remained in the lunch box was one salted nut.
- 29- The boat engine of out was it because run not would oil.
- 30- The letter said to the claim to market the to come prize.
- 31- It was a very simple meal of salted fish and boiled rice.
- 32- They decided to large the by break afternoon an take rock.
- 33- He wanted to leave his bags and jacket in the hotel room.
- 34- There were so many people that I couldn't find a seat.
- 35- He opened a out pulled and drawer bottom the shirt.
- 36- The skiing was didn't the mind didn't he that wonderful so snow.
- 37- They knew that it a with spaghetti eat to impolite was spoon.
- 38- The season with is love with associate often people that spring.
- 39- The letter was lost because it did not have a postage stamp.
- 40- The people in by travel to like always Europe northern train.
- 41- All morning the a under talked and sat children two tree.
- 42- At night the prisoners escaped through a hole in the wall.

## APPENDIX G: WORDS TO BE REMEMBERED IN THE READING SPAN

## TEST – PORTUGUESE - L1

1- dentes	12- olhos	23- dólar	34- pena
2- poder	13- guerra	24- mundo	35- paz
3- chuvas	14- ópio	25- vício	36- tribo
4- cosmo	15- cura	26- anos	37- prazo
5- mulher	16- pó	27- lona	38- mesa
6- vinho	17- Deus	28- país	39- vidas
7- mãe	18- preços	29- pulmão	40- corpo
8- filhos	19- jornal	30- sangue	41- tiques
9- crime	20- céus	31- marca	42- genes
10- mente	21- éter	32- classes	
11- ervas	22- crises	33- ar	

## APPENDIX H: WORDS TO BE REMEMBERED IN THE READING SPAN TEST

## – ENGLISH - L2

	11- club	22- glass	33- room
	12- corn	23- gun	34- seat
1- arm	13- cow	24- hand	35- shirt
2- ball	14- cup	25- key	36- snow
3- band	15- day	26- lock	37- spoon
4- bank	16- dog	27- mail	38- spring
5- bath	17- door	28- nut	39- stamp
6- bell	18- dress	29- oil	40- train
7- bird	19- face	30- prize	41- tree
8- box	20- fire	31- rice	42- wall
9- cheese	21- food	32- rock	
10- class			

## APPENDIX I: WORDS REMEMBERED IN THE READING SPAN TEST - L1 –

## PORTUGUESE

<u>Subject 1</u>	vinho	cosmo	cura
dentes	mãe		pó
poder	filhos	<u>Subject 4</u>	Deus
chuvas	crimes	dentes	preços
cosmo	mente	poder	jornal
mulher	ervas	chuvas	
vinho	olhos	cosmo	<u>Subject 5</u>
mãe	guerra	mulher	dentes
filhos	ópio	vinho	poder
crime	cura	mãe	chuvas
	pó	filhos	cosmo
<u>Subject 2</u>	Deus	crime	mulher
dentes		mente	vinho
poder	<u>Subject 3</u>	ervas	mães
chuvas	dentes	olhos	filhos
cosmo	poder	guerra	crime
mulher	chuvas	ópio	mente

ervas	dentes	olhos	genes
olhos	poder	guerra	
guerra	chuvas	ópio	<u>Subject 14</u>
ópio	cosmo	cura	dente
cura	mulher	pó	poder
pó	vinho	Deus	chuva
Deus	mãe	céu	cosmo
preços	filhos	éter	mulher
jornais	crime	crise	vinho
céus	mente	dólar	mãe
éter	ervas		filhos
dólar	olhos	<u>Subject 13</u>	crime
<u>Subject 6</u>	guerra	<u>dentes</u>	<u>Subject 15</u>
dentes	ópio	poder	dentes
poder	cura	chuvas	poder
chuvas	só	cosmo	chuva
cosmo	Deus	mulher	cosmo
mulher	preço	vinho	
vinho	jornal	mãe	<u>Subject 16</u>
	céu	filhos	dentes
<u>Subject 7</u>	éter	crime	poder
dentes	crises	mente	chuvas
poder	dólar	ervas	cosmo
cosmo		olhos	mulher
mulher	<u>Subject 11</u>	guerra	vinho
vinho	dentes	ópio	mãe
	poder	cura	filhos
<u>Subject 8</u>	chuvas	pó	crime
dentes	cosmo	Deus	mente
poder	mulher	preços	ervas
chuvas	vinho	jornal	olhos
cosmo	mãe	ceús	guerra
mulher	filho	éter	ópio
vinho	crime	crises	
mãe	mente	dólar	<u>Subject 17</u>
filhos	ervas	mundo	dentes
crime	olhos	vício	poder
mente	guerra	anos	chuva
olhos	ópio	lona	cosmos
	cura	país	mulher
<u>Subject 9</u>		pulmão	vinho
dentes	<u>Subject 12</u>	sangue	mãe
poder	dentes	marca	filhos
chuvas	poder	classes	crime
cosmo	chuvas	ar	
mulher	cosmo	pena	<u>Subject 18</u>
vinho	mulher	paz	poder
mãe	vinho	tribo	chuvas
filhos	mãe	prazo	cosmo
crime	filhos	mesa	mulher
	crime	vidas	vinho
<u>Subject 10</u>	mente	corpo	
	ervas	tiques	

## APPENDIX J: WORDS REMEMBERED IN THE READING SPAN TEST - L2 –

## ENGLISH

<u>Subject 1</u>	bank	bird	club
band	bath	box	corn
	bell	cheese	

Subject 2

arm  
ball  
band  
bank  
bath  
bell  
bird  
box  
cheese  
class  
club  
corn  
cow  
cup  
day  
dog  
door  
dress  
face  
fire  
food  
glass  
gun  
hand  
key  
lock  
mail

Subject 3

arm  
ball  
band  
bank

Subject 4

arm  
ball  
band  
bank

Subject 5

arm  
ball  
band  
bank  
bath  
bell  
bird  
box  
cheese  
class  
club  
corn  
cow  
cup  
day  
dog  
door  
dress  
face  
fire  
food  
glass  
gun

Subject 6

arm  
ball  
band  
bank  
bath  
bell

Subject 7

ball  
band  
bank  
bath

Subject 8

arm  
ball  
band  
bank  
bath  
bell  
bird  
box  
cheese  
class  
club  
corn  
cow  
cup  
day  
dog  
floor  
dress  
face  
fire  
food  
dress  
gun

Subject 9

arm  
ball  
band  
bank  
bath  
bell  
bird  
box  
cheese  
class  
club  
corn  
cow  
cup  
day  
dog  
door  
dress  
fire  
food  
glass  
gun

Subject 10

arm  
ball  
band  
bank

bath  
bell  
bird  
box  
cheese  
class  
club  
corn  
cow  
cup  
day  
dog  
door  
dress  
face  
fire  
food  
glass  
gun  
hand  
key  
lock  
mail  
nut  
oil  
prize  
rice  
rock  
room  
seat  
shirt  
snow  
spoon

Subject 11

arm  
ball  
band  
bank  
bath  
bell  
bird  
box

Subject 12

arm  
ball  
band  
bank  
bell

Subject 13

arm  
ball  
band  
bank  
bath  
bell  
bird  
box  
cheese  
class  
club  
corn  
cow  
cup  
day

dog  
door  
dress  
face  
fire  
food  
glass  
gun  
hand  
key  
lock  
mail  
nut  
oil  
prize  
rice  
rock  
room  
seat  
shirt  
snow  
spoon  
spring  
stamp  
train  
tree  
wall

Subject 14

arm  
ball  
bank  
bath  
bell

Subject 15

arm  
ball  
band  
bank  
bell

Subject 16

arm  
ball  
band  
bank  
bath  
bell  
bird  
box  
cheese  
class  
club  
corn  
cow  
cup  
day  
dog  
door  
dress  
face  
fire  
food  
glass  
gun

Subject 17  
arm  
ball  
band

bank  
bath  
bell

Subject 18  
arm  
ball  
band

bank  
bath

## APPENDIX K: CORRELATIONS: PEARSON AND SPEARMAN

Table A1

Pearson Correlation: WM /L1 X L1 General Main Ideas

		WM /L1	L1_GENERAL MAIN IDEAS
WM /L1	Pearson Correlation	1,000	,448
	Sig. (1-tailed)	,	,031
	N	18	18
L1_GENERAL MAIN IDEAS	Pearson Correlation	,448	1,000
	Sig. (1-tailed)	,031	,
	N	18	18

\* Correlation is significant at the .05 level (1-tailed).

Table A2

Spearman Correlation: WM /L1 X L1 General Main Ideas

		WM /L1	L1_GENERAL MAIN IDEAS
Spearman's rho	Correlation Coefficient	1,000	,531
	Sig. (1-tailed)	,	,012
	N	18	18
L1_GENERAL MAIN IDEAS	Correlation Coefficient	,531	1,000
	Sig. (1-tailed)	,012	,
	N	18	18

\* Correlation is significant at the .05 level (1-tailed).

Table A3  
Pearson Correlation: WM /L2 X L2 General Main Ideas

		WM/L2	L2_GENERAL MAIN IDEAS
WM/L2	Pearson Correlation	1,000	,372
	Sig. (1-tailed)	,	,064
	N	18	18
L2_GENERAL MAIN IDEAS	Pearson Correlation	,372	1,000
	Sig. (1-tailed)	,064	,
	N	18	18

Correlation is significant at the .05 level (1-tailed).

Table A4  
Spearman Correlation: WM /L2 X L2 General Main Ideas

		WM/L2	L2_GENERAL MAIN IDEAS
Spearman's rho	WM/L2	Correlation Coefficient	1,000
		Sig. (1-tailed)	,
		N	18
L2_GENERAL MAIN IDEAS	L2_GENERAL MAIN IDEAS	Correlation Coefficient	,400
		Sig. (1-tailed)	,050
		N	18

Correlation is significant at the .05 level (1-tailed).

Table A5  
Pearson Correlation: WM /L1 X L2 General Main Ideas

		WM /L1	L2_GENERAL MAIN IDEAS
WM /L1	Pearson Correlation	1,000	,482
	Sig. (1-tailed)	,	,021
	N	18	18
L2_GENERAL MAIN IDEAS	Pearson Correlation	,482	1,000
	Sig. (1-tailed)	,021	,
	N	18	18

\* Correlation is significant at the .05 level (1-tailed).

Table A6  
Spearman Correlation: WM /L1 X L2 General Main Ideas

		WM /L1	L2_GENERAL MAIN IDEAS
Spearman's rho	WM /L1	Correlation Coefficient	,510
		Sig. (1-tailed)	,015
		N	18
L2_GENERAL MAIN IDEAS	L2_GENERAL MAIN IDEAS	Correlation Coefficient	1,000
		Sig. (1-tailed)	,015
		N	18

\* Correlation is significant at the .05 level (1-tailed).



Table A7  
Pearson Correlation: WM /L2 X L1 General Main Ideas

		WM/L2	L1_GENERAL MAIN IDEAS
WM/L2	Pearson Correlation	1,000	,033
	Sig. (1-tailed)	,	,448
	N	18	18
L1_GENERAL MAIN IDEAS	Pearson Correlation	,033	1,000
	Sig. (1-tailed)	,448	,
	N	18	18

Correlation is significant at the .05 level (1-tailed).

Table A8  
Spearman Correlation: WM /L2 X L1 General Main Ideas

		W M/L2	L1_GENERAL MAIN IDEAS
Spearman's rho	WM/L2	Correlation	1,000
		Coefficient	,072
		Sig. (1-tailed)	,
L1_GENERAL MAIN IDEAS		N	18
		Correlation	,072
		Coefficient	1,000
	Sig. (1-tailed)	,388	,
	N	18	18

Correlation is significant at the .05 level (1-tailed).

Table A9  
Pearson Correlation: WM /L1 X W /L2

		WM /L1	WM/L2
WM /L1	Pearson Correlation	1,000	,644
	Sig. (1-tailed)	,	,002
	N	18	18
WM/L2	Pearson Correlation	,644	1,000
	Sig. (1-tailed)	,002	,
	N	18	18

\*\* Correlation is significant at the .01 level (1-tailed).

Table A10  
Spearman Correlation: WM /L1 X W /L2

Correlations

		WM /L1	WM/L2
Spearman's rho	WM /L1	Correlation Coefficient	1,000
		Sig. (1-tailed)	,
		N	18
	WM/L2	Correlation Coefficient	,589
		Sig. (1-tailed)	,005
		N	18

\*\* Correlation is significant at the .01 level (1-tailed).

Table A11  
Pearson Correlation: L1 General Main Ideas X L2 General Main Ideas

		L1_GENERAL MAIN IDEAS	L2_GENERAL MAIN IDEAS
L1_GENERAL MAIN IDEAS	Pearson Correlation	1,000	,144
	Sig. (1-tailed)	,	,285
	N	18	18
L2_GENERAL MAIN IDEAS	Pearson Correlation	,144	1,000
	Sig. (1-tailed)	,285	,
	N	18	18

\*\* Correlation is significant at the .01 level (1-tailed)

Table A12  
Spearman Correlation: General Main Idea X L2 General Main Idea

		L1_GENERAL MAIN IDEAS	L2_GENERAL MAIN IDEAS
Spearman's rho	L1_GENERAL MAIN IDEAS	Correlation Coefficient	1,000
		Sig. (1-tailed)	,234
		N	,175
L2_GENERAL MAIN IDEAS		Correlation Coefficient	,234
		Sig. (1-tailed)	1,000
		N	,175
		18	18

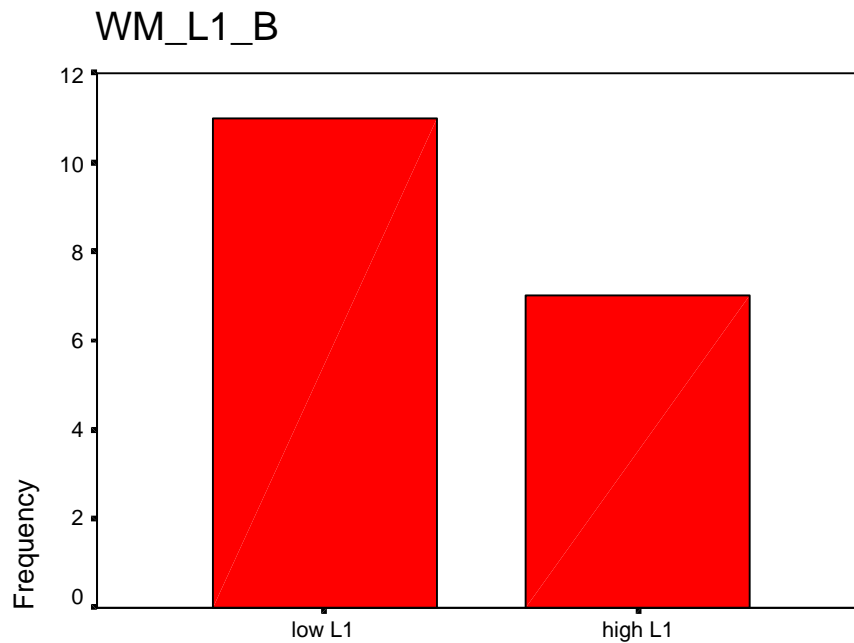
\*\* Correlation is significant at the .01 level (1-tailed)

APPENDIX L: WORKING MEMORY GROUPS: HIGH AND LOW SPAN  
READERS

PORTUGUESE

WM\_L1\_B

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 low L1	11	61,1	61,1	61,1
	2 high L1	7	38,9	38,9	100,0
	Total	18	100,0	100,0	



WM\_L1\_B

ENGLISH

WM\_L2\_C

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 low	10	55,6	55,6	55,6
	2 high	8	44,4	44,4	100,0
	Total	18	100,0	100,0	

