UNIVERSIDADE FEDERAL DE SANTA CATARINA
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CYNTIA BAILER

WORKING MEMORY CAPACITY AND ATTENTION TO FORM AND MEANING IN EFL READING

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Orientadora: Profa. Dra. Lêda Maria Braga Tomitch
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To my family

With all my love

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ABSTRACT

WORKING MEMORY CAPACITY AND ATTENTION TO FORM AND MEANING IN EFL READING

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2011
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Based on research on the relation between working memory capacity (WMC) and language comprehension performance and research on the simultaneous attention to form and meaning, this study investigates: (i) whether there is a correlation between working memory (WM), measured by the Reading Span Test (RST) and the Operation Span Test (OSPAN), and the ability to sustain attention between meaning and form while reading, measured by scores on the answers to a comprehension task and a form recognition task; and (ii) whether the type of attentional control (meaning/form) has a differential effect on EFL high school students' reading comprehension. Sixty-one participants were submitted to five data collection sessions which comprised two WM tests, three retrospective questionnaires, a task used to assess attention to form and meaning, and a feedback session. The task used to assess attention to form and meaning was composed of a control and an experimental condition and included a text to be read and comprehension questions. Participants in the control condition were required to read the text in 7 minutes and pay attention to meaning, while in the experimental condition, they were required to simultaneously read and highlight verbs in the simple past. In the following step, participants answered a comprehension exercise and were offered a feedback session. Data were analyzed and the statistical procedures adopted revealed, in general terms, that attention to form and meaning in L2 reading is affected by individual differences in WMC. The major contribution of this study is that WMC seems to play a role in attending to form and meaning, that is, individual differences in WMC were shown to determine efficient performance in the task of paying attention to form and meaning while reading in a population of EFL high school students.

Keywords: Working Memory. Attention to form and meaning. Reading.
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RESUMO

WORKING MEMORY CAPACITY AND ATTENTION TO FORM AND MEANING IN EFL READING

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Com base em pesquisas sobre a relação entre capacidade de memória de trabalho e o desempenho em tarefas linguísticas e pesquisas sobre atenção simultânea à forma e ao significado, este estudo investiga: (i) se há uma correlação entre memória de trabalho, medida pelo Teste de Capacidade de Leitura (RST) e o Teste de Memória de Trabalho para Operações Matemáticas (OSPAN), e a habilidade de sustentar atenção à forma e significado durante a leitura, medida pelos escores numa atividade de compreensão e uma atividade de reconhecimento de forma; e (ii) se o tipo de controle de atenção (significado/forma) tem um efeito diferencial na compreensão de leitura de estudantes de ensino médio de inglês como língua estrangeira. Sessenta e um participantes foram submetidos a cinco sessões de coleta de dados que compreenderam dois testes de memória de trabalho, três questionários retrospectivos, uma atividade usada para avaliar atenção à forma e significado, outro questionário e uma sessão de *feedback*. A atividade de avaliar atenção era composta de uma condição controle e outra experimental e incluía um texto para ser lido e questões de compreensão. Os participantes do grupo controle leram o texto em 7 minutos prestando atenção ao significado enquanto na condição experimental, leram e destacaram simultaneamente os verbos no passado. Na sequência, responderam um exercício de compreensão e tiveram uma sessão de *feedback*. Os dados, analisados estatisticamente, revelaram, em termos gerais, que a atenção à forma e significado em leitura em L2 é afetada pelas diferenças individuais na capacidade de memória de trabalho. A maior contribuição deste estudo reside no fato de que as diferenças individuais na capacidade de memória de trabalho parecem determinar o desempenho eficiente na atividade de prestar atenção à forma e ao significado durante a leitura de uma população de estudantes de ensino médio de inglês como língua estrangeira.

Palavras-chave: Memória de trabalho. Atenção à forma e significado. Leitura.
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LIST OF ABBREVIATIONS AND SYMBOLS

PPGI – Programa de Pós-Graduação em Inglês UFSC
WM – working memory
L2 – second language
EFL – English as a foreign language
SLA – second language acquisition
WMC – working memory capacity
RST – Reading span test
OSPAN – Operation-word span test
LTM – long-term memory
IP – input processing
FonF/FoF – focus on form
RQ – research question
N – number of participants
TCLE – Termo de Consentimento Livre e Esclarecido
RST_S – strict scoring procedure applied to the RST
RST_L – lenient scoring procedure applied to the RST
OSPAN_S – strict scoring procedure applied to the OSPAN
OSPAN_L – lenient scoring procedure applied to the OSPAN
OSPAN_LC – second lenient scoring procedure applied to the OSPAN
SEstatNet - Sistema Especialista para o Ensino de Estatística na Web
p level – probability level (α)
r_s – Spearman's correlation coefficient
CQ – comprehension questions
r – Pearson's correlation coefficient
CPF – correct past forms
M – mean

CHAPTER 1
INTRODUCTION

1.1 PRELIMINARIES

Working memory (WM) plays a special and indispensable role in human cognition. Daily cognitive tasks, such as reading, calculating, mentally rearranging a place to accommodate another piece of furniture, frequently entail various steps with intermediate results that ought to be maintained temporarily in mind so as one can solve the task successfully. WM is the theoretical construct that has been used in cognitive psychology to refer to the integrated system that temporarily stores and manipulates information during the performance of a cognitive task (Baddeley & Hitch, 1974; Baddeley, 2001). This study deals with WM for language, more specifically, for information processing in language comprehension (Just & Carpenter, 1992).

Several studies have found positive correlations between WM and performance in language comprehension tasks (Daneman & Carpenter, 1980, 1983; Daneman & Green, 1986; Miyake, Just & Carpenter, 1994; Tomitch, 2003a, 2003b; Turner & Engle, 1989; to mention but a few). Most of the studies in this area were carried out in the participants' mother tongue, generally English. Just a few studies have investigated the relationship between WM and L2 language tasks involving skills such as reading and speaking (Alptekin & Erçetin, 2009; 2010; Bergsleithner, 2010; Finardi, 2009; Fontanini et al., 2005; Fortkamp, 2000; Prebianca, 2009; Torres, 2003; Weissheimer, 2007). Therefore, it is believed that there is broad field to investigate the relationship between WM and comprehension of English as a foreign language (EFL).

Attention, as well, has been a matter of interest for scholars in the areas of psychology, linguistics and neuroscience. Its definition is controversial; for some people it is the mind control to focus on a specific thought or thing, for others, the difficulty experienced in trying to deal with two or more activities at the same time (Pashler, 1992; Schmidt, 2001). Nevertheless, it is a general consensus that some people are more capable of paying attention to something or some things for a specific period of time than others. Although much is known about the role of attention in perception and visual processes, the role of attention in the control of memory and action has been less studied (Robinson, 1995). A central issue resides in the role attention plays in reducing and controlling the flow of information (Tomlin & Villa, 1994). It is

believed that attention is related to WM, as in the central executive component proposed by Baddeley and Hitch (1974), though some theoreticians do not explicitly relate them.

The role of attention in second language acquisition (SLA) has been extensively studied. Theoretical models postulated an important role for attention in foreign language development (Robinson, 1995; Schmidt, 1990, 2001; Tomlin & Villa, 1994, VanPatten, 1994). It is known that during language acquisition, the learner goes through widespread and pervasive cognitive changes. The learner is overwhelmed by the incoming L2 input, and attention serves to bring order to the chaos by sorting out that input, sometimes succeeding in helping or even overwhelming the learner. Unlike native speakers, L2 learners ought to develop the ability to comprehend, and comprehension in real time may tax the computational resources (VanPatten, 2007). The Input Processing model, proposed by VanPatten, assumes that L2 learners process information for meaning first, and as these learners are limited-capacity processors, form competes with meaning for attentional resources during moment-by-moment processing for comprehension. Attention to form at the expense of meaning may result in decrements in comprehension. Research results from VanPatten (1990, 1994, 2007), Greenslade, Bouden and Sanz (1999), Wong (2001), Leow, Hsieh and Moreno (2008) and Bailer and D'Ely (2009) show that during input processing, available attentional resources are limited and compete for certain aspects of the input. These results differ, due to the nature of the studies, input modality and population investigated, therefore pointing out to some issues that need to be addressed by further studies in order to improve the way input processing and attention are understood.

Therefore, up to the present time and to the knowledge of this researcher, no studies have investigated the relationship, if there is any, between working memory capacity (WMC) and attention to form and meaning in L2 reading.

1.2 STATEMENT OF PURPOSE

The basic assumption underlying this study is that WMC may be related to the ability to sustain attention to form and meaning in L2 reading. WMC may affect comprehension, with higher spans performing better than lower spans. As well, higher spans may be better able to sustain attention to form and meaning while reading.

In order to contribute to the context presented above, the main objective of the present study is to investigate, in a population of EFL

high school students, the relationship between individual differences in WMC and the learners' simultaneous attention to form and meaning. More specifically, this study aims at investigating (i) whether there is, if any, correlation between WMC and the ability of sustaining attention to form and meaning while reading and; (ii) whether the type of attentional control, namely meaning and form, has a differential effect on reading comprehension. WMC is measured by two well-established WM tests, the Reading Span Test, henceforth the RST (Daneman & Carpenter, 1980) and the Operation-word span test, henceforth the OSPAN (Turner & Engle, 1989) in their Portuguese versions (adapted from Tomitch, 2003a; Prebianca, 2009, respectively) and L2 reading is assessed through a reading comprehension exercise and focus on form is tackled by underlining a specific grammatical feature (the past tense verbs) while reading. Retrospective questionnaires are administered so as to unveil participants' impressions on the tasks they performed with the purpose of helping to understand the variables involved.

1.3 SIGNIFICANCE OF THE STUDY

This study adds to existing research on individual differences in WMC as well as on the issue of simultaneous attention to form and meaning in four major ways. First, as previously pointed out, no studies to date, to the best of this researcher's knowledge, have investigated the relationship between WMC and attention to form and meaning. Second, this study uses the RST and the OSPAN to check whether both tests have the same relationship with L2 reading comprehension, it means, whether evidence is encountered for the task-specific view or the general capacity hypothesis. Third, it makes use of verbal past tense forms, which carry both form and meaning, to assess attention to form while reading in order to verify the effect of different attentional conditions (reading only for meaning and reading for meaning and form simultaneously). Fourth, its importance relies on the fact of being carried out in a Brazilian high school setting with teenagers, a population scarcely researched in the literature of these two areas, WMC and attention.

Thus, this study might contribute to the field of psycholinguistics by adding empirical data regarding the nature of capacity limits in WM, attention, the processing of input and reading comprehension in the L2. Finally, this study might also find its interface with pedagogical issues as the results might shed some light on the effect of individual differences and the role it plays in attention to form and meaning in

reading. All in all, it is an attempt to understand the role that variables such as WM and attention might play in influencing the learners' reading comprehension processes.

1.4 ORGANIZATION OF THE THESIS

In order to report on the study conducted to explore the relationship between WMC and attention to form and meaning in L2 reading, the present thesis is organized into 5 chapters, including the present introductory chapter (1).

Chapter 2 reviews theoretical and empirical work on reading, WM and attention. Initially, attention is devoted to the view of reading adopted by this study. Then, the concepts and views of WM are discussed, as well as the state of the art research in individual differences in WMC. And finally, a review is provided on the role of attention through the input processing perspective.

Chapter 3 outlines the objectives, research questions and hypotheses that guide this investigation. In addition, it describes the methodological decisions and procedures adopted in the present study, including a description of participants, instruments of data collection and analysis, task procedures and the statistical test run with the data.

Chapter 4 reports and discusses the results of the descriptive statistics and the correlational analysis following the order of the session in which the data were collected.

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 some pedagogical implications as regards the treatment of reading in classroom settings, and the role attention plays in the learning process.

CHAPTER 2
REVIEW OF LITERATURE

This chapter aims at presenting some theoretical background and empirical data about reading, WM and attention. It is organized in three sections: (1) the first part brings the view of reading adopted by this study; (2) the second section, subdivided into models of WMC and individual differences, discusses the concepts and views of WM and presents the state of the art of research in individual differences in WMC; and (3) the third section, subdivided into information/input perspective and research on attention to form and meaning, aims at providing a review on the role of attention, especially through the input processing point of view. The review of the literature presented here tried to cover the aspects that were considered fundamental in each area discussed and which were used to frame this investigation.

2.1 ON READING

The present study views reading as a complex cognitive process, not just as a final product to be analyzed (Tomitch, 2008). This researcher follows Aebersold and Field (1997, p.15) when they say that it is "the interaction between text and reader that constitutes actual reading". This construct is represented by models that attempt to describe the process from a somewhat different perspective, with a different focus. The aim of this section is to provide a brief review of the three major reading models[1], namely bottom-up, top-down and interactive, in relation to reading in a second language.

The bottom-up model, proposed by Gough (1972, as cited in Samuels & Kamil, 1998), posits that the reader constructs the meaning of a text from the smallest units (from letters to sounds, to words, to sentences, and finally to meaning and thinking). This process can be considered laborious and sequential, thus, compared to a stairway, since the reader starts by the simplest visual units, processing letters in parallel, and ends up with a higher process, which is meaning. It is applicable to beginning L2 readers, since they do not have a lot of knowledge about the language and need to go step by step, from letters, until they access meaning. For fluent readers, the process is so automatic

[1]Reading models are metaphors which try to explain what happens inside the individuals' mind while reading. They were created in the past and are crucial for the actual state of affairs in reading. Nevertheless, it is important to highlight that each reading situation is unique, thus, no model can be able to account for all reading phenomena (Samuels & Kamil, 1998).

that they are not aware of how it operates, unless they are confronted with a new word or a difficult sentence. According to Davies (1995), the bottom-up model imposes a very heavy load on WM, as the reader focuses on low-level sources of information, such as visual decoding, word-recognition, at the expense of higher-order ones, such as making predictions, accessing meaning and monitoring comprehension (Tomitch, 2003b). This model is often criticized because of its emphasis on visual decoding and on the physical text on the page (text-driven process). According to Urquhart and Weir (1998), it is difficult to see how one stage is over before the next begins. The bottom-up view is considered the model of the reading aloud process.

The top-down model (Goodman, 1969, as cited in Samuels & Kamil, 1998) postulates that processing occurs from larger units such as thinking and making predictions to progressively smaller units as literal comprehension and decoding. Using the metaphor of the stairway, the reader seems to be at the top of the stairway, with her/his predictions and hypotheses about the text and then goes down, step by step, to simpler units, like words and letters, and then, with the text data, s/he goes back to her/his hypotheses and predictions in order to confirm or refute them, and senses meaning. According to the model, readers fit the text into cultural, syntactic, linguistic, historical knowledge they already possess, then check back when new or unexpected information appears. In this model, reading is considered a psycholinguistic guessing game, being the good reader, the good guesser (Goodman, 1998). It can be applicable to fluent L2 readers, not to beginners, since they might encounter serious difficulties because of their low level of knowledge about the language. This reader-driven model has received much criticism (Eskey & Grabe, 1998) due to devoting much emphasis on background knowledge, text cues, context, expectations and devoting minor attention to linguistic knowledge and to the decoding stage.

The interactive model proposed by Rumelhart (1977) comes as an alternative, since it incorporates "the possibility of parallel processing, […] simultaneous processing of information from more than one source" (Davies, 1995, p.63). In this model, there is no predetermined direction or sequence. Reading becomes a process that moves both bottom-up and top-down, depending on the type of text as well as on readers' background knowledge, language proficiency level, motivation, strategy use and, culturally shaped beliefs about reading (Aebersold & Field, 1997; Smith, 1994). For Eskey and Grabe (1998, p.224), "skills at all levels are interactively available to process and interpret the text". This model accounts for an ideal situation of reading, the reading of

proficient readers. It seems to explain why beginner readers rely so much on semantic guessing and decoding – they spend much time on processing letters and words because they are learning how to do it automatically – and fluent readers do not, because they already process letters and words automatically and can use their time to higher-order processing, such as making and confirming or refuting predictions. Stanovich (1980, as cited in Samuels & Kamil, 1998) proposed the interactive-compensatory model, in which a skill can be compensated for by strength in another area. For instance, L2 readers may use their schemata – "data structures for representing the generic concepts stored in memory" (Rumelhart, 1981, p.5) to compensate for linguistic deficiencies. As well, the term threshold level – minimum linguistic knowledge - has been used to explain why background knowledge or reading skills are unable to compensate for a lack of linguistic proficiency.

Having discussed these models, an important question remains: what is the best model? Definitely none. Davies (1995, p.82) asserts that "no single model of reading accounts for the complex range of reading behaviors which are observable in different contexts". Furthermore, most models account for the ideal, the fluent reader with developed knowledge systems and skills. In relation to L2 learners – the population of this study -, each model has a limited contribution to make, since they are readers under development, with gaps and limitations (Eskey & Grabe, 1998). Therefore, each model has a contribution to make to the L2 learner in each stage of the learning process, be limited or not.

As aforementioned, reading is viewed in this study as a complex cognitive process and as the interaction between text and reader. Since each reader assigns meaning(s) to the written symbols in the text and taking into account his own personal characteristics such as motivation, aptitude, WMC, background knowledge, influences by family and cultural environment, reading comprehension differs from one reader to the other. In the subsection that follows, attention is given to the term WM, its models and the individual differences in WMC.

2.2 ON WORKING MEMORY (WM)

Experimental psychology has been investigating the role short-term memory/working memory[2] plays in human cognition for a long

[2]The terms short-term memory and working memory are brought together in this introductory part to illustrate that for some time these two terms were used interchangeably.

time. According to Tomitch (2003a), early theories considered it a system with a fixed number of slots that could hold information for retrieval for some time after a brief period of time. In other words, it was considered a passive unitary system with limited capacity to process and store information (Robinson, 2001).

Nowadays, short-term memory is seen as a dynamic system, an arena where processing and storage interact (Daneman & Carpenter, 1980; Just & Carpenter, 1992; Cantor & Engle, 1993; and others). Baddeley and Hitch (1974) proposed the term 'working memory' for this more active system, a dedicated memory system that maintains, stores and manipulates information in the short term for cognitive tasks such as language comprehension, learning and reasoning. It is known as 'an arena of computation' where storage and processing compete for capacity in the system (Daneman & Carpenter, 1980; Just & Carpenter, 1992; Tomitch, 2003a; and others). Baddeley and Logie (1999, p.28) point out that WM allow people

> to comprehend and mentally represent their immediate environment, to retain information about their immediate past experience, to support the acquisition of new knowledge, to solve problems, and to formulate, relate, and act on current goals.

Although there is no consensus in the field whether short-term memory can be equated to WM or not, two aspects of the early theories have been preserved: its transience and limitation in capacity. However, former and recent theories view the concept of limitation differently (Miyake & Shah, 1999; Tomitch, 2003a). While short-term memory presents limitations in the number of stored items, WM presents limitations in the number of available attentional resources for the processing and storage of information. Ashcraft (1994, as cited in Tomitch, 2003a) reveals that the term WM uses the active verb 'work', being it the place where mental activity happens. For the author, its limitation resides in how much work may be done at a time, how much WMC is available to be shared among the simultaneous processes.

2.2.1 Models of WM

Baddeley and colleagues (Baddeley & Hitch, 1974, 1994; Baddeley 1992; Baddeley & Logie, 1999) proposed a multicomponent model of WM consisting of a control system of limited attentional

capacity, termed the central executive, which is assisted by two subsidiary storage or 'slave' systems: the phonological loop and the visuospatial sketchpad. In 2000, a fourth component was added to the model, the episodic buffer (Baddeley, 2001, 2003; Baddeley & Repovš, 2006). It is suggested that WM "stands at the crossroads between memory, attention and perception" (Baddeley, 1992, p.559). In what follows, a brief description of each component is presented.

The central executive plays various executive functions, such as focusing, dividing and switching attention, relating content of WM to long-term memory (LTM) besides coordinating the subsidiary systems. Baddeley and Hitch (1994) suggested that the central executive component might be equated to the Supervisory Attentional System, proposed by Norman and Shallice (1986). Briefly, these authors assume that actions occur through the activation of schemas automatically, but when concurrent activities conflict with one another, action goals can enhance activation of some schemas and inhibit activation of others. Due to its numerous attributions, the central executive has been criticized as being a homunculus, a little man who takes the important decisions as to how the two slave systems should be used (Miyake & Shah, 1999). Until now, this component is the least empirically studied and the least understood.

The phonological loop, the most empirically studied component, stores and rehearses speech-based information. It is often regarded as the inner voice. Evidence supporting the loop comes from a range of different phenomena, such as the phonological similarity effect, the irrelevant speech effect, the word length effect and articulatory suppression (see Baddeley, 1992 for a complete description). Baddeley (1992, 2001) argues that it is necessary for the acquisition of both native and second language vocabulary.

The visuospatial sketchpad, regarded as the inner eye, is the workplace for holding and manipulating visual and spatial information. It is involved in visual perception, planning and executing spatial tasks, maintaining orientation in space and directing spatial movement (Baddeley, 1992; Baddeley & Hitch, 1994). Baddeley (2003, p.833) suggests that visual WM is "limited in capacity, typically to about three or four objects".

The latest component, the episodic buffer, is assumed to represent a storage system using a multimodal code. It is episodic in the sense that it holds integrated episodes or scenes and a buffer in providing a limited capacity interface between systems using different codes (Baddeley, 2001, 2003). Besides, it is assumed to combine information from LTM

with that from the subsidiary systems, to be attentionally controlled by the central executive and to be accessible to conscious awareness. Its central feature resides in the fact that it is compatible with approaches to WM based on individual differences, as the findings/correlations between WM span tasks and performance on a wide variety of tasks (Baddeley & Repovš, 2006).

Clearly, Baddeley and Hitch's (1974) model is a more complex and elaborated proposal than that of earlier unitary models. Contrasting to what was exposed in the previous section, Baddeley's model emphasizes a multicomponent system dynamic in nature. This model was groundbreaking, since it proposed a new paradigm of research on human memory. Almost four decades of research resulted in a number of interpretations of the construct WM. Miyake and Shah (1999) edited a book with 10 different views/models on WM, representing different approaches to the study of the system, differences in nature, structure and functions. These diverse approaches, even though positive to the field, may reflect conflicting views. Although researchers agree that WM refers to the system responsible for the temporary storage and processing of information required for the performance of complex cognitive tasks as learning, comprehending, producing language, reasoning, thinking, problem solving (Cantor & Engle, 1993; Daneman & Carpenter, 1980, 1983; Masson & Miller, 1983; among many others), there seems to be no agreement whether WM consists of various components or is a unitary system and whether the capacity of the system varies as a function of the task or is stable. Nevertheless, the field agrees that WM is the center where cognitive action takes place. Miyake and Shah (1999, p.450) propose the following, all-encompassing definition:

> Working memory is those mechanisms or processes that are involved in the control, regulation, and active maintenance of task-relevant information in the service of complex cognition, including novel as well as familiar, skilled tasks. It consists of a set of processes and mechanisms and is not a fixed "place" or "box" in the cognitive architecture. It is not a completely unitary system in the sense that it involves multiple representational codes and/or different subsystems. Its capacity limits reflect multiple factors and may even be an emergent property of the multiple processes and mechanisms involved. Working memory is closely linked to LTM, and

> its contents consist primarily of currently activated LTM representations, but can also extend to LTM representations that are closely linked to activated retrieval cues and, hence, can be quickly reactivated.

Research on WM may be distinguished in two different but complementary approaches, the psychometrical and the study of neuropsychological cases. Both make use of the dual-task methodology, what in turn, consists of asking participants to perform two tasks simultaneously, a processing and a storage task, as asking them to hold a list of words or a sequence of numbers while performing a reasoning, learning or comprehension task. The psychometrical approach focuses on the extent to which performance on WM tasks can predict individual differences in cognitive skills. It consists of correlating performance on dual tasks such as the RST (Daneman & Carpenter, 1980) and the OSPAN (Turner & Engle, 1989) with performance on cognitive tasks such as reading comprehension. The other approach, led by Baddeley and colleagues, makes use of the dual-task methodology and evidence from neuropsychological cases with the aim of analyzing the structure of the WM system. While Baddeley is interested in understanding the system itself, the approach to memory taken in this investigation is the one related to the psychometrical correlational approach which, in turn, concentrates on devising tasks which involve the processing and storage of information in WM (Tomitch, 2003a). Furthermore, this study deals with WM for language, as stated in Just and Carpenter (1992, p.123), that is seen as "a set of processes and resources that perform language comprehension".

2.2.2 Individual differences

As previously mentioned, there are individual differences in reading comprehension due to a number of factors, such as motivation, previous knowledge, activation of schemata and WMC. Concerning the latter, there is agreement among researchers that it plays an important role in all kinds of human cognitive activities (Kintsch et al., 1999; Tomitch, 2003a, 2003b), as it is the system responsible for simultaneous storage and processing of information. Researchers such as Just and Carpenter (1992) and Cantor and Engle (1993) propose WM as an arena of computation where processing and storage interact, competing for capacity in the system, as has already been mentioned previously. Thus,

the issue related to reading raised by Tomitch (2003a, p.24) is "how a reader manages to construct a meaningful representation of the text considering the great storage and processing demands required in the process of reading". Daneman and Carpenter (1980, p.450) explain that, while reading,

> the reader stores pragmatic, semantic and syntactic information from the preceding text and use it in disambiguating, parsing and integrating the subsequent text. Information can become part of working memory through several routes: it may be perceptually encoded from the text; it may be sufficiently activated so that it's retrieved from long-term memory; finally, it may be the output of a comprehension process. Information can be also lost from working memory, since its capacity is assumed to be limited.

The psychometric correlational approach assumes that this limited capacity differs among individuals and that these differences are good predictors of performance on cognitive tasks: individuals with larger WMC perform better on these tasks than individuals with smaller capacity. The explanation proposed is that who has greater WMC is able to hold in WM more information relevant to completing complex tasks, as a result showing better performance (Whitney, Ritchie & Clark, 1991; McNamara & Scott, 2001).

Research on individual differences in WMC has been most extensively carried out in the L1 and has found positive correlations with a wide range of higher order cognitive tasks, such as reading and listening comprehension (Daneman & Merikle, 1996); and enumeration (Tuholski, Engle & Baylis, 2001). According to Engle, Kane and Tuholski (1999, p.103), there are other areas that have found correlations with WMC, such as learning to spell, following directions, notetaking, writing, reasoning. As well, some researchers (Engle, Tuholski, Laughlin & Conway, 1999; Unsworth & Spillers, 2010) have noticed relationships between WMC and general fluid intelligence[3].

Specifically in the area of reading in L1, several studies have found correlations with WMC, as vocabulary learning from context (Daneman & Green, 1986); inference generation of different types (Mason & Miller, 1983; Daneman & Carpenter, 1983; Whitney, Ritchie

[3]According to Engle, Tuholski, Laughlin and Conway (1999, p.313), *g*F refers to "the ability to solve novel problems and adapt to new situations and is thought to be nonverbal and relatively culture free".

& Clark, 1991; Singer, Andrusiak, Reisdorf & Black, 1992); resolution of lexical ambiguities (Miyake, Just & Carpenter, 1994); adjusting processing and strategies to fit reading purposes (Linderholm & van den Broek, 2002); strategy implementation for reading expository text (Whitney, Ritchie & Clark, 1991; Budd, Whitney & Turley, 1995); and text structure (Tomitch, 2003a; 2003b). All these studies were conducted with English as the L1, except for Tomitch's works which were conducted in Portuguese, as an L1.

Few studies, to the knowledge of this researcher, have investigated the relationship between WMC and tasks performed in the L2: reading comprehension (Fontanini, 2007; Alptekin & Erçetin, 2009); main idea construction in L1 and L2 (Torres, 2003); inferential comprehension in reading (Alptekin & Erçetin, 2010); writing performance (Bergsleithner, 2010); speech production (Fortkamp, 2000; Prebianca, 2009; Finardi, 2009); speech development (Weissheimer & Mota, 2009); and different skills (Fontanini et al., 2005). Research on bilingualism has found that, compared to monolinguals, bilinguals are better able to direct their attention to task-relevant information and further maintain their attention despite adverse interference (Yang et al., 2005). However, up to the present time and to the knowledge of this researcher, no studies have investigated the relationship, if there is any, between WMC and attention to form and meaning in L2 reading.

Studies pointed out hitherto were just possible because researchers have devised tasks to measure WMC. Initially, researchers used tasks as the digit span and the word span that required participants to hold passively a small amount of information and rehearse it without further management. These tasks proved to assess short-term memory. Daneman and Carpenter (1980) created a task, supposed to tax both the processing and storage functions of WM, the RST. It involves the comprehension of sentences in addition to the recall of the last words of a group of presented sentences and a person's reading span is the maximum number of final words recalled in the order they were presented (see chapter 3 for details). As Tomitch (2003a, p.33) explains, the results obtained "are then used to predict performance on other cognitive skills such as reading, comprehension and reasoning". As the RST presents heavy processing requirements, the underlying assumption (Daneman & Carpenter, 1980) is that these requirements may decrease the amount of additional information that can be maintained.

In 1989, Turner and Engle devised the OSPAN test, which follows the general capacity hypothesis and consists of performing simple math operations in addition to the recall of words in groups (see

chapter 3 for details). As pointed out by Daneman and Merikle, in their meta-analysis of 77 studies (1996, p.428), math processes plus storage measures predict comprehension, since it reveals the "individual's efficiency at executing a variety of symbolic manipulations and computations that is related to comprehension ability".

Both tests, the RST and the OSPAN, are widely used measures of WMC, which proved to be both reliable and valid (Conway et al., 2005). In their meta-analysis Daneman and Merikle (1996) found that verbal processes plus storage measures of WMC are better predictors of global comprehension (r = .41) than are the math processes plus storage measures (r =.30). It has been claimed that the RST measures, besides WMC, verbal ability; and the OSPAN test, may also tap mathematical ability, motivation, and word knowledge, among other factors (Conway et al., 2005). In addition, as Engle, Tuholski, Laughlin and Conway (1999, p.318) state, "if the OSPAN and the RST primarily reflect WM as hypothesized they should be more highly correlated between themselves". These researchers found a moderate correlation between the two tests (.51). To this discussion, it is important to bear in mind that WM span tasks are not perfect or process pure, and that comparisons among studies are difficult to draw because each piece of research investigates a different population, almost all of them, undergraduate and graduate students with a limited range and different number of participants. Even though, the extensive literature on this issue has shown them to be valid and strongly reliable measures of WMC. Conway et al. (2005, p.776) illustrate this issue by saying "irrespective of what WM span tasks are *supposed* to measure, evidence suggests that they measure, with reasonable accuracy, whatever it is that they *actually* measure". To the knowledge of this researcher, no studies have investigated WMC by means of the RST and the OSPAN test, in a population of high school students of English as a foreign language.

As a result, two theoretical proposals can be traced in the literature regarding the nature of the relationship between WMC and performance in cognitive tasks (Daneman & Carpenter, 1980; Turner & Engle, 1989). Empirical evidence has confirmed both positions, namely, the task-specific view and the general view. Daneman and Carpenter (1980) postulate that WMC is specific, by emphasizing that an individual's capacity varies according to the efficiency in relation to the processes correlated with a particular task. Following this line, the RST is considered a good predictor of comprehension because it captures many of the processing requirements of sentence comprehension, and as a result present an excellent probability of tapping WM aspects which

are relevant to language comprehension (Daneman & Merikle, 1996; Friedman & Miyake, 2004). As Cantor and Engle (1993, p.1102) state, "when reading, good readers have fast and efficient reading processes that require less WMC than those of poor readers. Thus, good readers have functionally more capacity in reading-related tasks".

On the other side, Engle and colleagues (Turner & Engle, 1989; Engle, Cantor & Carullo, 1992; Engle, Kane & Tuholski, 1999; Kane, Conway & Engle, 1999) are in favor of the unitary capacity hypothesis, the general view, which considers WMC independent of task nature. They postulate that individual differences have implications for any task that is attention demanding and requires controlled effortful processing. In this view, higher spans have more limited capacity attentional resources available to perform a task regardless of the specific nature of the task. Therefore, the OSPAN test can be used to predict reading comprehension, among other skills. Contrary to the task-specific view, people do not differ in terms of processing efficiency but in the total amount of activation available to retrieve information from LTM, independent of the nature of the task (Cantor & Engle, 1993).

Following research findings, Just and Carpenter (1992) brought a revised version of the task-specific view. It presupposes the existence of general skills that are used in any task requiring the manipulation of language. According to Singer et al. (1992, p.540), "the relationship between reading span and language comprehension may be interpreted in terms of either the total activation capacity of WM or the efficiency of computational processes". In this realm, Just and Carpenter (1992, p.122) proposed a computational theory called "Capacity Constrained Comprehension", which shows how WMC constrains comprehension. The authors state that "both processing and storage are mediated by activation and that the total amount of activation available in working memory varies among individuals". When the resource demands of the task exceed the available supply, processing slows down, partial products are generated and performance is affected. Higher spans display more residual capacity to store the words to be remembered in the span task, for the reason that they are more efficient at retrieving information from LTM and at allocating their resources to meet the demands of the task. Furthermore, they present advantages in comprehension and "their extra capacity could also provide the resources to permit better induction of word meanings and hence better vocabulary acquisition" (Just & Carpenter, 1992, p.146).

The question related to what view to follow remains unanswered, since research findings have supported both lines. Miyake and Shah

(1999) propose the rejection of this simple dichotomous view by declaring the 'bankruptcy' of a completely unitary view of WM. For them, it is necessary to specify the source/sources of domain-specific effects found in experimental and correlational studies. Juffs and Harrington (2011, p.137), in a recent review about research on WM in SLA, state that WM cannot be considered a unitary construct and its role is different depending on the age of the L2 learners, the task and the linguistic domain. According to them, future research should concentrate on using more standardized, replicable measures of WM and matching these tests more closely with linguistic tasks. In the subsection that follows, a review on the definition and role of attention is provided through the input processing point of view.

2.3 ON ATTENTION

> Everyone knows what attention is. It is the taking possession by the mind in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration of consciousness, are of its essence. It implies withdrawal from some things in order to deal more effectively with others. (William James, 1890, as cited in Schmidt, 2001, p.12)

Attention has been a matter of interest for a very long time, dating back to 1890, and has been investigated mainly by psychologists, cognitive psychologists, and more recently, psycholinguists and neuroscientists. The definition of the term is controversial, sometimes even considered as a vague concept. For many people, it is used to speak of the difficulties experienced in carrying out more than one activity at the same time (Pashler, 1992). The role of attention in perception and visual processes, as signal detection and pattern recognition is well known; nevertheless the role of attention in the control of memory and action has been less studied (Baddeley, 1986 in Robinson, 1995). Above all adversities, there is agreement that the attention system has the role of reducing and controlling the influx of information, given that humans, as cognitive organisms, are constantly bombarded with overwhelming amounts of information (Tomlin & Villa, 1994).

The role of attention in SLA has been extensively studied in recent years. Theoretical models, although of different nature, have proposed an important role for attention in foreign language

development (Schmidt, 1990, 2001; Tomlin & Villa, 1994; VanPatten, 1994, 2007; Robinson, 1995). During acquisition, the learner goes through widespread and pervasive cognitive changes. According to Tomlin and Villa (1994, p.183), "the learner must create new knowledge representations for the second language grammar as well as develop the processing capabilities to produce and comprehend L2 speech in real time". In the SLA literature, two efforts associated with attention can be identified and stand out for their significance to the field. The first concerns Schmidt's ideas (1990) about the role of noticing[4] in SLA, a necessary condition in the language learning process and facilitative for other aspects of learning. The second concerns the interaction of attention to form with attention to meaning, being the former employed to aid in the comprehension of the meaning and the latter, employed to aid in the psycholinguistic processing of the components of an utterance. The premise underlying these constructs is that processing of both (meaning and form) require of the learner conscious attentional effort, "then tasks involving both simultaneously will, by exceeding total attentional capacity, result in degradation of comprehension when form receives the greater emphasis of conscious effort" (Tomlin & Villa, 1994, p.186). From the perspective of acquisition, grammar learning is improved when the learner pays attention to the linguistic form while from the viewpoint of instruction, the learner's knowledge and control of grammar is enhanced when the teacher can direct the learner's attention to linguistic form.

Four main concepts of attention have influenced research in SLA: attention as capacity, as selection, as effort and as control of information and action. The first, attention as a limited-capacity system is based on Kahneman's capacity theory (1973) that sees attention as a limited-capacity channel, in which information competes for limited attentional resources available to the processor. The tasks individuals perform differ in the demands they make on attention, that's why task difficulty can be defined in terms of capacity consumption (Robinson, 2001). According to this theory, "sustaining attention to tasks which are high in their capacity demands are more effortful than sustaining attention to tasks which are low in demands" (Robinson, 2001, p.653). This issue is tackled by studies of divided attention that have found that as the

[4]Schmidt's Noticing Hypothesis (2001) views attention as a key variable in the process of L2 learning. For him, "noticing is therefore the first step in language building, not the end of the process" (p.31). The term 'noticing' has been conceptualized under different perspectives. Tomlin and Villa (1994) use "detection within selective attention"; and Robinson (1995) uses "detection plus rehearsal in short-term memory".

number of task dimensions or components to be processed increase, there is reduction in performance (Robinson, 1995). In this sense, capacity limits are used to explain the 'mental load', the difficulty of controlled processing and L2 processing during complex and dual-task performance. Pashler (1992) explains that performing two tasks simultaneously entail rapid switching back and forth of attention between them.

The second concept, attention as selection, brings the view that some tasks require more attention than others, that attention is implicated in the processing of information and also in the performance of tasks. As attention is limited, any activity drawing upon it will interfere with other activities that require it, thus, attention must be strategically allocated (Schmidt, 2001). According to Robinson (2001, p.635), selection is a means of action control, as "actions are responses to task demands, and allocation of attention to input with the goal of meeting these demands is the result of control processes, operationalized in short-term/working memory". Heitz, Unsworth and Engle (2005, p.63) consider attention responsible for maintaining information "through activation of relevant brain circuitry, inhibit irrelevant and distracting information that impinges on us at any one time, and suppress prepotent response tendencies that are task irrelevant". Studies with dichotic listening tasks (Robinson, 1995) provide evidence to attention as the process of selecting critical information for further processing.

The third, attention as effort, a state concept, refers to the "energy or activity in the processing system, not to structural processes such as selecting, allocating resources, and rehearsing information in memory" (Robinson, 2001, p.651). Despite processing limitations of the human mind, it can run two tasks concurrently, as driving and having a conversation. When driving, it is difficult to talk because there is the need to focus attention on driving. As soon as driving becomes automatized through practice, it does not require so much mental capacity, allowing the driver to have a conversation, for instance. Certainly, the individual may choose to give more emphasis to driving when s/he encounters busy traffic, illustrating what is called capacity sharing (Pashler, 1994). Thus, "if the two tasks interfere, the interference can be attributed to dependence on a common system-namely, attention" (Tomlin & Villa, 1994, p.189) but it may be possible for an individual to process two attention-demanding tasks at the same time if the tasks are in some way compatible. Shiffrin (1997) considers effort in terms of capacity utilization, since effortful activity reduces

capacity to carry out simultaneous tasks. Besides reducing capacity, Robinson (2001) points out that failure to sustain attention to a task and maintain the level of effort results in decline in performance, at times due to affective influences, as motivation and anxiety.

The fourth concept, attention as a matter of control of information and action, assumes that automatic process require little or no attention and controlled processes require attention, of limited quantity, thus interfering with other processes that also require attention (Tomlin & Villa, 1994; Schmidt, 2001). To illustrate, let us recap the driving example mentioned above. Learning to drive requires attention but when it is enough practiced the processes of changing gears, using the clutch become so automatized that you can sing, appreciate the view, have a conversation, yet paying attention to drive. In consonance with Gopher (1992, as cited in Robinson, 2001, p.645), "attention control is constrained to a decision to engage, disengage and shift attention between tasks and the pursuit of intentions".

Tomlin and Villa (1994, p.190) propose "a finer grained analysis of attention that integrates these related conceptions of attention into a system that allows investigation of SLA data at the moment of acquisition". To reach such a goal, they use Posner and Petersen's (1990) description of the limited human attention system that comprises separate but interrelated networks: alertness, orientation and detection. Alertness is defined as the general readiness to process information (Robinson, 1995; Tomlin & Villa, 1994); and as the commitment of attentional resources to stimuli, being it related to motivation, interest in the L2 and classroom willingness to learn (Schmidt, 2001). The speed of information selection is a function of alertness. When selection happens too fast, sufficient information may not be processed, thus resulting in a non-accurate response.

Orientation concerns the allocation of resources, how the resources are directed to some types of information at the exclusion of others. According to Robinson (1995), prior experience may predispose learners to attend to specific aspects of the stimulus, since the allocation of resources is made based on expectations about the information, involving the activation of schemas or plans of action. Orientation is modulated by alertness that maintains a stage of vigilance to increase the speed at which priority information is detected (Schmidt, 2001). Instructional techniques are considered a form of orientation, since they facilitate detection (Tomlin & Villa, 1994). When teachers propose activities that aim at orienting the learner's attention to the linguistic form in the input, the learner may direct attention to the linguistic form,

increasing the chance of detecting formal distinctions but this may happen at the cost of being unsuccessful to detect other components of the input.

Detection is "the process that selects, or engages, a particular and specific bit of information" (Tomlin & Villa, 1994, p.192). Researchers like Schmidt (2001) agree that it is the necessary and sufficient condition for further processing and learning, the level at which acquisition should operate. It demands more attentional resources than alertness and orientation, because it enables processing at higher levels, such as storage and rehearsal in WM (Robinson, 1995).

Schmidt (2001) states that attention is definitely not a unitary phenomenon, it refers to a variety of mechanisms, as the ones exposed above. He includes the mechanism of inhibition, responsible for inhibiting the processing of irrelevant information, so that interference does not occur and the processing of relevant information proceeds. For him, attention is subject to voluntary control since individuals have freedom to pay attention to one stimulus over another. As well, it is believed that one of the important functions of teachers is to help focus learners' attention to specific aspects of the language being taught. Moreover, it is argued that attention is essential for learning[5], because unattended stimuli persist in WM "for only a few seconds at best, and attention is the necessary and sufficient condition for long-term memory storage to occur" (Schmidt, 2001, p.16).

In this line, Robinson (2001, p.631) provides a useful definition of attention, as "the process that encodes language input, keeps it active in working and short-term memory, and retrieves it from long-term memory". Some researchers acknowledge the relation between attention and WM; they argue that the two concepts are related "because both refer to control of information, and both are postulated to have limits with respect to how much information can be controlled (or processed)" (Kintsch et al., 1999, p.429). In Baddeley's view of WM (1992), as previously discussed, the central executive is explicitly related to attention and in charge of controlling information. Engle (2002 in Bergsleithner, 2010, p.6) recognizes that WMC is "more related to attention rather than to memory per se". Furthermore, Heitz, Unsworth

[5]There might be learning without attention, as the case of incidental learning. According to Ellis (2008), it is characterized by an absence of intentionality to learn, but may involve not planned conscious attention to some aspects of the L2. Even Schmidt (2001, p.27) points out that "there can be representation and storage in memory of unattended novel stimuli". Nevertheless, Ellis (2008, p.441) advises that "learning is more likely to occur when attention is focused".

and Engle (2005, p.64) confirm this view by stating that WMC reflects "the extent to which an individual is able to control attention, particularly in situations involving interference from competing information, activated representations, or task demands".

Empirical findings, according to Pashler (1994), suggest that attentional process seems to involve several dissociable mechanisms. On the other hand, researchers like VanPatten (1994) and Skehan (1998) follow the single capacity view and postulate that when learners' attentional limits are reached, they prioritize processing for meaning over processing for form. This capacity-constrained condition "leads learners to adopt a strategy of paying attention to content words at the expense of grammatical morphology during message comprehension" (Robinson, 2001, p.650). This position will be in depth analyzed in the following section. Nevertheless, Pashler (1992, p.44-45) advises that "several quite distinct processing limitations exist, each of which – in its own way – restricts our ability to carry out more than one task at a time".

2.3.1 Information/Input processing perspective

Language is not a focus of investigation in most of the studies conducted in cognitive psychology. According to VanPatten (1994), the bulk of research on attention is conducted with research designs with faces, numbers, colors, shapes and other visual stimuli, as well as with artificial linguistic systems[6]. For him, the issue of attention in SLA ought to be investigated with the very languages we teach and learn, because in real situations, learners must attend to more than one thing at a time, as engaging in connecting form and meaning.

Along with attention, the role of input in SLA has been a matter of interest over the years. Motivated by the perspective that attention is effortful and capacity limited, VanPatten (2007) postulated the input processing (IP) model, which is a model of what happens during comprehension that may subsequently interact or affect other processes and of how learners connect or do not connect particular forms with particular meanings. According to him, input processing can be

[6]Finite state grammars consist of letter strings and by means of grammaticality judgment, it can be checked the participant's competence about the rule formation of the 'language'. VanPatten (1994, p.30) argues that these "grammars lack the properties and functions of natural languages", since they have serial structure while natural languages present hierarchical structure, are far more complex to learn and more specifically, have communicative purposes.

considered a byproduct of comprehension, since learners should be able to make the appropriate form-meaning connections during the act of comprehension. He argues for a process-oriented approach to attention that "focuses on how learners allocate attention during on-line processing" (VanPatten, 1994, p.28). Three fundamental questions guide the model (VanPatten, 2007, p.116): (a) under what conditions do learners make initial form-meaning connections; (b) why, at a given moment in time, do they make some and not other form-meaning connections; and (c) what internal strategies do learners use in comprehending sentences and how might this affect acquisition. According to him (1994, p.35), "input is not much of a useful concept if we do not investigate what learners do with it".

The model (VanPatten, 2007) makes some claims about what guides the L2 learners' processing of linguistic information when they are engaged in comprehension. He proposed (1990) that form and meaning may compete for attentional resources during moment-by-moment processing. As learners are driven to get meaning while comprehending rather than trying to understand how the message is encoded, he postulated that learners will tend to process input for meaning before they do so for form. In addition, as learners are limited-capacity processors and comprehension consumes plenty of resources, the model claims that in the early and intermediate stages of L2 acquisition, learners may not be able to pay conscious attention to form in the input, as native speakers may be. Schmidt (2001) agrees, stating that beginning learners are cognitively overloaded, and that is the reason they cannot pay attention to all meaningful differences at once.

The notion of focus on form (FonF/FoF) needs to be clarified, since in the heart of this term lies the idea of inducing learners to pay attention to linguistic form in activities whose primary focus is on meaning. It is a source of individual differences in cognitive ability since it "refers to how focal attentional resources are allocated" (Long & Robinson, 1998, p.23). Form may be defined as an item that includes both lexical and linguistic features (Leow, Hsieh & Moreno, 2008). It is defended that in the context of meaningful L2 language use, it may be necessary to promote and guide selective attention to features of the input "which otherwise may go unnoticed, unprocessed and unlearned (Robinson, 2001, p.641). Researchers as Schmidt (1990), Long (1991) and Robinson (1995) claim an important role for paying attention to form by stating that it may be facilitative in promoting L2 development. Long (1991) has developed the term form-focused instruction, which refers to teaching, for instance, the geography of a country where the

foreign language is spoken, cultures of its speakers and so forth rather than teaching the grammatical form itself directly. He asserts that form-focused instruction "overtly draws students' attention to linguistic elements as they arise incidentally in lessons whose overriding focus is on meaning, communication" (Long, 1991, p.46). In the real world communication situations, it may be possible to notice a form while talking to someone, but primarily people pay attention to the meaning of the message (VanPatten, 1989).

VanPatten (1994) assumes that the limited attentional resources are directed first at the elements that carry meaning, as content words, lexical items, meaningful morphology, tense and aspect inflections. In short, learners are directed primarily to "lexicon, and only later, when the cost comes down, towards communicatively redundant formal features of language" (Schmidt, 2001, p.13). According to VanPatten (1989, p.414), "learners have difficulty in attending to form which does not contribute substantially to the meaning of the input regardless of type of input". Only when comprehension has been automatized that learners will have resources available to allow them to focus on the form of the message. In addition, when the learner performs a task that is automatized, it does not interfere with the other task being performed concurrently (Norman & Shallice, 1986). The same does not hold true when the tasks demand controlled processing, when a higher level of attention is demanded. In this case, participants in experimental conditions directed to attend to form while also processing input for meaning may experience decrements in comprehension. Leow, Hsieh and Moreno (2008, p.667) state that

> if learners are limited capacity processors, then simultaneous attention to both meaning and form should result in a cognitive overload that impacts negatively on comprehension. This is also tied to language experience. Comprehension will be more effortful for beginning and intermediate students because they will need to employ more attentional resources to make those form-meaning/function connections.

Research within the information-processing framework (Robinson, 2001) assumes attention as limited and consequently, accuracy, fluency and complexity may compete for resource allocation during the L2 task production (Skehan, 1998); and that 'form' and 'function' compete for scarce attentional resources during input processing (VanPatten, 1989, 1990; Leow, Hsieh & Moreno, 2008).

Schmidt (2001) and Posner (1995, p.620) agree that "it is more difficult to attend to sources of information when both are presented to the same modality than when they are presented to separate modalities". Trade-offs may be explained in terms of control functions during processing and interference in "resource allocation to the specific task demands which central processing responds to, and not in terms of a priori capacity limits on a single pool of attention" (Robinson, 2001, p.646). According to Wong (2001, p.348), any individual can focus on either meaning or form; "the critical question is whether one can pay attention to both meaning and form at the same time and how this can be facilitated when it is difficult to do so".

VanPatten (1989) hypothesized that if participants have difficulty in directing attention toward both meaning and form, then a task involving conscious attention to non-communicative grammatical morphological forms in the input will negatively affect comprehension of meaning. He hypothesizes that if learners are able to attend simultaneously to form and meaning, it will be possible to argue for a stronger role for noticing/consciousness during processing. There are a number of researchers interested in this issue, who seek to find evidence for the IP model and the role of attention in L2 learning. VanPatten (1994) recommends that research on this issue should involve a simultaneous focus on meaning and form and be tied to research on comprehension. As Wong (2001) recommended, it needs to tackle under what conditions learners can attend to form and meaning at the same time and if so, what kind of forms. Furthermore, input and attention are not useful concepts in SLA if we do not investigate what the learners do with the input and what they do in their brain while processing it (VanPatten, 1994). This issue is the focus of the following subsection.

2.3.2 Research on attention to form and meaning

The studies conducted by VanPatten (1990), Greenslade, Bouden and Sanz. (1999), Wong (2001), Leow, Hsieh and Moreno (2008) and Bailer and D'Ely (2009) are pertinent to the strand of simultaneous attention to form and meaning research. They were carried out in intact classes with adult college-level L2 learners, except for Bailer and D'Ely's small scale research, conducted with teenagers. The design of these studies comprised a control group that processed the input only for meaning and experimental conditions that besides understanding had to notice forms. Comprehension was assessed by means of immediate recall or multiple-choice exercises. Results differ and point out to some

issues that need to be addressed in order to build up evidence and improve the way we understand input processing and attention.

VanPatten (1990) demonstrated that L2 learners of Spanish (202 participants) have difficulty processing aural input for meaning while attending to morphological forms. He addressed three different levels of proficiency and found that early stage learners display more difficulty in attending to both demands. Results revealed that "conscious attention to form in the input competes with conscious attention to meaning, and, by extension, that only when input is easily understood can learners attend to form as part of the intake[7] process" (VanPatten, 1990, p.296). Particularly, attention to important lexical items as 'inflación' and 'la' does not affect comprehension of meaning, but attention to non-communicative grammatical morphological form as the verbal '-n' affects comprehension.

Greenslade, Bouden and Sanz (1999) replicated VanPatten's study by using his original design except for modifying the input mode to written and using one level of proficiency. Results were similar to VanPatten's, in that attention to grammatical forms negatively affects text comprehension, whereas attention to lexical items does not impair comprehension significantly (53 participants). Upon comparing the data with VanPatten's, the authors found significant differences between the mean scores and that the recall percentages of their study in the written mode were significantly higher than the ones reported by VanPatten, suggesting that learners were less cognitively constrained while reading. Thus, results suggest that the input mode is an important factor influencing how learners process forms.

Wong (2001) investigated 79 low-intermediate L2 learners of English, whose first language was French. She directly compared the aural and written modes within the same participant pool and intended to explore whether results would be maintained across different modalities. She used VanPatten's design, translated into English and excluded the experimental condition verbal '-n'. Wong concluded that learners are not constrained in the same way during processing in the aural and written modes. In the aural mode, she reported that the control group comprehended significantly more than participants in the experimental condition 'the' but performed statistically similar to the 'inflation' group. Contrary to VanPatten, she found no significant difference in comprehension between the 'inflation' group and the

[7]Intake, according to VanPatten (1989, p.409), is "a subset of the input that the learner actually perceives and processes".

definite article ‘the’ group. In the written mode, Wong reported no significant difference in comprehension between the control and the definite article ‘the’ groups and between the ‘inflation’ and the definite article ‘the’ conditions. In short, only the control and ‘inflation’ conditions support the findings from previous studies. Results suggest that “attention to form in the written mode does not necessarily impede comprehension and that other factors need to be considered” (Wong, 2001, p.360). She points out that the degree of the form’s communicative value and the degree of its perceptual saliency may have played an important role. As well, she advised future researchers not to use cognates with respect to the participants’ L1 and L2 as target items.

Leow, Hsieh and Moreno (2008) carefully analyzed the methodology employed in previous studies and revealed some potential issues. One relates to the choice of target forms: polysyllabic vs. monosyllabic words, as matter of salience, and the selection of an item that connects grammatical form with its meaning/function. Another issue is the lack of even distribution of target forms in the input, which might have played a role since participants have limited cognitive capacity. The studies reviewed did not control the amount of exposure to the L2 input in each group, a fact that might have biased the results. Also, the assessment task employed to measure comprehension should be reliable to not depend too much on the memory capacities of the participants. The most crucial methodological issue identified was that not all participants in the experimental groups performed according to the condition they were assigned. The authors suggested that concurrent think-aloud protocols could provide the data to check if participants were performing in accordance with the task conditions, besides enhancing internal validity of the study. The authors carried out an investigation with 72 L2 learners of Spanish and assigned them to the conditions: control, ‘sol’; ‘la’; ‘lo’; and verbal ‘-n’. They modified an online text, designed a multiple-choice test to assess comprehension and made use of think-aloud protocols. Findings revealed that participants did indeed pay attention to the target forms, but not at a deep and consistent level. In addition, the type of attentional condition did not have a differential effect on reading comprehension, what might be attributable to the low level of processing of the target forms. It seems that the experimental task did not create any differential cognitive overload while processing for meaning, contrary to what was reported previously (VanPatten, 1990; Greenslade et al., 1999). Findings provide partial support to the nonsignificant effect of simultaneous attention to

form and meaning in reading (Wong, 2001) and do not support or refute VanPatten's Primacy of Meaning Principle.

Bailer and D'Ely (2009) investigated the issue with 20 Brazilian teenage-learners of English as an L2. The design comprised two groups, the control who read just for meaning and the experimental who read for content and underlined verbal past forms. As it was a small scale study, statistics could not be run. Even so, results show that the control condition outperformed the experimental one, indicating that participants indeed paid more attention to meaning than to form. From a theoretical perspective, the findings seem to bring support to VanPatten's Primacy of Meaning Principle (2007) in that learners read a text focusing primarily on its meaning.

As it could be seen, research about the effects of attentional conditions regarding L2 simultaneous attention to form and meaning in comprehension present inconclusive results (Leow, Hsieh & Moreno, 2008). More studies need to be carried out taking into consideration the issues of modality; proficiency level; participants' age; target form; factors that might affect input processing and might provide more evidence either for or against a specific view. As Wong (2001, p.346) has pointed out, "there is general consensus that attention to the input is a crucial construct for SLA". Due to its high importance, it deserves greater attention from researchers.

In this realm, the present study focuses on the issues aforementioned by investigating the effect of different types of attentional condition (meaning/form) on reading comprehension in a Brazilian high school EFL population. In addition, it aims at shedding some light on the relationship between WM and attention to form and meaning. The following chapter details the objectives and hypotheses of this study, the participants, tasks and procedures for data collection and analysis.

CHAPTER 3
METHOD

This chapter describes the method used to investigate the relationship between individual differences in WMC and the learners' simultaneous attention to form and meaning in reading activities for a group of EFL high school students. In order to do so, the objectives, the research questions and hypotheses of this study will be outlined, followed by a description of the study design, the participants, the instruments and procedures of data collection and analysis.

3.1 OBJECTIVES

The main objective of the present study is to investigate, in a population of high school students of English as a foreign language, the relationship between individual differences in WMC and learners' simultaneous attention to form and meaning. To be more specific, this study aims at investigating:

1. whether there is, if any, a correlation between WMC and the ability of sustaining attention to form and meaning while reading and;

2. whether the type of attentional control, namely meaning and form, has a differential effect on reading comprehension.

3.2 RESEARCH QUESTIONS

In order to pursue the aforementioned objectives, the present investigation attempts to answer the following research questions.

RQ1: Is there a correlation between WM, measured by the RST and the OSPAN, and the ability to sustain attention between meaning and form while reading, measured by scores on the answers to a comprehension task and a form recognition task?

RQ2: Does type of attentional control (meaning/form) have a differential effect on EFL high school students' reading comprehension?

3.3 HYPOTHESES

Drawing on the research questions and objectives outlined above, a set of hypotheses was formulated. They are based on the view that attention is limited and allocated in WM (Kahneman, 1973; VanPatten, 1990, 1994, 2007) and also based on the assumption that if learners are limited capacity processors, simultaneous attention to both meaning and form should result in a cognitive overload that impacts negatively on comprehension, because more attentional resources are needed to make the form-meaning/function connections (Leow, Hsieh & Moreno, 2008).

> Hypothesis 1a: There is a correlation between amplitude of WM, measured by the RST and the OSPAN, and the ability to sustain attention between meaning and form while reading, measured by scores on the answers to a comprehension task and a form recognition task.
>
> Hypothesis 1b: Higher spans will perform better at comprehension and will be able to sustain attention to form simultaneously to meaning, measured by highlighted occurrences of simple past verbal forms.
>
> Hypothesis 2a: The type of attentional condition, namely focusing on meaning and focusing on form, has a differential effect on EFL high school students' reading comprehension.
>
> Hypothesis 2b: The individuals who just attend to meaning should perform better at comprehension than the ones who attend to form and meaning simultaneously.

3.4 RESEARCH DESIGN

In order to address the research questions and hypotheses of the present study, the following research design was implemented:

Table 1
Research Design

1st session	2nd session	3rd session	GROUPS OF BALANCED WMC	4th session	5th session
TCLE	RST Retrospective Questionnaire	OSPAN Retrospective Questionnaire		CONTROL Text Reading Comprehension Questions Retrospective Questionnaire	FEEDBACK
TCLE	OSPAN Retrospective Questionnaire	RST Retrospective Questionnaire		EXPERIMENTAL Text Reading Form Recognition Task Comprehension Questions Retrospective Questionnaire	

N = 61
Pilot Study: N = 9

As can be seen in Table 1, the design of this study includes a pilot study, conducted with 9 participants and the final study with 61 participants. In both conditions, participants signed a consent form, performed two WMC tests (the RST and the OSPAN), followed by retrospective questionnaires. Half of the sample performed the RST before the OSPAN, while the other half performed the OSPAN before the RST. This procedure was implemented with the objective of controlling for order effects. Then, tests scores were used to divide the sample into two groups of balanced WMC. The control group, with 30 participants, had to read a text in a specific amount of time, answer the

comprehension questions and a retrospective questionnaire whereas the experimental group, with 31 participants, read the same text and performed a form recognition task in the same specific amount of time, answered the comprehension questions and a questionnaire. The tests/tasks were applied in four different sessions and the participants were offered a fifth meeting in which they received feedback on their performance. Every procedure involved in data collection and criteria for implementing them will be fully described in the subsequent sections of this chapter.

3.5 PARTICIPANTS

Sixty-three Brazilian students of English as a foreign language enrolled in high school composed the original pool of participants of the present study. The institution was *Colégio Universitário*, a private school in Gaspar (Santa Catarina/Brazil). This school was chosen because the researcher had been a teacher there for two years, and it is believed that this fact might have facilitated students' participation. In addition, it is thought that the level of confidence in the ex-teacher/researcher might have permitted clarifications. Furthermore, the institution signed a consent form (see Appendix A1) authorizing this researcher to perform the study.

All of the 63 participants volunteered to participate and signed the consent form (see Appendix A2). After this step, the first session, in which the researcher explained in details the data collection and participants signed the consent form, two of the participants decided to quit the study due to personal problems with schedules for the data collection sessions, remaining 61 participants. The cohort consisted of 20 learners enrolled in the 1st year high school, 26 in the 2nd year high school and 15 in the 3rd year high school. Participants were 36 males and 25 females, ages ranging from 14 to 17 with an average of 15,4 years. The present sample had the characteristics of a regular classroom and therefore, it is supposed to include a variety of proficiency levels. The study was conducted apart from the class schedule, in the afternoon, according to the participants' available time schedule. The participants had five meetings each with the researcher at the school. Meetings lasted about 30 minutes each and were conducted during the months of March and May of 2011.

Participants were invited to volunteer for the study by the researcher herself (March 22nd, 2011), who entered the classes with the coordinator and the permission of each teacher, emphasizing the

relevance of the research and explaining the procedures in case they decided to participate. The students received information about details and how they would profit by participating. It was highlighted that the aim of the study was to collect data for academic purposes and not to evaluate students' performance and to give them a grade. Nevertheless, this researcher, in a meeting with the school director and the English teacher, negotiated a bonus of 1 point in the English grade of the trimester for who participated. This fact may explain why 70% of the students enrolled in high school at *Colégio Universitário* took part in the study. Out of 34 students enrolled in the 1st year, 20 participated. Out of 36 enrolled in the 2nd year, 26 participated and out of 17 enrolled in the 3rd year, 15 participated. This researcher opted to offer participants candies and lollipops at the end of each session and provided a feedback session at the end of the process, as a way of rewarding participants for their willingness and availability. Besides, participants received a bonus in the English grade. At the end of each meeting, the researcher also scheduled the next one, properly registered in a short piece of paper entitled 'next meeting'. This note included the date, the day of the week, the time and the researcher's cell phone number in case the participant could not come. Furthermore, the researcher offered help with English tips and general learning issues on-line by giving all participants her e-mail address so that they could keep in touch any time they needed. The intense support of the English teacher, coordinator, directors and the school staff also contributed to the learners' participation. Mortality rate, probably due to all these incentives, was almost zero. Moreover, the high rate of participation taking into account the total number of students enrolled in high school (87) and 61 participating reflects the students' interest in taking part in this study, in contributing, learning and also getting a bonus in their grade.

Besides having the school and the participants consent, it was necessary to have the parents' consent (see Appendix A3), since the participants were underage. With this document, the researcher was authorized to collect the data and use them in the study (more details in the subsequent section).

By means of questionnaires, some data about the participants' English background were gathered. Most of the participants (35) have been studying English formally at school since the 1st grade (58%), which means that they have been having classes for about 8-10 years. Some participants (21) have had classes since the 5th grade (34%), i.e. for 7 years; and 5 participants (8%) have been studying English since the 4th grade, it means, for 5-6 years. In addition, from the sample, 30

participants (49%) attend an extracurricular course at a language institute/with a private teacher. Out of this number, 7 participants (23%) have attended classes for one year or less; 3 (10.5%) for one year and a half; 7 (23%) for two-three years; 7 (23%) for four years; and 6 (20.5%) for five-six years.

It is important to know whether participants like English, which probably shows their intrinsic motivation to learn the language. Most of the participants (44) reported their liking for English (73%); 10 participants (16%) stated that they like English *so-so* because they like the language but do not appreciate the classes at school; and the remaining 7 participants (11%) acknowledged that they do not like the language. Interestingly, when asked about their interest in learning English, all participants answered positively, revealing their extrinsic motivation. As reasons, 26 participants (42%) reported being career and better chance at employment; 23 (38%) career and tourism; 7 (11%) career and the possibility of understanding songs and films; 4 (7%) the potential for understanding friends and online games; and 1 (2%) the possibility of understanding songs and singing. It is important to highlight the high occurrence of the reason 'career' (56 participants – 91%), revealing that they are worried about their future and acknowledge English as a decisive factor in the job market.

Participants were also asked about their perception of their own memory and their ability to do and to pay attention to two things simultaneously. From the sample, just 12 participants (19.7%) consider their memory bad; the majority, 31 participants, (50.8%) considers it good while 18 participants (29.5%) think it is good depending on the situation and subject involved. When asked about their ability to do two things at the same time, the great majority, 51 participants, (83.6%) reported being able to do so while the remaining 10 (16.4%) recognized being able to do one thing at a time. Participants who have answered the previous question positively provided examples of things they can do simultaneously. Briefly, half of the participants (26) reported being able to study or do the homework while they watch TV or listen to music. Twelve participants (24%) stated that they can use the computer and talk on the phone or watch TV while 3 (6%) acknowledged that doing two things simultaneously results in just one activity being done right. The remaining 5 participants reported being able to do more cognitively demanding activities simultaneously such as listening to the teacher and taking notes; writing and talking about different subjects (2 – 4%); playing some musical instruments (1 – 2%); and listening to music, talking on the internet and answering somebody's question personally (1

– 2%). The data gathered by this means reveals that the teenager participants of this study are indeed used to multitasking, even if one of these tasks is not being done properly, or given the proper attention.

Participants were asked about their ability of paying attention to two things at the same, for instance, paying attention to the teacher's explanation and being able to take notes. Data revealed that 25 participants (41%) acknowledged being able to do so, 25 (41%) not being able and 11 (18%) declared that it depends on the subject involved, i.e. if the subject is Chemistry and the participant is not good at it, it turns out to be difficult to do the two things at the same time.

In a nutshell, the participants of this study are teenagers, students of a private school, who have been attending English classes for a great amount of time and are interested in the language. Besides, they know this researcher for some time and demonstrated being willing to participate in this study, and to learn from this experience. Although the data presented here does not aim at answering any research question, it is believed that it will help the reader better understand the context in which the sample of this study is inserted.

3.6 INSTRUMENTS

The instruments of data collection used in the present investigation comprised (i) two tests designed to assess WMC: the RST and the OSPAN; (ii) two retrospective questionnaires designed with the objective of unveiling participants' perceptions and impressions while performing the tests; (iii) a text to be read; (iv) a form recognition task to be performed by the experimental group; (v) comprehension questions designed to assess reading comprehension in both groups; and (vi) a retrospective questionnaire created with the aim of bringing the participants' voice regarding their perceptions, their feelings during the activities and some background data to characterize the participants. In what follows, a detailed explanation of every instrument will be provided.

3.6.1 Consent Forms

As already mentioned, the institution involved, all the participants and their parents were required to sign consent forms (see Appendix A). All the three forms were written in the Portuguese language, having two pages each. The first page explains the research objectives, briefly, the activities the participants had to perform and brings information

regarding confidentiality besides the researcher's contact (e-mail, phone numbers) in case they had doubts. This page was signed by the researcher, the advisor and co-advisor and was kept by the participants for possible doubts. The second page is a form, where the participant put her/his complete name, signed and provided the number of her/his ID card. This form was kept by the researcher, since it is the proof that the participant agreed in taking part in the study and in permitting the use of her/his data in the analysis.

Furthermore, this researcher designed a practical guide as a handout to each participant, in which they could visualize in a schematic manner how many meetings they would have and what tasks they should perform in each one (see Appendix A4 for an example). It is believed that this guide provided the participant with detailed but at the same time organized and concise information regarding the data collection phases.

3.6.2 Assessment of Working Memory Capacity (WMC)

3.6.2.1 The Reading Span Test (RST)

The RST was first developed by Daneman and Carpenter (1980) in order to investigate the relationship between individual differences in WMC of native speakers of English and their comprehension of sentences in addition to the recall of the last words of a group of presented sentences. The assumption underlying the RST is that WMC reflects individuals' ability to process and store information simultaneously while performing a demanding cognitive task as reading. Hence, the larger the participant's WMC, the better performance s/he has on the RST. As the authors of the test follow the view that WMC is specific, the results can be used to predict performance on reading comprehension. Empirical evidence has proven that the RST is reliable and a good predictor of WM, since it is "successful in taxing the processing and storage capacity of working memory" (Daneman & Carpenter, 1980, p.457; Daneman & Merikle, 1996).

The Brazilian version of the RST implemented in the present investigation was designed by Tomitch (2003a) based on Daneman and Carpenter's (1980) test, and was partially adapted because a few sentences were out of context for high school students and a few others were changed due to the need of maintaining a standard in the size of the last words (3-4 syllables), as observed by Tomitch (personal

communication). The test was administered in Portuguese (participants' L1) to avoid confounds with participants' proficiency in L2.

This test consisted of 60 unrelated sentences (see Appendix B1), ranging from 13 to 17 words in length, presented in sets of 2, 3, 4, 5 and 6 sentences. There were nine additional sentences in the training session, presented in a set of 2, 3 and 4 sentences so that participants could get acquainted with the test, feel comfortable and practice before the test itself. Each sentence was displayed on a computer screen, arranged in sets: 3 sets of 2 sentences, 3 sets of 3, 3 sets of 4, 3 sets of 5 and 3 sets of 6 sentences. The end of each set was indicated by a white screen with question marks on it, for instance, the end of a set of 2 sentences was indicated by 2 question marks, 3 sentences with 3 question marks and so forth. Each participant was instructed to read each sentence out loud, trying to comprehend it and memorizing the last word of each sentence. Immediately after the participant finished reading the sentence, another sentence was shown on the screen and the participant had to start reading it loud right away. When the question marks appeared, the participant had to try to recall the last words of all sentences in that set, exactly in the order they were presented (Friedman & Miyake, 2004). As an example, there is the following set:

> **Para realizar as atividades cerebrais do pensamento, os neurônios tiram energia do oxigênio e da glicose.**
>
> **O truque, portanto, é partir triunfante rumo ao objetivo antes do início da partida.**
>
> **Cerca de 250 milhões de pessoas, ao redor do mundo, se encontram na mais profunda depressão.**
>
> Words to be recalled: **glicose / partida / depressão**

Participants' recalled words were registered in a file designed by this researcher and adequately scored (see Appendix B4 for an example). The measure of the participant's reading span is the level at which s/he was correct on at least two sets (Daneman & Carpenter, 1980). In consonance with Tomitch (2003a), half credit was given if the participant passed one set at a certain level. For instance, a participant recalled correctly all the words in the right order in the three sets of 2 sentences and in the three sets of 3 sentences recalled correctly just one set, receives half point, being her/his span 2,5. This scoring procedure known as strict is used in this study and represented, in the analysis, by

the variable RST_S. This researcher also scored the participants answers leniently, it means, participants were given credit for any set for which s/he recalled all sentence final words, irrespective of the order of recall. This way of scoring is represented by the variable RST_L in the analysis.

3.6.2.2 The Operation-word Span Test (OSPAN)

The OSPAN was first developed by Turner and Engle (1989) with the objective of testing the hypothesis that WMC is general in nature and not specific to the cognitively complex task related to language. It requires participants to solve a series of math operations while trying to remember a set of unrelated words. Empirical evidence has proven that the OSPAN is a reliable and valid measure of WMC (Turner & Engle, 1989; Conway et al., 2005).

The Brazilian version of the OSPAN implemented in the present investigation was designed by Prebianca (2009) based on Turner and Engle's (1989) test. It differed from the original test in that the words to be recalled were in Portuguese, instead of English. The words were all disyllabic, unlikely to be unknown by native speakers of Portuguese. As for the RST, the OSPAN was also administered in Portuguese to avoid confounds with participants' proficiency in L2.

This test consisted of 42 operation strings on the left accompanied by Portuguese words to the right side (see Appendix C1), in the middle of the computer screen. From the 42 trials, 19 strings presented correct responses while 23 strings displayed incorrect responses. The test was organized in 3 test blocks of 4 sets each. Within each set, trials could vary from two to five in a pre-established order. Block 1 was composed of 4 sets of 3, 5, 3 and 2 trials, respectively; block 2 had 4 sets of 5, 4, 2 and 4 trials; while block 3 contained 4 sets of 3, 5, 2 and 4 trials. Besides, there were 14 additional trials in the training session, presented in a set of 2, 3, 4 and 5 operation strings accompanied by words. This training session aimed at providing participants with practice before the test itself, giving them the opportunity of getting acquainted with the test, and as a result, making them feel comfortable.

The test was presented in a computer screen, the operation strings and words once at a time. The end of each set was indicated by a white screen with question marks on it, for instance, the end of a set of 2 trials was indicated by 2 question marks, 3 trials with 3 question marks and so forth. As well, the beginning of each block was indicated by a white

screen with the words 'Block 1', 'Block 2' and 'Block 3'. Each participant was instructed to read aloud the math string and at the same time solve the operation as fast and accurately as possible, to judge it (correct = yes, incorrect = no), and to read the word and memorize it. As an example, there is the following set:

Math operation	Participant's response	Word for later recall
(10 ÷ 2) - 3 = 2 ?	**YES**	**carta**
(10 ÷ 10) - 1 = 2 ?	**NO**	**lençol**
(7 ÷ 1) + 2 = 7 ?	**NO**	**terra**

Immediately after the participant read the word, another trial was shown on the screen and the participant had to start reading aloud and solving the math operation right away. It is important to highlight that the calculation had to be done silently and without the aid of pencil and paper. When the question marks appeared, the participant had to try to recall the words of that set; exactly in the order they were presented. Contrary to the RST, in this test, the number of operation-word pairs presented was randomized to prevent participants from being able to predict the number of words they would have to recall.

Participants' judgments of the math operations and the recalled words were registered in a file designed by this researcher and properly scored (see Appendix C3 for an example). The measure of the participant's span is the sum of the correctly recalled words for trials that were perfectly recalled (Turner & Engle, 1989). The score, thus, was the total number of correct items in the correct position. This scoring procedure, strict, yielded the results from the variable OSPAN_S. In addition, so as to ensure that participants were not trading off between solving the operations and remembering the words, an 85% accuracy criterion on the math operations was required for the participant's score to be included in pool (Unsworth et al., 2005). The second scoring procedure was more lenient in terms of processing efficiency. According to Prebianca (2009, p.73), "all words recalled obeying the form and order of presentation and the criterion of 85% accuracy were credited 1 point". As the OSPAN consists of 42 trials, following this criterion, the total number of errors on math operations the participant could have is 6. If the participant judged a specific operation of a particular set incorrectly but was able to accurately recall the word following that operation, s/he received a point as long as s/he had not reached 6 errors. This procedure yielded data for the variable OSPAN_L. As this researcher noticed that the participants presented

few errors on the math operations, it was decided to establish a third scoring procedure, in which the participant who judged the operation correctly, but recalled the following word in an incorrect order in the set, was credited 1 point. This way of scoring yielded data for the variable OSPAN_LC.

As already mentioned, the two different WM span tests employed in the present study reflect two different views of WMC (Engle, Cantor & Carullo, 1992). The OSPAN follows the general capacity hypothesis, which suggests that WMC would predict significant correlations with other complex language tasks performance, as in this study, correlations not only between the RST and measure of reading comprehension, but also between the OSPAN and the measure of reading comprehension. The RST, nevertheless, reflects the task-specific hypothesis, which proposes that WMC is functional and dependent on the task performed. In this study, this view would predict that only the RST correlates significantly with the measure of reading comprehension.

3.6.2.3 Retrospective Questionnaires

In order to unveil participants' perceptions and impressions while performing the two WMC tests, retrospective questionnaires (see Appendix D) were administered right after the end of each test. Questionnaires, according to Dörnyei (2003), can yield factual, behavioral and attitudinal data about the respondents. In this investigation, open-ended questions were chosen, since they can offer illustrative quotes and can lead us to identify issues not previously anticipated. Moreover, the flexible nature of questionnaires makes them ideal to be used in concert with other data collection methods. It is believed that "the combination of qualitative-quantitative methodology designs can bring out the best of both approaches while neutralizing the shortcomings and biases inherent in each paradigm" (Dörnyei, 2003, p.130-131).

Following this perspective, the first retrospective questionnaire, applied after the first WM span test, sought to provide answers regarding the participant's perception of her/his own memory; her/his capacity or ability to sustain attention to two tasks at the same time; how the participant felt performing the test; and what strategies s/he used to memorize and remember the words.

The second retrospective questionnaire, applied after the second WM span test, in turn, sought to provide answers concerning how the participant felt performing the test; what strategies s/he used to

memorize and remember the words; which test, from the two s/he performed, was more difficult and why; and if the participant had any suggestion regarding the instrument and its application.

The answers to these questionnaires were coded, translated to English and will be quoted verbatim for the purpose of illustration and exemplification in the discussion of the results section. It is believed that the answers will help better understanding the results and thus, help providing data triangulation.

3.6.3 Assessment of Reading Comprehension

3.6.3.1 Selected Text

To reach the objectives of this investigation, a text was selected according to a set of 3 criteria. First, it was necessary to bear in mind the target sample of this study, high school students of English. Their level of proficiency should be taken into consideration. As in this study a proficiency test was not carried out to level the students, it was necessary to find a text that presumably all students from the age group could read without great problems. Secondly, this text should be found in an EFL book used in Brazilian public schools. Thirdly, the text should present several occurrences of simple past tense verbs, the form chosen. This choice was made because verbs in the past carry meaning and form. Besides, the students from high school should be acquainted with this grammatical feature at this level of formal education, since the simple past is generally taught and practiced in the 8th and 9th years of elementary school, according to the EFL books syllabuses.

The text chosen was a narrative entitled “What did you do all day?” taken from the book Challenge (Amos, Prescher & Pasqualin, 2005, p.51), a unique volume for the three years of high school, widely used in Brazilian public schools. It had 270 words and presented 32 occurrences of simple past tense verbs, regular and irregular. This text was typed (see Appendix E1), since it is believed that the original layout (with images) may have given support to a better comprehension.

3.6.3.2 Form Recognition Task

The form recognition task was devised with the purpose of assessing whether the participants from the experimental group could pay attention to form while reading the text. It consisted of highlighting every verbal past forms encountered. As the chosen text presents 32

occurrences of simple past verbs, regular and irregular, the participant was directed to attend to this feature. According to Leow, Hsieh and Moreno (2008), the key difference is in the choice of target forms. The researcher should bear in mind that just the careful choice of a form that carries both form and meaning will achieve the objective: assess whether the reader is paying attention to it. Furthermore, it is believed that the inclusion of this exercise could provide revealing results concerning paying attention to a form that carries both meaning and grammatical function in the input.

3.6.3.3 Comprehension Questions

In order to verify the role of attention to form and meaning, comprehension questions were developed (see Appendix F1). This researcher gave preference to open-ended questions, especially because it is believed that the alternatives in the multiple-choice exercise may lead individuals to the right answer, and also, they may guess and luckily get the right option. Therefore, by answering open questions, the participants can truly show what they understood and recalled from the text.

The 11 open/discursive questions were designed to measure both global and specific comprehension. These questions were prepared in Portuguese, so as to ensure that what was being measured was how much of the text content participants had understood, not what words or phrases they remembered from the story.

According to the Pearson and Johnson's taxonomy (1978), out of the 11 questions, 7 can be classified as textually explicit (questions 2, 3, 4, 5, 6, 7, 9), since they have obvious answers on the page - verbatim answers -, and involve literal comprehension or simply 'reading the lines'. From the total, 2 questions can be categorized as textually implicit (questions 1 and 8), because the answers are on the page, but not so obvious. They involve 'reading between the lines'. As said by the authors, "both question and answer are derivable from the text but there is no logical or grammatical cue tying the question to the answer and the answer given is plausible in light of the question" (1978, p.163). The remaining 2 questions can be considered scriptally implicit (questions 10 and 11) given that the answer is not in the text; the reader needs to use his/her prior knowledge/script in order to come up with an answer. According to the authors, a reader uses an appropriate script whenever s/he confronts text containing aspects which are part of that script. This

is the so called 'reading beyond the lines'. Thus, the formulated questions involve both literal and inferential comprehension.

It is important to highlight that the majority of the implemented questions contain more than a single question, as the following example:

Question 4: Onde estavam as crianças? O que estavam fazendo?
Where were the kids? What were they doing?

All the questions were properly scored, as in the above example, the participant would get one point for a complete right answer, half point for incomplete and zero for incorrect. In case of three questions inside one item, the participant got .33 for each right answer.

3.6.3.4 Retrospective Questionnaires

With the objective of raising relevant factual information and bringing the participants' voice regarding their participation, it was decided to implement two more retrospective questionnaires (see Appendix G), right after the comprehension exercise.

One questionnaire is directed to the control group participants while the other, to the experimental group. Both questionnaires ask factual information about the participants' L2 background, language learning experience and strategies used to understand unknown words, in addition to their perceptions and impressions regarding the activities performed; especially how they felt during the tasks. The two questionnaires have the same questions, except for the experimental group's that presents one more question. This additional question aims at bringing information about the participants' prior knowledge of the simple past tense and its relation to the understanding of the text.

As the answers to the other questionnaires, these answers were coded, translated, and will be quoted verbatim for the purpose of illustration and exemplification in the discussion of the results section. It is assumed that the answers will provide information for data triangulation, and consequently help understanding the results.

3.7 PROCEDURES FOR DATA COLLECTION

The procedures for data collection used in the present investigation entail 5 meetings with this researcher, as can be seen in Table 3.1 of this method chapter: (i) clarifications and consent form signing; (ii) the first WMC test and a retrospective questionnaire; (iii)

the second WMC test and a retrospective questionnaire; (iv) text reading, form recognition task, comprehension exercise and one of the retrospective questionnaires; and (v) feedback session. The data collection phase took two months, from March 22nd to May 26th, 2011. In what follows, a detailed explanation of all the procedures will be provided.

3.7.1 The First Meeting

In the first meeting, the participants, either individually or in groups, were clarified exactly about what they would have to do; how many meetings and how long the data collection would take; and about the issue of confidentiality. The telephone number and e-mail address of this researcher was also provided in case of doubts. The participant would only sign the form if s/he agreed in taking part of the study by her/his free will.

This meeting lasted about 15-30 minutes; each participant received a plastic folder with the participant's consent form, the parents' consent form and a practical guide about the procedures of the study (see Appendix A). All these materials were taken home, except for the second page of the participant's consent form, which already signed, was kept by this researcher. The participants were instructed to read the parents' consent form with their parents at home and establish contact with the researcher in case they had any doubt. The next meeting, when the participants would perform the first WMC test, they should bring the second page of their parents' consent form signed, so that this researcher could keep it with her. The first pages of each consent form should be kept by the participants themselves, along with the practical guide. This folder was considered their research material; they would have to bring it every meeting.

3.7.2 The Second and Third Meetings

The second and third meetings lasted about 30 minutes each and participants came individually, according to the previously scheduled time. In the second meeting, the participants performed the first WMC test. For 30 participants, it was the RST, while for the other 31, the OSPAN. In the third meeting, the participants were required to perform the second WMC test: the 30 participants who performed the RST in the first meeting would perform the OSPAN, while the 31 who performed the OSPAN first, would perform the RST in this third meeting.

For each test, before starting the training session, participants received oral and on paper instructions as regards what they would have to do, how they would be scored. To avoid misunderstanding regarding test procedures and requirements, all instructions were given in the participants' native language, Portuguese. Also, they were informed that these tests would measure their capacity to recall words, Portuguese words, in a certain order. The researcher emphasized that the tests required their full attention especially when the sentences appeared on the screen for the RST and when the math operations and words appeared on the screen for the OSPAN.

For the RST, the training phase consisted of 3 sets: of 2, 3 and 4 sentences. It was conducted so as to make participants familiar with the procedures. Participants were allowed to repeat the training session as many times as they felt necessary. During this time, they were free to interrupt and ask any questions they might consider important concerning the implementation of the task (see Appendix B1 for the list of sentences; B2 for the list of words to be recalled; B3 for the written instructions; and B4 for the scoring sheet). The researcher told the participants that they were required to recall the words as soon as they visualized the blank screen with question marks on it. They were warned that the test was organized in an increasing order; it started with 3 sets of 2 sentences, then 3 sets of 3, 3 sets of 4, 3 sets of 5 and finally 3 sets of 6 sentences. When participants confirmed being comfortable to start, the researcher began the test.

For the OSPAN, the training session consisted of 4 sets: of 2, 3, 4 and 5 operation strings accompanied by words (see Appendix C1 for the list of operation-word strings; C2 for the written instructions; and C3 for the scoring sheet). During this phase, participants were encouraged to ask any questions they might have regarding the test procedures. The researcher explained to them that they would need to focus on the presentation of math operations besides trying to memorize the words displayed with each operation for further recall. They were explicitly told to try to solve the math operations as fast as possible avoiding rehearsal of the words. As soon as the blank screen with question marks appeared, they were required to recall the words. The participants were also warned that the test was organized in blocks, in a random order, but still completing 3 sets of 2 operation-word strings, 3 sets of 3, and so forth. When participants reported feeling prepared to perform the test, the researcher started it.

After concluding each WMC test, each participant answered a questionnaire; the first retrospective questionnaire after the first test, and

the second questionnaire after the second test (see Appendix D for each questionnaire). Participants were told to write in a readable way and to be as accurate as possible in their answers. They were also informed that their answers would help better understanding the results. In addition, they had as much time as needed to answer the questions.

3.7.3 The Fourth Meeting

Participants could come to the fourth meeting individually or in groups, since the activities performed in this meeting did not require individual attention from the researcher. Previously to the meeting, this researcher divided the participants, according to their scores on the WMC tests, into two groups of balanced capacity, namely control and experimental group. It is important to highlight that as the data collection happened according to the participants' availability, it was not possible to control totally the balanced capacity nature of each group. Comparing both groups, in terms of WMC strict scores on the RST, for the control group, the mean is 2.25 and for the experimental group, 2.98, thus a difference of .73. The mean for the strict scores on the OSPAN is 33.2 for the control group, and 34.1 for the experimental group, thus a difference of .9. As can be seen, there is not a huge difference between groups; nevertheless, it is vital to bear this information in mind when comparing performance on comprehension.

Each group received oral and on paper instructions in Portuguese (see Appendix E2 for the control group instructions and E3 for the experimental group instructions) regarding what exactly they would do in this meeting. Paper instructions were given because this researcher would meet with students in different days, and written instructions would ensure that the same set of instructions would be given to every student.

In order to verify the role of attention to form and meaning, both groups were given the text (see Appendix E1) to read in 7 minutes, based on previous piloting. It is believed that this specific time set is crucial, given that having all the time available, participants may choose to do their best or not, they may spend more time re-reading the text as many times as they want in order to memorize the details, as well as spend more time looking for the target forms, thus, influencing the results. This fact may be considered a flaw in Leow, Hsieh and Moreno's research (2008), since the researchers did not control for time. It is assumed, in this study, that in order to really test attention, a specific amount of time must be set. The control group (30 participants)

was required to read the text, looking for its meaning. The experimental group (31 participants), besides reading, had to underline/highlight the verb forms of simple past tense, in the same 7 minutes. Participants were instructed to try to understand the text using the words they know and in relation to the unknown words, to try to understand them by the context. Besides, they were told to stay with the text for the 7 minutes. They were not allowed to make any noise, neither to give the text back to the researcher before the time finished. They were told to take advantage of the time available to read, re-read and reflect upon the text. When the 7 minutes ended, the researcher collected the texts.

Participants received the comprehension questions sheet (see Appendix F1). They were told they would have all the time needed to answer the questions. The researcher instructed them to read each question attentively and to answer in Portuguese, in a concise and clear way. It was highlighted that the objectives of the study would only be reached if the participants performed the activities seriously. Thus, they were told to answer the questions with the knowledge they had and with what they recalled from the text, and were told not to cheat.

When participants handed in the comprehension exercise, the researcher gave them retrospective questionnaires (see Appendix G1 for the control group questionnaire and G2 for the experimental group one). Once more, the control group received a questionnaire while the experimental group received another. Participants had no time limit for answering and were instructed to give information as accurate as possible, since their answers would help understanding the results.

The activities of this meeting took, from the participants, from 30 to 60 minutes, because each participant did not have a specific amount of time to complete the activities, except for the reading part that took 7 minutes.

3.7.4 The Fifth Meeting

In the fifth meeting, participants were offered feedback on their performance. They were met individually and it took about 30 minutes to talk to each one of them. First, the researcher showed the participant the scoring sheets for each WMC test performed, explained the results and what they mean for their reality, their everyday life. Second, the text was read by the researcher, with pauses, and both, participant and researcher, translated it. Then, the researcher showed the comprehension exercise sheet and the participant could observe her/his mistakes and what s/he got right. The researcher gave tips about reading, and together,

they could trace a way for the participant improve her/his reading skills in L2. Besides, participant and researcher could talk about the answers to the questionnaires.

As this was the last meeting, the researcher took the opportunity to reward the participants for their willingness and readiness to come to each meeting. First, the researcher invited the participant to watch a brief video about how to stimulate memory, available at *Youtube*[8], a production from Veja, a popular magazine in Brazil. Next, the participant told the researcher the parts that most called her/his attention. Then, the researcher handed in an explanatory text (see Appendix H1) that could be taken home as a present, written by the researcher herself. This text brings important concepts regarding the memory systems and tips on how to keep memory active and how to improve it. Subsequently, the researcher provided the participant with a popular test in neurolinguistics courses, about her/his predominant channel of communication (see Appendix H2): auditory, visual and kinesthetic. With the result of this test, the researcher gave tips on how this participant should study in an efficient way according to her/his predominant channel of communication. And to finish, the researcher offered the participant either a Speak Up magazine or a graded reader as a way of being thankful to her/his participation. Besides, each participant received a chocolate bar.

The inclusion of this fifth step, the feedback session, to the data collection phase was thought as a way of acknowledging the importance of each participant for this study. As Dörnyei (2003, p.90) points out, "[…] surveyors typically exploit their participants without offering anything in return - as soon as the data have been gathered, they disappear". He highlights that offering feedback is a nice gesture and it also prepares the grounds for future surveys. The video, the explanatory text and the communication channel test do not have academic value; they are not counted in the results. Nevertheless, their significance resides in the fact that the student comes to participate in a study with the objective of gaining something, either knowledge or recognition, of learning something about her/himself, something that can be profitable, useful in her/his everyday life. This researcher believes that the participant should be 'flattered', should be treated as someone really important, especially because without her/him, the investigations cannot be carried out.

[8]ESTIMULE a memória e o cérebro. A VEJA magazine production. 2008. (3 min.) Available at <http://www.youtube.com/watch?v=_exVMrYdLeM>

According to Silva, D'Ely and Dellagnelo (2010), there is, still in the beginning of the 21st century, the tendency to perpetuate the dichotomous view between the relations of teaching and research, teacher and researcher, school and university. The authors highlight the impact of research in the context of investigation, the importance of providing feedback, be it formally or informally, for the context (school) and the participants, since the ultimate objective of conducting research should be contributing to the context in which it was conducted and to the personal and professional development of the participants. In their analysis of 72 theses produced at PPGI-UFSC in the period 1977-2004, they could not find this worry among the researchers, what reflects a negligent attitude towards the participants and context involved. This researcher, advisor and co-advisor believe in the importance of considering research as social practice and providing participants and context with this opportunity.

3.8 THE PILOT STUDY

Pre-pilot sessions and a pilot study were conducted in the second semester of 2010 and beginning of 2011 in order to test, evaluate, revise and improve the instruments and procedures. By definition (Mackey & Gass, 2005), the pilot study is a small-scale trial of all the proposed procedures, materials, and methods proposed to an investigation. In the case of this research, some instruments were pre-tested, in pre-pilot sessions, with 8 participants, while the pilot study was conducted with 9 high school students, in the period from February 24th to March 11th, 2011. The institution chosen was *Colégio Madre Francisca Lampel*, a private school in Gaspar (SC). It is understood that the population of the two schools (Colégio Madre Francisca Lampel and Colégio Universitário) is similar, since both schools are private. Furthermore, these two schools are different universes from the ones usually researched in PPGI's thesis and dissertations (students from extracurricular courses in universities and undergraduate programs) in the area of reading and SLA.

To begin with, this researcher talked to the school director and the coordinator, explained the objectives of the study and they signed the consent form. Following, this researcher entered the classrooms inviting the students to take part. Most of them got interested but because of personal issues, just 9 agreed to participate. Because of this, it was negotiated with the English teacher of Colégio Universitário (the school where the complete study took place) a bonus on the participants'

grade, to increase participation. The participants of the pilot study received a folder containing their consent form, their parents' consent form and the practical guide designed to help them visualize the steps of the investigation. The process of writing these consent forms involved getting some models, adjusting these models to the population of the study (high school students) and to each group (institution/participant/parents) and pre-piloting with 4 participants. This testing phase brought insights regarding the fact that the writing style should be neat and easy to understand, the information about the procedures should be explicit and clear as well as the information about confidentiality. In addition, care was taken when explaining the objectives of the research in order to not spoil participants' perceptions. Besides, the fact that the participant should keep a version of the letter with her/him in case of doubts during the research development, made the researcher put the file in two pages, the first, kept with the participant signed by the researcher, the advisor and the co-advisor; the second page is a form, where the participant put her/his complete name, signed and provided the number of her/his ID card. This form was kept with the researcher, since it was the proof that the participant agreed in taking part in the study and in permitting the use of her/his data in the analysis.

Regarding the WMC tests, this researcher had access to the sentences, in case of the RST (Tomitch, 2003), and to the operation-word strings, in case of the OSPAN (Prebianca, 2009). These sentences and operation-word strings were typed and put into a PowerPoint file, what entailed following some standards, such as the placement on the screen and the size of the font. As well, this researcher created a scoring sheet, practical enough to be used to register the participants' answers while controlling the test. All participants received on paper and oral instructions for the WMC tests. When piloting the instructions and the tests themselves, it was perceived that the tests were really tiresome and sometimes, the participant got disappointed with her/his performance, since s/he felt that was not remembering the words. Indeed, the tests demand a lot of attention and concentration, but the researcher cannot give the participant the impression that the test is difficult in the instructions. That's why this researcher opted to put the following sentence in the instructions of the two tests: 'the test demands a lot of attention, so try to concentrate and don't get disappointed if you don't remember all the words'. Also, after each test, participants received a retrospective questionnaire to answer. It was difficult to create questions that would reflect important issues for the research regarding this part of

data collection. These questionnaires were pilot tested and brought insightful answers. Regarding the issue of time, in the pilot study, the participants took an average of 19.7 minutes to perform the RST; and 13.2 minutes to perform the OSPAN, without counting the instructions. Because of this, it was decided to maintain the 30-minute meeting for each test. In the case of the test, the pilot study contributed not only to the researcher training in administering the tests but also to the better understanding of the scoring procedures.

For the next step, participants were divided into two groups of balanced WMC, the control and the experimental group. Each group received proper instructions. The writing process required careful, neat writing, and adequate language. This researcher had to put herself in the participant's place, trying to imagine the doubts and anxieties a high school student might feel when confronted with such activities. In the instructions for the experimental group, the researcher paid much attention to the order of instruction for the reading part. In the instructions of a previous small scale research (BAILER & D'ELY, 2009), the participants were told that they would have to read the text and highlight the target forms. It is believed that this might have been a flaw, because the right instruction would be highlighting the forms and reading for comprehension simultaneously. As a result, this aspect was taken into consideration when designing the written instructions.

The text piloting revealed that it had 2 words (bewildered and incredulously) which were unknown to the age group, so this researcher changed them to synonyms which are cognates in Portuguese (confused and surprised) with the aim of increasing participants' probability of understanding the passage. Also, the text was typed, since the original layout might help participants understand the text. Both groups had a specific amount of time to read this text, in the pilot study, 10 minutes. It was noticed that 10 minutes was too much: the participants from the experimental group could pay attention to form and meaning freely; therefore, it was decided to reduce the time by 30%, to 7 minutes. It is believed that it is a fair amount of time for a high school student to read the text chosen.

Concerning the comprehension questions, in the beginning this researcher decided to follow Leow, Hsieh and Moreno's research (2008) in the selection of multiple-choice questions. However, due to the well-known ongoing debate in the area regarding this issue, this researcher, with the help of her advisor and co-advisor, decided to use open-ended questions. This type of questions has in itself a considerable difficulty, since the questions should not provide answers for the next ones, neither

give tips. The piloting sessions proved that the questions were clear in their objectives (just two questions had to be rephrased to increase comprehension and leave out the possibility of ambiguous understanding) and also showed that the participants were able to answer them properly.

From the pre-piloting sessions, the researcher learned about the care the writing of a questionnaire requires, because the questions need to be pertinent to the topic of the study and lead to answers that will shed some light on the issues being researched. Initially, it was thought of administering just one questionnaire after the comprehension questions and it would cope with all the steps taken in the study. When reflecting upon this matter, it was observed that the participants might not remember much about the first session, the first WMC test. Therefore, two more questionnaires were created to solve this potential problem. It was decided, then, that the first questionnaire would be administered right after the first WMC test; the second questionnaire right after the second WMC test; and the third right after the comprehension exercise. In fact, after the comprehension questions, it was decided to implement two retrospective questionnaires: one for the control group and another for the experimental group. In short, in the initial project there was one questionnaire at the end of data collection, and in the final project, three. This way, the retrospective questionnaires may definitely facilitate the emergence of perceptions and the way participants felt performing the activities, hence, providing data triangulation.

The pilot study also helped this researcher feel at will and calm when collecting the data. This is especially important for novice researchers, since they become anxious and nervous, feel afraid of doing something wrong; thus passing to the participant these feelings. Besides, the pilot study increased the level of organization regarding the research materials. This researcher organized each participant's material in a plastic folder; papers inside with a clip and a checklist, with all the research steps. All the participants' plastics were organized in a binder. Also, a paper note entitled 'next meeting' was created, where the researcher scheduled date, day of the week and time the participant would come the next time. In this paper, the researcher's cell phone number was included, so that participants could communicate any problems. Furthermore, the pilot study took 2 weeks (9 participants), making it clear that the study with 61 participants would be feasible (13.5 weeks), according to this research schedule. Actually, the complete study took 9 weeks, less than expected.

All in all, it was possible to notice how many contributions the pre-piloting sessions and the pilot study made for this investigation. Indeed, these movements allowed us to test, evaluate, revise and improve the methodological choices, as well as foresee results, solve doubts and perceive details that before went unnoticed.

3.9 DATA ANALYSIS

The data collected in this study were submitted to statistical tests so that a careful analysis of the research results could be carried out and the research questions could be addressed. The analysis was done through the online environment SEstatNet[9] (Nassar, Wronscki & Ohira, 2011) and the software STATISTICA 10.0 Trial; and comprised descriptive statistics, correlational analyses, non-parametric tests and reliability testing.

Descriptive statistics were run in order to describe and summarize the basic features of the data gathered for the present study as well as to check for normal distribution of the variables. This aspect helped the researcher to make appropriate methodological decisions as regards the inferential statistical tests that would have to be run to answer the research questions and hypotheses described previously in this chapter.

Pearson and Spearman Correlation Coefficients were run, first between the RST and the OSPAN scores (strict, lenient), to see if there was correlation in the participants' answers to both tests. Later, the answers to both WM tests and to the comprehension questions were submitted to these correlational tests so as to see whether there is a significant correlation between results and learners' WMC. As well, the number of past forms highlighted/underlined, the WM tests scores and the scores on the answers to the comprehension questions were submitted to correlational analyses. Resembling other research on the relationship between reading ability and information processing (Whitney, Ritchie & Clark, 1991), this part of the data is essentially correlational in nature. According to Dörnyei (2007, p.223), the statistical procedure named correlation helps the researcher examine the relationship between variables, since it "allows us to look at two variables and evaluate the strength and direction of their relationship or association with each other". In order to achieve that, a correlation coefficient is computed between the two variables, which can range

[9]SEstatNet: Sistema Especialista para o Ensino de Estatística na Web. Available at <http://www.sestatnet.ufsc.br/>

between –1 and +1. A high coefficient means a strong relationship; a coefficient of 0 suggests no relationship between the two variables while a negative correlation coefficient suggest inverse relationships. This procedure sought to answer the first research question: whether there is a correlation between WM, measured by the RST and the OSPAN, and the ability to sustain attention between meaning and form while reading, measured by scores on the answers to a comprehension task and a form recognition task.

Parametric and non-parametric tests (t-test and Mann-Whitney) were run in order to compare participants' scores on the answers to the comprehension questions among groups (control and experimental). This test was chosen because the objective was to compare two sets of quantitative data in terms of its average values (Barbetta, 2011) and also because the participants of this study were divided into two groups, the control having 30 and the experimental, 31. This procedure sought to answer the second research question: whether the type of attentional control (meaning/form) has a differential effect on EFL high school students' reading comprehension.

Cronbach's alpha was run so as to check the internal consistency of the scores on the answers to the comprehension questions. It is a coefficient of reliability, which varies from 0 to 1, since it is the ratio of variances (among items and the participants' totals). In general, an instrument or test is classified as having appropriate reliability when alpha is at least .70, but in some contexts, alpha .60 is acceptable considering that the results be interpreted with caution (Maroco & Garcia-Marques, 2006).

The following chapter presents the results of the data analysis and discussion in light of the literature. It is important to state that all statistical analyses were performed by the researcher herself with the help of professor José Francisco Fletes from the Department of Statistics (INE) at UFSC.

CHAPTER 4
RESULTS AND DISCUSSION

This chapter reports and discusses the results of the descriptive and statistical analyses made to address the hypotheses and research questions of the present study. The chapter is organized into seven sections, in which the data are brought in the order of the session they were collected, with the aim of keeping the line of reasoning proposed in the method chapter.

The first section, entitled Working Memory Tests, is divided into three subsections: the RST, the OSPAN, and Correlations between the two tests. The first two subsections bring descriptive statistical data and present a second subsection that brings the questionnaire data to help better understand the variables. The last subsection shows the correlational analysis performed to check whether there is correlation between these two tests.

In the second section, Reading measure: the comprehension questions, presents the descriptive statistics and the reliability test run with the scores on the answers to the comprehension questions. Additionally, the data gathered by means of the questionnaires are brought in a subsection to help shed some light on some processes participants engaged and some decisions they took during the reading task.

The third section describes the correlational tests run between the comprehension scores and the WM tests. First, the correlations between the whole group on these variables are presented, then, the differences between higher and lower spans in the pool and last, the differences between higher and lower spans in the experimental group.

In the fourth section, focus is given to the data gathered by means of the form recognition task. As well, the hypothesis that the participants in the experimental group condition could attend to form and meaning simultaneously is checked. In addition to that, questionnaire data are presented in a subsection so as to improve our understanding regarding this part of the data collection.

The fifth section presents the correlations run among the form recognition scores, the comprehension scores and the WM spans in order to either confirm or refute the hypothesis that higher spans would perform better at the form recognition exercise than lower spans.

In the sixth section, entitled ‘Attention Condition: analysis by group’, the differences displayed by the control and the experimental group are

examined. Besides, focus is given to the effects of each condition on the participants' comprehension performance.

The seventh section reports the main results described all over the chapter in the attempt of answering the two research questions posed in the study. In addition, the findings are discussed in the light of the theoretical ground work presented in the review of literature section. To reiterate, our first research question asked whether there was, if any, correlation between WMC and the ability of sustaining attention to form and meaning while reading. The second research question addressed the issue of whether the type of attentional control, namely meaning and form, has a differential effect on reading comprehension.

4.1 WORKING MEMORY TESTS

The following subsections report all the data gathered by means of the WM tests, the RST and the OSPAN, and the retrospective questionnaires administered after each test. First, the descriptive statistics run to better know the sample is presented, which assisted the decision of the appropriate statistical test for the correlation between the two tests. The Microsoft Office Excel 2003 and the SEstatNet environment were used to perform the statistical tests. In sequence, the data collected by means of the questionnaires are brought and last, the results of the correlations are presented.

4.1.1 The RST

Table 2 (following page) displays the scores of each participant in the RST according to the two scoring procedures adopted, strict[10] and lenient[11], in addition to the descriptive statistics, the mean, standard deviation, minimum and maximum scores of each scoring technique (see Appendix B6 for the histograms and box plot for the RST scores). The mean is defined as the sum of all scores divided by the number of observed participants and the standard deviation tells the distribution of the participants' scores, that is, it tells how spread out they are, and how much dispersion there is from the mean. A low standard deviation indicates that the scores tend to be very close to the mean, whereas a

[10]RST_S: the score is the level at which the participant was correct on at least two sets. Half credit was given if the participant passed one set at a certain level (see method chapter).
[11]RST_L: the participant was given credit for any set for which s/he recalled all sentence final words, irrespective of the order of recall (see method chapter).

high standard deviation indicates that the scores are spread out over a range of values.

Table 2

Participants' scores on the RST and descriptive statistics

PARTICIPANT	RST_S (strict)	RST_L (lenient)
P1	**3.5***	3.5
P2	3.0	3.0
P3	0	2.0
P4	**3.5**	3.5
P5	0	2.0
P6	2.5	2.5
P7	2.5	2.5
P8	3.0	3.0
P9	2.5	2.5
P10	**3.5**	3.5
P11	0	2.0
P12	2.5	2.5
P13	0	2.0
P14	0	2.0
P15	3.0	3.0
P16	**3.5**	3.5
P17	2.5	2.5
P18	3.0	3.0
P19	3.0	3.0
P20	3.0	3.0
P21	0	2.0
P22	2.0	2.0
P23	**3.5**	3.5
P24	2.5	2.5
P25	2.5	2.5
P26	3.0	3.0
P27	2.0	2.0
P28	**6.0**	6.0
P29	3.0	3.0
P30	**3.5**	3.5
P31	2.5	2.5

P32	3.0	3.0
P33	2.5	2.5
P34	3.0	3.0
P35	3.0	3.0
P36	2.5	2.5
P37	3.0	3.0
P38	**3.5**	3.5
P39	0	2.5
P40	3.0	3.0
P41	2.0	2.0
P42	2.5	2.5
P43	2.5	2.5
P44	**3.5**	3.5
P45	2.5	2.5
P46	3.0	3.0
P47	3.0	3.0
P48	**4.0**	4.0
P49	3.0	3.0
P50	**3.5**	3.5
P51	3.0	3.0
P52	2.5	2.5
P53	**3.5**	3.5
P54	2.5	2.5
P55	2.5	2.5
P56	3.0	3.0
P57	**3.5**	3.5
P58	3.0	3.0
P59	3.0	3.0
P60	3.0	3.0
P61	2.5	2.5
Mean	2.62	2.86
Standard Deviation	1.11	0.64
Minimum	0	2
Maximum	6	6

*Scores in bold indicate that these participants were classified as higher spans

It is interesting to point out that a span of 6 sentence final words is the best performance observed: 1 participant, P28. Following the strict

scoring procedure, there are: 1 participant with a span of 4 (P48); 11 participants with a span of 3.5; 21 participants with a span of 3.0; 17 participants with a span of 2.5; 3 participants with a span of 2.0 and 7 participants with a span of 0. To aid in addressing the research questions and hypotheses, this researcher decided to classify participants as higher and lower spans. Although there is not much agreement in the field concerning the definition of high and low spans, it was decided to classify as higher spans the ones who scored 3.5 and above, and as lower spans the ones who got 3.0 or below (Tomitch, 2003a). From the pool, 13 participants may be considered higher spans, while the remaining 48, may be classified as lower spans. According to the scores on this test, it is possible to say that the majority of participants in this study are lower spans.

4.1.1.1 Questionnaire data

In order to gather quantitative data concerning participants' views and strategy use during the completion of the WM tests, participants were asked to answer a retrospective questionnaire after performing the RST. Despite the fact that the data collected by means of this retrospective questionnaire are not central to answer the research questions, this researcher thinks it is important to bring the results in this subsection to maintain the line of reasoning proposed in the method chapter, it means, by presenting the results according to the order the activities were organized.

This questionnaire contains two questions, from which answers are pertinent to understand this variable. The first question seeks to bring data about how participants felt performing the test. The majority of participants, 22 (35%), reported feeling a bit nervous while 16 (25%) participants reported feeling calm. As the test was considered difficult by the participants, 12 (20%) reported feeling challenged by it, as participant 39 described: "I had to put a lot of effort to remember the words" (*my translation*). Just 4 participants (7%) reported feeling very well, 4 (7%) a bit tired, 1 (2%) off, 1 (2%) confused and 1 (2%) anxious. P54 illustrates the confusion he felt by saying "as there were too many words, I got confused; most of the times I could remember more about the beginning or the middle of the sentence" (*my translation*). Therefore, concerning the way participants felt while performing the task, the majority of participants reported feeling a bit nervous, a fact that may have reflected in their performance on the test.

The second question inquired what participants did to memorize the last words, whether they used a strategy or not. The majority, 24 participants (39%), sought to imagine the word, to associate it with something familiar while 16 (26%) tried to repeat the words silently at the same time they were reading the other sentences. Some participants made use of mimics: 6 (10%) mimed the initial letter of the word and 3 (5%) did something with the hands to help them remember the words. Some participants chained the words: 5 (8%) made a sentence with the words from the set and 5 (8%) made up a story to help remembering the words. One participant (2%) memorized the initial letter of each word and just one (2%) reported not having made use of any strategy to memorize the words. Interestingly, this participant scored 0 in the strict correction of this test.

Following the classification of strategies employed by Friedman and Miyake (2004), it is possible to say that from our pool, 16 participants used phonological strategies (subvocal rehearsal); 10 applied semantic strategies (making sentences, stories); and 34 made use of visual strategies (mental imagery, mimics). Therefore, although not central to this study, this datum may lead us to claim that the use of strategies plays a role in determining the effective use of attentional resources.

Participants' retrospective answers to the questionnaires illustrated that they actively tried to retain the sentence final words in WM, as the strategies mentioned in the chart. When the participant was unable to recall the correct word, s/he attempted to reconstruct the sentence on the basis of whatever had been retained. In these reconstructions, the participant made errors by choosing a word that had been present in the sentence, but was not the final word.

The finding that the participants in this study used strategies runs counter to what has been claimed in the field, that when the presentation rate is controlled by the researcher, the WM task occurs too quickly for the participant to use strategies. McNamara and Scott (2001) have stated that strategy use influences performance on WM tasks. The problem resides on the fact that "researchers have relied on the assumption that strategies require more time" (McNamara & Scott, 2001, p.11). As aforementioned, the tests were controlled: as soon as participants finished reading the final words, the next slide was shown on the screen. Therefore, this researcher sought to limit the amount of time available for the participants devise and implement such strategies. As the participants of this study are young, used to multitasking and logical

thinking, these data may indicate that they are strategic memorizers and might be strategic readers.

4.1.2 The OSPAN

Table 3 below displays the scores of each participant in the OSPAN according to the three scoring procedures adopted, strict[12], less lenient[13] and more lenient[14], in addition to the descriptive statistics, the mean, standard deviation, minimum and maximum scores of each scoring technique (see Appendix C5 for the histograms and box plots for the OSPAN scores). As can be seen, the means rise as the scoring procedure becomes more lenient, while the standard deviations decrease, because the variability of scores becomes lower. As participants' scores resulted in a high mean, it may be suggested that the OSPAN, for the population of this study, was easier than the RST.

Table 3

Participants' scores on the OSPAN and descriptive statistics

PARTICIPANT	OSPAN_S	OSPAN_L	OSPAN_LC
P1	35	35	35
P2	20	20	28
P3	34	34	35
P4	34	34	37
P5	28	28	33
P6	30	36	30
P7	33	39	33
P8	30	30	38
P9	35	37	35
P10	36	38	36
P11	36	36	37
P12	33	34	34
P13	22	23	22

[12]OSPAN_S: the score is the sum of the correct items recalled in the correct position (see method chapter).
[13]OSPAN_L: the participant was given credit when s/he judged a specific operation of a particular set incorrectly but was able to accurately recall the word following that operation, as long as s/he had not reached 6 errors in the math operations (see method chapter).
[14]OSPAN_LC: the participant was given credit when s/he judged the operation correctly but recalled the following word in an incorrect order in the set (see method chapter).

P14	33	33	35
P15	**39***	39	39
P16	30	31	32
P17	37	39	38
P18	32	32	34
P19	**38**	39	40
P20	37	37	37
P21	33	34	35
P22	22	26	25
P23	**42**	42	42
P24	31	32	31
P25	34	36	34
P26	34	36	34
P27	**41**	41	41
P28	34	35	34
P29	36	37	36
P30	**40**	41	40
P31	33	34	37
P32	36	37	36
P33	30	30	32
P34	**39**	39	40
P35	**39**	41	39
P36	31	32	33
P37	35	36	38
P38	**38**	38	39
P39	29	30	34
P40	26	26	27
P41	**39**	39	39
P42	36	37	38
P43	**38**	38	38
P44	35	36	38
P45	35	36	35
P46	36	37	36
P47	**41**	41	41
P48	28	30	30
P49	35	37	35
P50	36	37	36
P51	35	35	35

P52	33	33	33
P53	35	37	35
P54	30	32	30
P55	28	29	31
P56	27	27	32
P57	**38**	39	38
P58	36	37	37
P59	36	37	36
P60	33	33	37
P61	31	34	31
Mean	33.70	34.72	35.70
Standard Deviation	4.59	4.52	3.81
Minimum	20	20	22
Maximum	42	42	42

*Scores in bold indicate that these participants were classified as higher spans

It is interesting to point out that the score 42 is the best performance observed: 1 participant, P23. Following the strict scoring procedure, there are: 2 participants with a span of 41 (P27; P47); 1 participant with a span of 40 (P30); 4 participants with a span of 39; 4 with a span of 38; 2 with a span of 37; 9 with a span of 36; 8 with a span of 35; 5 with a span of 34; 7 with a span of 33; 1 with a span of 32; 3 with a span of 31; 5 with a span of 30; 1 with a span of 29; 3 with a span of 28; 1 with a span of 27; 1 with a span of 26; 2 with a span of 22; and 1 participant with a span of 20. To aid in addressing the research questions and hypotheses, this researcher decided to classify participants as higher and lower spans. Though there is not much agreement in the field concerning the definition of high and low spans, it was decided to classify as higher spans the ones who scored 38 and above, and as lower spans the ones who got 37 or below (Prebianca, 2009). Higher spans were the ones who scored a standard deviation (4.5) above the mean (33.7), whereas lower spans were those who scored below this value. From the pool, 12 participants may be considered higher spans, while the remaining 49, may be classified as lower spans. According to the scores on this test, it is possible to say that the majority of participants in this study are lower spans.

Compared to the RST, the number of higher spans is similar, 13 for the RST and 12 for the OSPAN. Taking a closer look at the participants who were classified as higher spans, just 4 (P23, P30, P38

and P57) were considered higher spans in both tests. As the classification criterion for the OSPAN took into consideration the mean, which was high, these results may suggest that, for the population of this study, the OSPAN was much easier, what may explain higher scores, and consequently, a higher mean than the ones from the RST. The questionnaire data, presented in the following subsection, may clarify this issue.

4.1.2.1 Questionnaire data

In order to gather quantitative data concerning participants' views and strategy use during the completion of the WM tests, participants were asked to answer a retrospective questionnaire after performing the OSPAN. As mentioned previously, the data collected by means of this questionnaire does not aim at answering the research questions; instead, it aims at shedding some light on the issues that might have impacted participants' performance. Besides, these data are presented in this subsection, following the order in which the activities were organized.

The questionnaire participants answered after performing the OSPAN contains two questions the answers of which are important to be reported. The first question seeks to bring data about how participants felt performing the test. The majority of participants, 26 (42%), reported feeling calm and 14 (23%) feeling very well during the test, suggesting that the participants considered this test easier than the RST. Participant 14 reveals his preference for the second test he performed, the OSPAN, by saying: "I thought it is interesting, it is a nice way of evaluating students' memory. I felt normal, calm, but in the first test [RST], I felt a bit nervous" (*my translation*). Thirteen participants (21%) reported feeling a bit nervous, 5 (8%) challenged, 1 (2%) a bit tired, 1 (2%) off and 1 (2%) confused. Participant 1 felt challenged, as she said "the operations were my weak point, but I could find a strategy that helped me" (*my translation*). Participant 49 revealed that "as I didn't know how many words I would have to remember, I got a bit nervous" (*my translation*).

Comparing questionnaire responses about the two tests, it is possible to say that participants reported feeling better performing the OSPAN (65%) than the RST (32%). In addition, participants felt more challenged by the RST (20%) than by the OSPAN (8%) and more nervous (35% - 21%). It is important to bear in mind that half of the sample performed the RST first while the other half the OSPAN, a procedure adopted to control for task effects, as if all participants had

performed one of the tests first, the results of the second WM test could be a function of the performance on the first test, as participants' would have been familiar with the 'task' itself.

The second question asked about the strategies participants employed to memorize the words. The majority, 33 participants (53%), imagined the word or associated it with something familiar while 12 (20%) repeated the words silently at the same time they were reading the following operation and solving it. Some participants sought to chain the words, 8 (13%) made up a story with the words from the set and 1 (2%) made a sentence to help remember the words. Some participants also made use of mimics, 3 (5%) did something with the hands to help them remember the words and 2 (3%) mimed the initial letter of the words. One participant (2%) memorized the initial letter of each word, and, interestingly, 1 (2%) participant reported being calm as his strategy. This participant performed the RST first and reported feeling nervous and for the OSPAN, his second test, he attempted to keep calm.

Following the classification of strategies employed by Friedman and Miyake (2004, p.156), it is possible to say that from our pool, 12 participants used phonological strategies (subvocal rehearsal); 9 applied semantic strategies (making sentences, stories); and 39 made use of visual strategies (mental imagery, mimics). Comparing these responses to the ones given to the RST question, all participants reported using a strategy for both tests, except for just one that declared that he had not employed any strategy for the RST. During the RST, more participants employed phonological strategies (16 – 12); more semantic strategies (10 – 9); and less visual strategies (34 – 39). According to Weissheimer (2007), semantic and visual/imagery strategies are the more efficient memory strategies. It seems that there might be a relation between the more sophisticated the strategy, the more retrieval will be.

As it was pointed out in the RST results description, it was not enough to control the presentation rate of the OSPAN with the objective of preventing strategy use from taking place. It can be highlighted that participants who developed effective strategies for the processing component (sentence/math operation) of the tasks may have had greater capacity to devote to storage (Weissheimer, 2007). In addition, this tendency in the usage of strategies may reflect the profile of the population of this study. Therefore, a pertinent question could be: who may guarantee that participants are not reading the operations slower to concentrate on the words while the experimenter is thinking they are processing the math operation? Friedman and Miyake (2004, p.137) draw our attention to the fact that "it is perhaps inevitable that

participants will develop idiosyncratic strategies for balancing the processing and storage components of working memory span tasks". Another relevant issue, proposed by Fontanini et al. (2005, p.223, *my translation*), would be, "to what extent participants' span reflects capacity or effective use of strategies or still, whether both constructs interact effectively in WM". According to Weissheimer (2007), McNamara and Scott (2001), and Friedman and Miyake (2004), strategy use and WM performance go hand-in-hand, since individuals who implement more efficient strategies recall more items than those who do not. Thus, it seems plausible to claim that individual differences reside as well "in the ability to employ efficient strategies for dealing with the test, and not solely in working memory capacity per se" (Weissheimer, 2007, p.184).

Upon answering the questionnaire after the second WM test, participants were asked which test they considered the most difficult. The majority of the participants (49 – 80%) considered the RST the most difficult test. Participant 40 illustrated this point by saying "the sentences test was much more difficult, because the quantity of words distracts you and you end up forgetting the last word" (*my translation*). Eight participants (13%) found the OSPAN more difficult, as P1 revealed: "the math test, because it requires more concentration due to calculus" (*my translation*). Just 4 participants (7%) considered both tests equally difficult, as P60 pointed out: "I consider both tests at the same level of difficulty, because in both, to be able to memorize the word, there was a math operation or a text disturbing you" (*my translation*). Thus, results suggest that, for the population of this study, the OSPAN was much easier, what may explain higher scores than the ones from the RST. Besides, it is important to consider that when a test is considered easy, generally the probability of differences to emerge is smaller.

4.1.3 Correlations between the RST and the OSPAN

In Appendices B6 and C5, it is possible to check the histograms and box plots for the variables RST and OSPAN in all scoring procedures adopted. The variable RST, both strict and lenient, and OSPAN_L do not follow a normal distribution. The variable OSPAN follows a normal distribution in the strict and in the most lenient scoring procedure. As some variables are not normally distributed, the non-parametric test Spearman's Rank Correlation was chosen. Table 4, in the following page, provides the results for the correlations run between the scores of both tests. As can be seen, all correlations happen at a *p*

(probability) value inferior to .05 and the highest correlation is found between the RST_S and the OSPAN_S.

Table 4

Correlations: scores on the RST and the OSPAN

	RST_S x OSPAN_S	**RST_L x OSPAN_L**	**RST_L x OSPAN_LC**
Spearman's Coefficient r_s	*.29*	.24	.26
p value	*.01*	.02	.02

Following the table for the absolute minimum value for the Spearman's Correlation Coefficient (r_s) proposed by Barbetta (2011), it should be more than .255 for 60-69 participants. Besides, the correlation between the RST_S and the OSPAN_S is statistically significant at α = .05 but weak, since the value explains less than 10% of the covariation (r^2).

Methodologically speaking, Conway et al. (2005) point out that WM span tests have proven to be both reliable and valid measures of WMC. This researcher expected to find a high or even a moderate correlation between the RST and the OSPAN scores, as Engle, Tuholski, Laughlin and Conway (1999), who found a correlation of .51 between the tests (this value explains 25% of the covariance). Possibly due to the nature of the tests and the population investigated, a significant but not high correlation was found. It is important to highlight that the correlation found is significant.

As mentioned in the review of literature chapter, the RST authors (Daneman & Carpenter, 1980) follow the *task-specific view* and argue that as reading is an integral part of their test; the RST is useful to predict reading ability. Cantor and Engle (1993, p.1102) bring that "when reading, good readers have fast and efficient reading processes that require less WM capacity than those of poor readers". Consequently, good readers may display more capacity in reading-related tasks. On the other hand, Turner and Engle (1989) follow the *general capacity hypothesis*, arguing that WMC is independent of the nature of the processing component of the span test. They demonstrated to be able to "predict reading ability with a WM span task that does not involve the reading of sentences" (Conway et al., 2005, p.772). Undeniably, as the extensive literature of the area has been showing, both tests measure the same construct but in different ways. According

to the results of this investigation, both tests seem to measure the same construct, especially because the scores correlated significantly.

In the case of the population of this study, the differences between performance on the two tests may rely on the fact that the OSPAN was much easier than the RST. As Conway and Engle (1995, p.587) point out: "individual differences will only reveal themselves in tasks that force the subject to engage in controlled effortful processing". Perhaps the point is that the OSPAN did not demand as much attention as the RST. Following Kane, Conway and Engle (1999, p.102), "working memory is needed only under attention-demanding circumstances". Possibly due to their age and profile, our participants may be more efficient in calculus than in reading. As stated by Daneman and Green (1986, p.17), "the capacity of working memory will vary as a function of how efficient the individual is at the specific processes demanded by the task to which working memory is being applied".

4.2 READING MEASURE: THE COMPREHENSION QUESTIONS

Table 5 below displays the descriptive statistics, the mean and standard deviation - for each question in the comprehension exercise and in the last line, the totals for the task. It can be noticed that questions 2 and 6 had the highest number of right answers while questions 7 and 11 were considered the most difficult by the participants, according to the means.

Table 5

Descriptive Statistics for the scores on each comprehension question (CQ)

	Mean	**Standard Deviation**
Q1	.60	.46
Q2	.87	.23
Q3	.86	.28
Q4	.59	.39
Q5	.66	.46
Q6	.87	.31
Q7	.53	.35
Q8	.66	.42
Q9	.73	.29
Q10	.67	.46
Q11	.56	.49
TOTAL	*7.66*	*2.79*

As mentioned in the method chapter, Cronbach's alpha was run so as to check the internal consistency of the comprehension questions. This coefficient of reliability can vary from 0 to 1, the closer to 1, the better. Cronbach's alpha for the items of the comprehension exercise used in this investigation is .86, indicating that the task is reliable to measure comprehension in the population of this study.

Table 6 below presents the scores of each participant in the comprehension exercise and the group condition s/he was assigned. In addition the descriptive statistics (mean, standard deviation, minimum and maximum scores) are displayed (see Appendix F2 for the histogram and box plot for the comprehension questions scores). As can be seen, the scores varied from 2 to 11 and the mean, 7.66, may be considered high, indicating that the participants of this study are good readers. It is important to take into consideration the fact that this sample had the characteristics of a regular classroom, therefore included different levels of proficiency.

Table 6

Participants' scores on the answers to the CQ and total descriptive statistics

PARTICIPANT	GROUP CONDITION	CQ SCORE
P1	CONTROL	4.5
P2	EXPERIMENTAL	10.7
P3	CONTROL	5
P4	EXPERIMENTAL	9
P5	CONTROL	10
P6	CONTROL	4.3
P7	EXPERIMENTAL	9
P8	CONTROL	3.5
P9	EXPERIMENTAL	8.2
P10	EXPERIMENTAL	10.9
P11	CONTROL	7
P12	EXPERIMENTAL	10.7
P13	CONTROL	10.2
P14	CONTROL	3
P15	CONTROL	5.5
P16	EXPERIMENTAL	9.5
P17	EXPERIMENTAL	8.2
P18	CONTROL	3.5

P19	EXPERIMENTAL	10.5
P20	EXPERIMENTAL	9.5
P21	CONTROL	8
P22	CONTROL	9
P23	EXPERIMENTAL	10.5
P24	CONTROL	4.3
P25	CONTROL	4
P26	CONTROL	5.8
P27	CONTROL	3
P28	EXPERIMENTAL	11
P29	EXPERIMENTAL	8.3
P30	EXPERIMENTAL	9.7
P31	CONTROL	2
P32	EXPERIMENTAL	11
P33	CONTROL	5
P34	EXPERIMENTAL	9.7
P35	CONTROL	10.7
P36	EXPERIMENTAL	10.7
P37	CONTROL	10.2
P38	EXPERIMENTAL	10.5
P39	EXPERIMENTAL	9.3
P40	CONTROL	2
P41	CONTROL	4.3
P42	CONTROL	7.5
P43	EXPERIMENTAL	8.3
P44	CONTROL	8.3
P45	CONTROL	2
P46	CONTROL	7.2
P47	CONTROL	10
P48	CONTROL	11
P49	EXPERIMENTAL	10.2
P50	CONTROL	8.7
P51	EXPERIMENTAL	4
P52	CONTROL	6.8
P53	EXPERIMENTAL	10.7
P54	EXPERIMENTAL	7.5
P55	EXPERIMENTAL	8.2
P56	EXPERIMENTAL	10.3

P57	EXPERIMENTAL	8
P58	EXPERIMENTAL	9.3
P59	EXPERIMENTAL	4.7
P60	EXPERIMENTAL	4.7
P61	EXPERIMENTAL	8.7
Mean	7.66	
Standard Deviation	2.79	
Minimum	2	
Maximum	11	

Although the text seemed to be suitable to the participants' schooling level, it may be inferred, from the participants' performance on the comprehension questions, that some participants read the text in a bottom-up fashion, since they maybe wasted too much of the given time devoting themselves to decoding the words at the expense of higher order processes, thus, resulting in low performance in the comprehension exercise.

4.2.1 Questionnaire data

Immediately after answering the comprehension questions, participants were required to complete a retrospective questionnaire. One of the items asked participants to comment on each step from that session. As it was an open item, participants commented on the ones they thought were the most relevant. Concerning the reading part, 12 participants felt well, thought it was easy, as opposed to 4 participants who considered it difficult. As regards the process of comprehending the text, 18 participants reported being easy; 26, average; and 17, difficult. In relation to the comprehension questions themselves, 31 participants thought they were easy while 30, difficult. This balance shows that the task was not too easy neither too difficult for the sample investigated. This tendency is confirmed by the 30 participants who answered how they felt answering these comprehension questions: 24 reported being well and calm; 4, a bit nervous and 2, a bit tired.

Participants were asked about what they did to understand the unknown words encountered in the text. The majority, 54 participants (88%) reported using the context and associating these unknown words to the ones they know. Three participants (5%) stated their preference for associating these unknown words to Portuguese; 1 (2%) preferred to

guess the meaning and 3 participants (5%) declared doing nothing to understand these unknown words.

The following item asked participants if there were words that still they could not understand/assign meaning. Twenty-five participants (41%) reported not being able to understand all words, even when using the strategies mentioned. The majority, 32 participants (52%), declared being able to assign meaning to some words, not all; and just 4 participants (7%) could understand all the unknown words using the strategies cited. The last item regarding this part of the data asked whether the unknown words made the text comprehension more difficult. There is a balance, since 23 participants (38%) reported that the unknown words did not make the comprehension more difficult while 22 participants (36%) declared the opposite, that the words made comprehension more effortful. And 16 participants (26%) reported that the unknown words made comprehension a little bit more difficult.

These results gathered by means of questionnaires may reveal that these participants are strategic readers, since they make use of strategies when confronted with unknown words. In addition, as they are teenagers, they are improving their reading abilities, especially in the L2.

When asked about which part of the research they liked the most, most of the participants (40 – 66%) considered the WM tests, especially because they had never performed one before. As revealed by P19, "I like challenges, that's why I liked the memory tests more" (*my translation*). Eight participants (13%) preferred the comprehension questions, as P28 "I liked the comprehension exercises, because when there is a story, it becomes easier to memorize the details" (*my translation*). Seven participants (11%) enjoyed the text reading, by the fact that it was written in English; and 6 (10%) liked all steps.

Another question inquired participants whether there was something that confused/disturbed them during the tasks. More than half of the participants (35 – 57%) declared that nothing had annoyed them; followed by 9 participants (15%) who considered their lack of vocabulary in English as an impeding factor; and 8 (13%) reported having difficulty in the language. Three participants (5%) considered their nervousness; 3 (5%) tiredness/headache; and 1 (2%) lack of concentration due to noise as hindering aspects. In addition, two participants (3%) reported the time to read the text as not enough. The factors raised cannot be totally controlled by the researcher, except for the time to read the text. Out of 61, just 2 participants raised this issue,

thus, not a common complaint. Therefore, it is believed that the time given for reading was sufficient.

4.3 CORRELATIONS BETWEEN THE COMPREHENSION QUESTIONS AND THE WORKING MEMORY TESTS

In Appendix F2, it is possible to check the histogram and the box plot for the comprehension questions. This variable follows a normal distribution along with OSPAN_S. The variable RST_S, as previously shown, does not follow a normal distribution. For the variables RST and CQ, the non-parametric test Spearman's Rank Correlation was chosen. And as the OSPAN and CQ variables are normally distributed, the parametric test Pearson's Linear Correlation was chosen.

Table 7

Correlations: RST x CQ and OSPAN x CQ

	Spearman's Coefficient r_s	**Pearson's Coefficient *r***	***p* value**
RST_S x CQ	*.37*	-	*.00*
RST_L x CQ	*.39*	-	*.00*
OSPAN_S x CQ	-	.00	.49
OSPAN_L x CQ	.12	-	.17
OSPAN_LC x CQ	-	.01	.45

As revealed by Table 7 above, the comprehension scores only correlate significantly with the RST scores. This result can be explained because reading is a complex cognitive process and just the RST seems to predict reading performance in the sample investigated. Despite the fact that both WM tests are supposed to measure the same construct and predict a variety of complex cognitive activities, the OSPAN scores, in this population of high school students, did not correlate with reading in the L2. The OSPAN may require a different line of reasoning, more mathematical; and for the population investigated, it was much easier than the RST.

Since the comprehension scores only correlated with the RST scores (.37, a weak correlation because it explains just 14% of the covariance), this researcher decided to classify participants as high/low spans (according to the RST_S scores) and run descriptive statistics in order to check whether higher spans performed better at comprehension

than lower spans. The variable RST_S does not follow a normal distribution while the variable CQ does. Therefore, the non-parametric test Mann-Whitney was run. According to Table 8 below, the difference between higher and lower spans is significant (see Appendix F4 for the histograms and box plot of the comprehension exercise scores according to the division higher/lower spans). This difference corroborates the view that individuals differ in functional capacity, that is, "in the processes they have for maximally utilizing their limited capacities" (Daneman & Merikle, 1996, p.423).

Table 8

Statistics for the CQ scores according to WMC

	Higher spans	**Lower spans**
N (total = 61)	13	48
Sum of ranks	557	1334
Mann-Whitney U	158	
p value	0.003	

As well, it is important to check whether the higher spans of the experimental group outperformed the lower spans of the same condition. Table 9 below reveals that the difference between higher and lower spans in the experimental condition is statistically significant, as demonstrated by the non-parametric Mann-Whitney test (see Appendix F5 for the histograms and box plot). This result indicates that in the small sample from the experimental group, it may be claimed that higher spans are more capable of performing two activities at the same time (reading and highlighting verbs) than lower spans, besides performing better in comprehension.

Table 9

Statistics for the Experimental group CQ scores according to WMC

	Higher spans	**Lower spans**
N (total = 31)	9	22
Sum of ranks	184.5	311.5
Mann-Whitney U	58.5	
p value	0.03	

4.4 ATTENTION MEASURE: THE FORM RECOGNITION TASK

Participants from the experimental group were required to perform the form recognition task while reading the text for meaning. This task was devised with the purpose of assessing whether the participants from the experimental condition could pay attention to form while reading the text. There were 32 verbal past forms (regular and irregular) throughout the text and participants were supposed to highlight (circulate or underline) the forms they encountered (see Appendix E4 for the histogram and box plot). Table 10 below presents how many simple past tense verbs participants could underline/highlight while reading in addition to the descriptive statistics for this variable, CPF (correct past forms). The 31 participants who performed this activity presented scores ranging from 13 to 32 with a mean of 26.3.

Table 10

Participants' scores on the Form Recognition Task and descriptive statistics

PARTICIPANT	**CPF**
P2	31
P4	31
P7	24
P9	22
P10	32
P12	31
P16	32
P17	31
P19	32
P20	30
P23	31
P28	31
P29	17
P30	28
P32	29
P34	25
P36	32
P38	32
P39	28
P43	16

P49	32
P51	30
P53	32
P54	19
P55	17
P56	23
P57	21
P58	23
P59	21
P60	13
P61	22
Mean	26.3871
Standard Deviation	5.8633
Minimum	13
Maximum	32

In general, participants knew the verbs in the simple past because of the low occurrences of wrong forms selected. Eight participants did not select any wrong form; 13 participants selected two wrong words; 2 participants underlined five wrong words; 1 participant highlighted three; 2 participants chose four wrong items; 2 participants selected nine wrong forms; and 1 participant underlined ten wrong items. Moreover, due to the high occurrence of correct forms, it is possible to say that participants could indeed pay attention to form while reading, irrespective of being higher or lower spans.

4.4.1 Questionnaire data

After performing the comprehension questions, participants answered a questionnaire and the data from two questions are reported in this section since they may elucidate participants' engagement in the task and previous knowledge about the form required. The first question required participants to state their opinion about the activity of highlighting the verbs and reading the text simultaneously. The majority of the participants, 19 (61%), considered difficult the act of paying attention to form and meaning simultaneously. For instance, participant 2 considered that "the task of circulating demanded much attention, because there are adjectives that are equal to the past form of the verbs, you've got to pay attention to the context" and P49 pointed out that "the

difficulty resided in the short time period to understand the text and highlight the words" (*my translation*). Nine participants (29%) reported it as being an easy task. For participant 12, "circulating was easy, I know some verbs that are indispensable for you to communicate" (*my translation*). The remaining 3 participants (10%) revealed not knowing the past tense well. Interestingly, these 3 participants are the ones who chose the highest number of wrong forms in this task. Nevertheless, the task showed to be effective in making participants cope with meaning and form.

The second question asked participants whether their previous knowledge about the simple past helped them to better understand the text. Great part of the participants, 23 (75%) considered their previous knowledge about the simple past decisive to understand the text, as illustrated by P12 "my knowledge helped me a lot, without it, I could not highlight anything neither understand the text" (*my translation*). The minority, 6 participants (19%) reported it as helping a little and 2 (6%), not helping at all. Participant 20 reported his knowledge as "helping a little, I think that without the extracurricular course, I would have got a worse result" (*my translation*).

4.5 CORRELATIONS AMONG THE FORM RECOGNITION TASK, THE COMPREHENSION QUESTIONS, AND THE WORKING MEMORY TESTS

Table 11 (following page) displays the results for the correlations between the scores on the Form Recognition Task, on the Comprehension Questions and on the WM tests. As can be noticed, the scores on the form recognition task correlate well with the scores on the answers to the comprehension exercise (.58), reinforcing the idea that participants could pay attention to form and meaning while reading. Therefore, it can be claimed that participants in this study did indeed pay attention to the target forms while processing for meaning, as Leow, Hsieh and Moreno (2008) found.

When correlated with the scores on the WM tests, the form recognition scores only correlate with the RST scores (.40). The results for the correlations with the OSPAN are not statistically significant. As formerly stated, the RST scores correlated because the form recognition task involves reading while the OSPAN did not, since it seems to not predict reading performance in the sample investigated.

Table 11

Correlations: CPF x CQ; CPF x RST and CPF x OSPAN

	Spearman's Coefficient r_s	**Pearson's Coefficient *r***	***p* value**
CPF x CQ	-	*.58*	*.00*
CPF x RST_S	*.40*	-	*.01*
CPF x RST_L	*.40*	-	*.01*
CPF x OSPAN_S	-	.07	.34
CPF x OSPAN_L	-	.06	.36
CPF x OSPAN_LC	-	.10	.27

As the scores on the form recognition exercise only correlated with the RST scores (.40), this researcher classified the experimental group participants as higher/lower spans and ran a statistical test to check whether WMC affected performance. The variable Correct Past Forms (CPF) follows a normal distribution while the variable RST_S does not. Therefore the non-parametric test, Mann-Whitney was run. According to Table 12 below, the higher span participants could highlight/underline more right forms than the lower spans (see Appendix E5 for the box plot and histograms).

Table 12

Statistics for the Form Recognition Task scores according to WMC

	Higher spans	**Lower spans**
N (total = 31)	9	22
Sum of ranks	197.5	298.5
Mann-Whitney U	45.5	
p value	0.009	

By the result, it is possible to say that higher and lower spans differ in their ability to recognize and highlight verbs while reading, because the difference is statistically significant. This result corroborates the idea that individuals differ in capability for controlled processing (Engle et al., 1999). This way, the higher spans of this sample are more capable of highlighting forms, verbs, and reading for meaning simultaneously than the lower spans who have less WMC available to perform the two activities.

4.6 ATTENTION CONDITION: ANALYSIS BY GROUP

Participants were divided into two groups of somewhat balanced capacity. The initial idea was to control totally for that, but as data collection happened according to the participants' available schedule, it was not possible to have all the participants performing the same tests/tasks at the same period. Data collection lasted two months; there were participants who finished everything in a week, in two weeks, while others started in the middle of the second month. As already mentioned in the previous chapter, there is a difference of .73 in terms of the scores on the RST and .90 in terms of the scores on the OSPAN test. There are not huge differences between groups, yet it is necessary to take this into consideration when comparing performance on the tests.

Each group, control and experimental, was compared in terms of performance on the comprehension questions (see Appendix F3 for the histograms and box plot). Table 13 presents the statistics for both conditions. It can be seen that the experimental group outperformed the control group in the comprehension exercise.

Table 13

Statistics for the Attentional conditions according to the scores on the CQ

	Control Group	**Experimental Group**
N (total = 61)	30	31
M	6.21	9.08
SD	2.87	1.85
t-Student measure	-4.62	
p value	0.000014	

The parametric Student t-test for independent samples was run so as to check whether the difference between the groups was significant. The independent variable - the one manipulated by the researcher -, is the attentional condition (control/meaning and experimental/form). The dependent variable - measured to see the effect the independent variable has on it – is the answers to the comprehension questions. According to Table 13 above, the result indicates that the conditions control and experimental, respectively focus on meaning and focus on form, tend to produce different results in terms of comprehension, measured by the answers to the comprehension questions. This difference is statistically significant in the population investigated and reveals that participants allocated in the experimental group displayed better results in terms of

comprehension than the ones allocated in the control group. Participants from the experimental condition might have benefited from the instruction given – highlight all the verbs in the simple past you encounter and read for meaning –, as opposed to the control participants who were instructed just to read for meaning. It is important to bear in mind that verbs are content words, therefore crucial for the understanding of the passages. And although there was the effort to keep an eye on the formal aspects, it might have fostered their processes to comprehend the passage.

4.7 RESEARCH QUESTIONS

Having the data reported in the previous subsections, it is at this moment possible to answer the research questions and hypotheses posed in the method chapter of this thesis. Two subsections follow, one for each research question, that aim at providing a summary of the results, thus answering each research question, and discussing the factors which may have played a role in the results of this investigation.

4.7.1 RQ1: Is there a correlation between WM and the ability to sustain attention between meaning and form while reading?

The answer to the first research question is partially positive, that is, there is a positive correlation between WMC, as measured by the RST, and the ability to comprehend a narrative text (r_s = .37 at p < .05). In addition, there is a correlation between the scores on the RST and the highlighted occurrences of simple past (r_s = .40 at p < .05). The same did not hold true for the correlation between WM by the OSPAN and the scores on the answers to the comprehension task and the form recognition task, especially because the OSPAN did not work as a predictor of reading performance.

Before running any correlation between WMC and reading ability, the correlation between both WM tests was checked. As already posed, the RST and the OSPAN test significantly correlate, but not highly (r_s = .29 at p<.05). Since the population investigated is composed of teenagers, several issues that may have had an impact on this low correlation may be raised. According to the scores and participants' answers to the questionnaires, it can be claimed that the RST was more difficult than the OSPAN test. Nevertheless, in both tests, experimenter-paced, participants reported making use of strategies. Definitely, it may be said that the participants of this study are strategic memorizers and

strategic readers, since they showed good reading ability in the L2. But is it possible to claim that the participants were more strategic in the OSPAN test? Well, this issue is not at the core of this study, but this researcher prefers to believe that the OSPAN, being easier for the age group, did not demand as much attention as the RST. The OSPAN measured WMC but for the sample investigated, it cannot be used to predict reading ability. The literature in WM states that individual differences will only be revealed in attention-demanding tasks, in tasks that require controlled effortful processing (Just & Carpenter, 1992; Kane, Conway & Engle, 1999; Tomitch, 2003a). Furthermore, our participants may be more efficient in calculus than in reading.

Possibly, the correlations among the RST and OSPAN scores with the comprehension exercise scores reflect the nature of the two WM tests. In the sample investigated, performance on comprehension did only correlate significantly with the RST scores (.37). As already mentioned, the RST follows the task-specific view whereas the OSPAN, the general capacity hypothesis. Daneman and Merikle (1996, p.430), in their meta-analysis of 77 studies, concluded that to achieve the best predictive validity, "the working-memory measure should include a verbal process component *and* a verbal storage component". Maybe that is the case for our study, because the RST components are verbal while the OSPAN elements involve math calculus and verbal processes. Hence, it may be claimed that, in the sample investigated, the RST can be used to predict reading performance while the OSPAN cannot. In addition, as Farmer, Christiansen, and Kemtes (2005) pointed out, given the highly linguistic nature of the RST, participants with more language experience have better language-related skills, and may, as a result, exhibit superior performance. In this study, the variable language experience was not controlled; this researcher only has knowledge about the amount of time these participants have been studying English formally at school. Therefore, this investigation cannot bring evidence for Farmer, Christiansen, and Kemtes' point of view.

There is a great amount of research following Daneman and Carpenter's (1980) hypothesis and also a great sum of studies following Turner and Engle's (1989) view. From the data collected - WMC data in L1 and reading data in L2 -, it seems to be a trend that WMC might be task specific. But, the results are applicable to the sample studied in that specific context, thus, not generalizable to whole population.

Therefore, our hypothesis 1a (there is a correlation between amplitude of WM, measured by the RST and the OSPAN, and the ability to sustain attention between meaning and form while reading,

measured by scores on the answers to a comprehension task and a form recognition task) is confirmed by the RST and refuted by the OSPAN. As well, our hypothesis 1b (higher spans will perform better at comprehension and will be able to sustain attention to form simultaneously to meaning, measured by highlighted occurrences of simple past verbal forms) is confirmed. Our findings do support the claim that higher spans perform better at comprehension than lower spans, following Just and Carpenter (1992) in that performance on language comprehension tasks varies as a function of WMC. In addition, the results do provide evidence that higher spans have more ability to sustain attention to form simultaneously to meaning, measured by highlighted occurrences of simple past verbal forms.

4.7.2 RQ2: Does the type of attentional control have a differential effect on reading comprehension?

The answer to the second research question is positive, that is, the type of attentional control (meaning/form) indeed has a differential effect on EFL high school students' reading comprehension. This finding runs counter to Leow, Hsieh and Moreno's study (2008), whose results revealed no significant difference in comprehension between conditions, consequently, no differential effect on comprehension.

This researcher followed Leow, Hsieh and Moreno's (2008) assumption that as learners are limited capacity processors, simultaneous attention to both meaning and form should have resulted in a cognitive overload that impacted negatively on comprehension. It was expected that the participants who have just attended to meaning (control condition) should have performed better at comprehension than the ones who have attended to form and meaning simultaneously (experimental condition), especially because more attentional resources might have been needed to make the form-meaning connections. In the present investigation, participants in the experimental condition were instructed to highlight verbs, which are content words, crucial for the understanding of meaning. Therefore, keeping an eye on the verbal past forms indeed fostered processing to comprehend the text.

Contrary to what was initially expected, it was found that the experimental group outperformed the control group in the comprehension exercise, means 6.21 and 9.08, respectively at p value $<.05$. Hence, paying attention to form did not result in detrimental effects for comprehension. Wong (2001), in her study, found the same pattern in the written mode. However, there are studies that found the

opposite. VanPatten (1990), who conducted an investigation with L2 learners of Spanish, concluded that his participants displayed difficulty in attending to form and meaning simultaneously of aural input. Greenslade et al (1999) replicated VanPatten's study (1990) in the written mode and found that form and meaning may compete for attentional resources in the processing of written input. Despite the fact that the literature on this issue is controversial and research has been carried out in two distinct modes – aural and written -, some factors deserve more attention, such as the choice of the target forms, depth of processing and proficiency of the participants, to be discussed below.

VanPatten (1989) postulated that learners consider it difficult to attend to form that does not contribute substantially to the meaning. This follows his Primacy of the Meaning Principle (1996, p.14-15): learners process input for meaning before they process it for form. Besides, learners prefer processing content words before anything else; prefer processing lexical items to grammatical items for semantic information; and prefer processing "more meaningful" morphology before "less" or "nonmeaningful" morphology. In addition, VanPatten (2007) suggests that learners may rely on lexical semantics to interpret sentences. According to him (p.123), lexical semantics refers to the "requirements that the meaning of the verbs place on nouns for an action or event to occur". As target forms, VanPatten's (1990) and Greenslade, Bouden and Sanz's (1999) study use the lexical items (inflación), the article (lo/la), the verb morpheme (-n). Leow, Hsieh and Moreno (2008) use the same except for the word 'sol' in the place of 'inflación'. Wong (2001) uses the word 'inflation' and the definite article 'the'. No studies, to the knowledge of this researcher, have used verbal past forms in this kind of task. Participants read a text with 32 occurrences of the simple past, 18 regular and 14 irregular. For the regular verbs -ed means pastness, which is a form-meaning connection, since it involves syntax and semantics. And due to the nature of the irregular verbs, participants had to know them in order to recognize them. It was found that requiring readers to attend to an item that was important for understanding the meaning of the passage did not negatively affect comprehension, as Wong did (2001) and partially supported by Leow, Hsieh and Moreno (2008). In the case of the present study, these words were crucial for the understanding of the message, and attending to them, had a positive impact on comprehension.

Another important issue raised by Leow, Hsieh and Moreno (2008) is depth of processing. They made use of think-aloud protocols with the objective of better understanding the actual processes learners

engaged in while interacting with the input. They found (2008, p.685) that the "effort might not have been too taxing on the attentional resources which is what would normally hinder the processing for the meaning of the text as VanPatten (1990) and Greenslade et al. (1999) suggested". Although in this study think-aloud protocols were not used, it can be speculated that the task of identifying the verbs might not have been challenging enough to hinder attentional resources. Half of the verb forms were regular forms, and their recognition might have been done on a very automatic fashion. As it is known, automatic processes require little attention while controlled processes require attention as well as interfere with other processes that require it (Schmidt, 2001). The case for this study might be that the participants recognized the regular simple past tense verbs automatically and just had to actively pay attention to the irregular forms.

An additional factor that may have influenced the results is the participants' proficiency in the L2. As this background information was just collected in the last questionnaire, this factor could not be taken into consideration when dividing the participants into the two groups. Table 14 below brings the data, already exposed in the participants' subsection of the method chapter but here divided into groups.

Table 14

Questionnaire data about the participants' English background in terms of attentional condition

	TOTAL	**CONTROL**	**EXPERIMENTAL**
Have had English classes since the 1st grade	35	17	18
Have had English classes since the 4th grade	21	8	13
Have had English classes since the 5th grade	5	5	0
Have attended an English course	30	9	21
For 1 year or less	7	4	3
For 1 year and a half	3	0	3
2-3 years	7	4	3
4 years	7	0	7
5-6 years	6	1	5

The data show that participants have almost the same amount of exposure to formal English classes at school. However, from the 30

participants that attend an extracurricular English course, 21 belong to the experimental group and the remaining 9 to the control condition. In addition, if it is compared the amount of time these participants attend the course, it is possible to observe that the experimental group participants take the course for a longer period of time than the control group ones (Control group = 1 participant for more than 3 years/ Experimental group = 12 participants for more then 3 years). Farmer, Christiansen and Kemtes (2005, p.642) propose that "individual differences in language comprehension are, in part, product of differences in language experience". Undeniably, proficiency may have played a role in this part of the data, since all the other phases happened in the participants' L1. As VanPatten (1990) points out, simultaneous attention to form and meaning becomes easier as proficiency level increases. As well, the way participants read the text might have influenced their outcome in comprehension, as the ones who read in a more bottom-up or top-down fashion may have displayed not as good results as the ones who read more interactively.

Furthermore, there is an important factor, not mentioned in the literature, to the knowledge of this researcher. Upon delivering the instructions for the text reading for the experimental group participants, the researcher stressed that they should highlight the past tense verbs while reading for meaning. Upon reflecting about this issue, it may be claimed that this researcher should have not influenced the readers and should have let them do the reading the way they wished. However, this was the way encountered to lead them focus on formal aspects first. It was thought to ask them to prioritize the form, and not to read twice, first for highlighting, then for meaning.

It can be said that the command given to the experimental group served as a strategy for the participants. Following Olshavsky (1977, p.656), strategy is "a purposeful means of comprehending the author's message". According to Afflerbach and Cho (2009), reading comprehension strategies demand reader attention and effort and are focused on the goal of constructing meaning. Thus, comprehension strategies are employed "to solve the specific goal of comprehension" (Dole, Nokes & Drits, 2009, p.363). As the forms participants were required to select carry both form and meaning, having this strategy at hands, participants could understand better the text, its details, and the task did not become as demanding as expected. In addition, the fact that participants assumed a behavior under the instructions may reveal that the participants of this study are good readers, as they could convert the instruction into a strategy and benefit from this. Therefore, the

experimental group might have profited from that, as opposed to the control group, who was only instructed to read the text and do not pay attention to anything else.

It is important to bear in mind that the text was a narrative and certainly, participants' knowledge about the structure of a story may have helped participants from both groups to attend to details such as the answers to the classical questions who, where, when, what and how. The control group participants did not have such a good result in comprehension maybe because they were instructed just to read for meaning; they had the 7 minutes to read the text and could employ any strategy as they wished or even could choose to employ none.

In short, hypothesis 2a (the type of attentional condition, namely focusing on meaning and focusing on form, has a differential effect on EFL high school students' reading comprehension) was confirmed, since the conditions focus on form and focus on meaning produce different and significant results. Nevertheless, hypothesis 2b (the individuals who just attend to meaning should perform better at comprehension than the ones who attend to form and meaning simultaneously) was refuted, because the experimental group participants displayed better results on comprehension than the control group participants. As factors that might have influenced the results, there is the instruction given to the experimental group, which may have served as a comprehension strategy, the target form itself, the issue of depth of processing and the issue of proficiency in the L2.

All in all, there is a very complex relationship among WMC, attention to form and meaning and reading comprehension. This study attempted to shed some light on these issues and found that, in the sample investigated, higher spans exhibit better performance on comprehension and are more able to cope with the task of recognizing past tense verbs while reading a text for meaning. As well, this study seems to support the task specific view of WMC, since comprehension performance correlated only with the RST scores and not with the OSPAN scores. In relation to the attentional condition, participants who were instructed to read for meaning presented lower scores than the ones who were instructed to highlight all the verbs in the past tense while reading. It was suggested that the instructions given, the choice of target form, the level of automaticity in identifying these forms, and the level of proficiency in the L2 might have played a significant role in the results obtained.

CHAPTER 5
FINAL REMARKS, LIMITATIONS, SUGGESTIONS AND PEDAGOGICAL IMPLICATIONS

5.1 FINAL REMARKS

The present research had as main objective to investigate, in a sample of high school students of English as a foreign language, the relationship between individual differences in WMC and the learners' simultaneous attention to form and meaning. More specifically, this study aimed at investigating (i) whether there is, if any, a correlation between WMC, measured by the RST and the OSPAN, and the ability of sustaining attention to form and meaning while reading, as measured by scores on the answers to a comprehension task and a form recognition task; and (ii) whether the type of attentional control, namely meaning and form, has a differential effect on EFL high school students' reading comprehension. This study employed retrospective questionnaires so as to unveil participants' impressions on the different tasks they performed.

In order to reach such goals, a set of experiments, previously pilot tested, was implemented. The first objective generated two hypotheses: (i) there would be a correlation between amplitude of WM, measured by the RST and the OSPAN, and the ability to sustain attention between meaning and form while reading, measured by scores on the answers to a comprehension task and a form recognition task; and (ii) higher spans would perform better at comprehension and would be able to sustain attention to form simultaneously to meaning, measured by highlighted occurrences of simple past verbal forms. The second objective may be unfolded into two hypotheses: (i) the type of attentional condition, namely focusing on meaning and focusing on form, would have a differential effect on EFL high school students' reading comprehension; and (ii) the individuals who just attended to meaning should have performed better at comprehension than the ones who attended to form and meaning simultaneously.

Data were analyzed quantitatively and the statistical procedures revealed that, in general terms, attention to form and meaning in reading is affected by individual differences in WMC. A summary of the main findings of this investigation is presented next:

Finding 1: the RST and the OSPAN scores correlate significantly (.29) in the population investigated. It is a low but significant correlation. Departing from the fact that individual differences will only take place

in tasks that compel the participant to engage in controlled effortful processing (Just & Carpenter, 1992; Conway & Engle, 1996; among others), the OSPAN test, with a high mean and considered easier by the participants, did not demand as much attention as the RST, with a lower mean. Though not central to the study, it was found, by means of the questionnaire data, that participants made use of different strategies to remember the final words, bringing support to the view that WMC tests do not measure WMC per se, but also the ability to employ efficient strategies for coping with the tests (Weissheimer, 2007).

Finding 2: the RST scores correlate with comprehension performance (.37) in the population investigated while the OSPAN scores do not (.0004 at $p > .05$). This finding may be explained by the fact that as reading is a complex cognitive process, just the RST reflects this complexity, bringing evidence for the task-specific view of WMC.

Finding 3: Higher spans display better results in the comprehension exercise than lower spans. The difference is statistically significant and corroborates the view that individuals differ in processing efficiency, thus in the processes they have for maximally making use of their capacities (Just & Carpenter, 1992; Daneman & Merikle, 1996).

Finding 4: Higher spans are more capable of performing two activities at the same time, as reading and highlighting verbs, than lower spans. This result brings evidence for the fact that WM is a variable that impacts on learners' performance, being the higher the span, the better the performance.

Finding 5: Participants in the experimental condition could indeed pay attention to form while reading. This result might be a function of the type of form participants had to attend to, in this case, verbs. Due to the fact that verbs carry meaning, making them focus on structural aspects of past tense verbs did not hinder comprehension, on the contrary, functioned as a way of making them more effective in understanding the text message.

Finding 6: Participants in the experimental condition could pay attention to form and meaning simultaneously, as the significant correlation between the form recognition task and the comprehension scores ($r = .58$ at $p < .05$) reveals. It can be claimed that participants in this study did indeed pay attention to the target forms while processing for meaning, as Leow, Hsieh and Moreno (2008) found.

Finding 7: Higher spans could highlight more right forms than lower spans. The correlation between the form recognition exercise and the RST scores is significant ($r_s = .40$ at $p < .05$) while the correlation

with the OSPAN is not ($r = .07$ at $p > .05$). Once more, the OSPAN does not seem to reflect reading processes in the population investigated, or at least, it does not reflect the same complexities that reading a text does. Higher spans are more capable of recognizing verbs and reading simultaneously for meaning than lower spans that seem to have less WMC available to perform the two tasks. This result supports the view that individuals differ in capability for controlled processing (Engle et al., 1999).

Finding 8: the type of attentional condition has a differential effect on reading performance. Reading for meaning only results in lower mean (6.21) in the comprehension task than reading for form and meaning simultaneously (9.08). This difference is statistically significant in the population investigated and contrary to what was expected, because this work was based on the assumption that learners are limited capacity processors and having to divide attention between two tasks at the same time impacts negatively comprehension (Leow, Hsieh & Moreno, 2008). Underlying this hypothesis, there is the issue of choice of the target form. This researcher chose verbs in the past tense since they carry both form and meaning, thus crucial for understanding the meaning of the passage, and asked participants from the experimental group to devote their attention to these verbs while reading for meaning. Though they put effort on recognizing the formal aspects, it might have fostered the processes to aid in comprehending the text. Participants may have assumed the behavior of using the instruction as a strategy to pay attention to the meaning and consequently, displaying a better result on comprehension than the control group. Other variables may have played a role, such as level of proficiency in the L2 and the participants' use of automatic processing when identifying the regular past tense forms.

In sum, the results of this investigation speak in favor of a complex relationship between WMC and attention to form and meaning in reading in the L2. In the population investigated, higher spans exhibit better performance on comprehension and are more able to cope with the task of recognizing past tense verbs while reading a text for meaning. As well, paying attention to form and meaning tend to produce better results in comprehension than just paying attention to meaning. The instructions given to the participants, the choice of these forms, the level of automaticity participants' display in identifying these forms and the level of proficiency in the L2 might have played a role in these results. In addition, this study brings evidence for the task-specific view of WMC. This study attempted to shed some light on these issues and

found a very complex relationship between the key constructs in the population investigated. Nevertheless, further research is needed to investigate the relationship among different measures of WMC and attention to form and meaning in L2 reading, especially with different proficiency levels, age groups and dealing with different linguistic forms.

5.2 LIMITATIONS OF THE STUDY AND SUGGESTIONS FOR FURTHER RESEARCH

Due to the nature of this study, the results gathered are to be seen as suggestive rather than conclusive. Despite the fact that it has been methodologically and theoretically driven by the literature in the field, the present investigation suffered from several limitations which are now pointed out, followed by suggestions for further research:

The population investigated. The pool of participants investigated in this study was composed of native speakers of Brazilian Portuguese studying English as a foreign language and formally attending high school. Thus, the results and the conclusions drawn from them are related particularly to this population. So as to allow generalization of the findings presented in this thesis, further research should consider investigating a greater sample size including different ages, language backgrounds and even different L2s.

Participants' level of proficiency in the L2. Although the WM tests and the comprehension questions were implemented in the L1, the reading of the text was done in English. In the specific context investigated, there is no in house proficiency test and implementing a proficiency test entails creating a test or even adapting a well-established test, which in turn takes long time as well as including raters in evaluating participants to improve reliability. This researcher is aware that proficiency ended up being an intervening variable in this study. Therefore, it would be interesting to investigate WMC and attention to form and meaning in participants of different proficiency levels, properly controlled, using the method design proposed by this study.

Retrospective questionnaires. The inclusion of three retrospective questionnaires aimed at providing factual, behavioral and attitudinal data to help this researcher better understand the results. One limitation of the present work is that the participants' background information was not included in the first retrospective questionnaire; actually it was included in the last one. Having the profile of the participant in the first encounter is important since it can help the researcher divide the

groups/conditions properly, taking into consideration how long participants study English at school and how long they take extracurricular courses.

Experimental condition. As a researcher, I regret the fact that the control group could not face the experimental condition. Nevertheless, it would not make sense to ask participants to read the same text again following the experimental instructions. Indeed, it would be interesting to deal with two different texts, of similar level of difficulty, and compare performance of the very same participant, performing in both conditions. It is a possibility of providing participants with the opportunity of facing the different condition.

Pre-test knowledge about the target form. Participants in this study were not pre-tested to check whether they knew the simple tense. The text and the target form were controlled taking into consideration the English curriculum of Brazilian schools and the grades these participants study, thus, it was expected that they had already learned this grammar item. Data from the retrospective questionnaire revealed that only 3 participants reported not knowing the simple past very well and data from the form recognition task revealed that these participants highlighted more wrong forms than the participants who reported knowing the grammar feature. Despite the fact that they did not highlight the forms right, the task showed to be effective in making them cope with meaning and form. Nevertheless, it is important to pre-test participants' knowledge about the target form before applying the tasks. This researcher had not done so due to time constraints, since it would imply pre testing participants before starting the study. Moreover, these three participants could have been taken out from the study, but they were not because this researcher intended to investigate a sample with the same characteristics of a regular classroom.

Instructions for the reading task. This researcher stressed that the experimental group participants should highlight the verbs first while reading for meaning; and the control group participants should just read for meaning. Upon reflecting about this issue, I may conclude that I should have not influenced them and let them do the reading the way they preferred. Though this way, I asked the experimental participants' to focus to the formal aspects while reading. If they have read for underlining first and then read again for meaning, it would generate a problem because they were not doing both things simultaneously. Definitely, a balance needs to be reached and further research should devote more time to reflect and test the effect of these instructions.

WMC tests. This study employed the RST and the OSPAN, widely used measures of WMC, which have proved to be both reliable and valid (Conway et al., 2005). This investigation found a weak but significant correlation between them, meaning that both tackle the same process. The OSPAN supposedly measured general processing capacity, as Turner and Engle (1989) postulate, which is common to many language and non-language tasks, so much so that it correlated with the RST, which is considered to measure verbal ability. Even though these tests were applied in the participants' L1 – one requiring the processing of verbal material and the other requiring the processing of mathematical material -, it is advised that further studies include other measures of WMC such as the Counting Span (Case, Kurland & Goldberg, 1982 in Conway et al., 2005); or make use of other versions of the Daneman and Carpenter's (1980) RST, as the one with the grammaticality judgment. Moreover, it would be interesting to test participants' WMC of a higher proficiency level in the L2.

Analysis of strategies implemented in the WM tests. Although this researcher categorized the strategies participants made use of while performing the two WM tests, it would be interesting to dedicate more attention and time to this issue, by comparing the strategies higher and lower spans utilized and checking whether there is a relation between the type of strategies used and the effectiveness of the retrieval process, as Weissheimer (2007) did. As this issue is secondary for the objectives of this study, this researcher opted to not deepen the discussion; nonetheless, this constitutes a fertile area for further research.

Despite the shortcomings aforementioned, it is believed that the present study has contributed to enlighten, at least a bit, the complexities involving WMC and attention to form and meaning in L2 reading.

5.3 PEDAGOGICAL IMPLICATIONS

This study follows the interest on the effect of individual differences in WMC on L2 acquisition. According to Robinson (2001, p.660), results have shown that WMC affects "the extent and efficiency of focal attention allocation" and may be closely related to L2 proficiency and skill development. To this author (1995), little is understood about the nature of the interaction between cognitive resources during information processing and language learning. In this realm, this study sought to bring some conclusions about the interaction between WMC and attention to form and meaning. As WM is a source of individual differences, it turns out to be more difficult for learners

with lower WMC to attend concurrently to different stimuli in the input and to have a good performance on comprehension. Despite the fact that VanPatten (2007) has clearly affirmed that input processing is not about pedagogy, processing instruction is directed at creating comprehension-based activities to push learners away from non-optimal processing. Nonetheless, this researcher attempted to elaborate on the pedagogical implications of this study.

In L2 classrooms, teachers encounter a great variety of students with different backgrounds, proficiency levels, levels of motivation, and certainly, a range of WM capacities. Although WM tests are not administered at schools, teachers need to be aware that individual differences in WM are present and play a role in learning and performance. As well, the results from this study showed that there will always be attention to form while reading, especially when dealing with linguistic features that carry meaning. It means that readers go to a text for meaning but still keep an eye on the formal aspects, on specific forms that call their attention. Pedagogically speaking, teachers should prepare learners with vocabulary and grammar for them to understand the meaning of the texts they read and also bring topics that they are familiar with, which might be a way to enhance comprehension. Besides, controlling the level of text difficulty and providing students with exercises that focus on formal aspects may end up being positive for fostering learners' comprehension. In addition, teaching reading strategies and providing students with an aspect to focus, an objective to read, as this study did, has shown to lead to better comprehension. As Schmidt (2001) pointed out, providing a strategy for focusing attention or for sustaining attention while doing something else results in deeper processing, and in the case of this investigation, results in superior comprehension.

To conclude, this study attempted to understand the role that WM and attention might play in influencing learners' reading comprehension processes. Besides preparing students with linguistic knowledge and providing appropriate activities, it is of paramount importance to make learners aware of their role as readers, how strategic they can be. As Tomitch (2009) indicate, teachers should provide students with tools so that students/readers can have free access to texts they might choose, be it to acquire knowledge about a certain subject, entertainment, but in short, their growth as integrated and performing parts of the society they live in.

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APPENDIX A1 – Institutions' consent form

UNIVERSIDADE FEDERAL DE SANTA CATARINA
PPGI – Programa de Pós-graduação em Língua Inglesa

Ao prezado diretor geral _____
À prezada diretora _____
Ao prezado coordenador pedagógico _____

Eu, Cyntia Bailer, venho por meio desta carta solicitar a autorização desta instituição, _____, para a realização de uma importante etapa de minha pesquisa de Mestrado. Sou aluna do Programa de Pós-graduação em Língua Inglesa da Universidade Federal de Santa Catarina (UFSC – Matrícula 201001063), meu trabalho se concentra nas áreas de leitura e cognição e é orientado pela professora doutora Lêda Maria Braga Tomitch e co-orientado pela professora doutora Raquel Carolina Souza Ferraz D'Ely.

Minha pesquisa tem por objetivo investigar questões de atenção na habilidade de leitura e suas relações com a capacidade de memória. Muitos estudos já mostraram que a atenção se relaciona com a amplitude de memória, e é um fator imprescindível para a aquisição de uma língua estrangeira, entretanto, mais pesquisas são necessárias para que melhor seja possível entender o papel da atenção e da memória no campo da leitura.

Para tal, solicito a autorização desta instituição para a seleção de colaboradores, alunos do ensino médio, e para a aplicação dos instrumentos de coleta de dados. O material coletado e o contato interpessoal não oferecerão riscos de qualquer ordem aos colaboradores e à instituição. Pelo contrário, as tarefas desenvolvidas pelos alunos participantes durante a pesquisa irão enriquecer suas experiências e conhecimentos da Língua Inglesa.

Entretanto, os alunos selecionados não serão obrigados a participar da pesquisa, podendo desistir a qualquer momento. Todas as informações são confidenciais. Quaisquer dúvidas poderão ser esclarecidas a qualquer momento; seja pessoalmente, por telefone ou por e-mail, abaixo mencionados.

De acordo com estes termos, favor assinar o termo na página seguinte. Uma cópia ficará com a instituição e outra com a pesquisadora. Muito obrigada.

_____	_____	_____
Cyntia Bailer	Lêda M.B. Tomitch	Raquel C.S.F. D'Ely
Pesquisadora	Orientadora	Co-orientadora
cyntiabailer@gmail.com		
47 3332-0556 / 9979-0435		

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO - INSTITUIÇÃO

Pelo presente instrumento, que atende às exigências legais, o(a) senhor(a) _____, **responsável legal pelo Colégio Universitário** após leitura da CARTA DE INFORMAÇÃO À INSTITUIÇÃO DA PESQUISA, está ciente dos serviços e procedimentos aos quais **serão submetidos os alunos selecionados desta instituição.** Não restando quaisquer dúvidas a respeito do lido e do explicado, firma seu CONSENTIMENTO LIVRE E ESCLARECIDO de **concordância em autorizar a realização** da pesquisa proposta.

Fica claro que o sujeito de pesquisa ou seu representante legal podem, a qualquer momento, retirar seu CONSENTIMENTO LIVRE E ESCLARECIDO e deixar de participar do estudo alvo da pesquisa. Todo trabalho realizado torna-se informação confidencial, guardada por força do sigilo profissional.

Gaspar, ____ de fevereiro de 2011.

_____
Assinatura do representante da instituição

APPENDIX A2 – Students' consent form

UNIVERSIDADE FEDERAL DE SANTA CATARINA
Termo de Consentimento Livre e Esclarecido – Participantes

Você está sendo convidado a participar de um projeto de pesquisa sobre memória, leitura e compreensão textual em língua inglesa. Você foi selecionado porque você é um aluno de Inglês como Língua Estrangeira e está matriculado no ensino médio. Este estudo está sendo conduzido por Cyntia Bailer (aluna do Mestrado em Língua Inglesa/PGI/UFSC), orientado pela professora doutora Lêda Maria Braga Tomitch e co-orientado pela professora doutora Raquel Carolina Souza Ferraz D'Ely.

Objetivo da Pesquisa:
O objetivo deste estudo é investigar questões de atenção na habilidade de leitura e suas relações com a capacidade de memória. Muitos estudos mostram que a atenção se relaciona com a amplitude de memória, e é um fator imprescindível para a aquisição de uma língua estrangeira, entretanto, mais pesquisas são necessárias para que melhor possamos entender o papel da atenção e da memória no campo da leitura.

Procedimentos:
Você será solicitado a desempenhar as seguintes tarefas: (1) realizar dois testes de memória; (2) ler um texto; (3) realizar os exercícios propostos; e (4) responder a um questionário sobre sua experiência educacional e suas impressões ao realizar as atividades. Os procedimentos serão realizados na escola, em período extraclasse, em horários marcados previamente e aplicados pela própria pesquisadora.

Não há nenhum risco em participar da pesquisa. Pelo contrário, as tarefas desenvolvidas por você durante esta pesquisa irão enriquecer seus conhecimentos da Língua Inglesa. Após a coleta de dados, a pesquisadora entrará em contato com você a fim de propiciar feedback quanto a sua atuação nas tarefas propostas.

Confidencialidade:
Ao final da pesquisa, os resultados do estudo serão tornados públicos e compartilhados com a escola e os participantes, porém sua identidade será totalmente preservada e não será incluída nenhuma informação que possa identificá-lo(a). O acesso aos dados coletados será confiado somente à pesquisadora, orientadora e co-orientadora deste trabalho.

Sua decisão de participar ou não de nossa pesquisa não afetará sua relação com a escola. Ademais, ainda que você tenha consentido em participar da pesquisa e por qualquer razão não querer mais fazê-lo, você poderá desistir a qualquer momento, desde que informe a pesquisadora. Em caso de dúvidas ou sugestões, o contato com a pesquisadora pode ser feito através do seguinte e-mail: cyntiabailer@gmail.com

Assinando o consentimento pós-informação, você estará consentindo com o uso dos dados coletados para a pesquisa. Muito obrigada,

_____	_____	_____
Cyntia Bailer	Lêda M. B.Tomitch	Raquel C.S.F. D'Ely
Pesquisadora	Orientadora	Co-orientadora

Consentimento Pós-Informação

Eu, _____
(nome completo), fui esclarecido sobre a pesquisa "Working memory capacity and attention to form and meaning in EFL reading: is there a correlation?" e concordo que meus dados sejam utilizados para a realização da mesma.

Gaspar, _____ de _____ de 2011.

Assinatura: _____ RG: _____

APPENDIX A3 – Parents' consent form

UNIVERSIDADE FEDERAL DE SANTA CATARINA
Termo de Consentimento Livre e Esclarecido - Pais

Prezados pais,

Eu, Cyntia Bailer, venho por meio desta carta solicitar a sua autorização para a participação de seu filho(a), aluno(a) desta instituição, _____, na realização de uma importante etapa de minha pesquisa de Mestrado. Sou aluna do Programa de Pós-graduação em Língua Inglesa da Universidade Federal de Santa Catarina (UFSC – Matrícula 201001063), meu trabalho se concentra nas áreas de leitura e cognição e é orientado pela professora doutora Lêda Maria Braga Tomitch e co-orientado pela professora doutora Raquel Carolina Souza Ferraz D'Ely.

Seu filho(a) foi convidado a participar deste projeto de pesquisa sobre memória, leitura e compreensão textual em língua inglesa. Ele(a) foi selecionado por ser um aluno de Inglês como Língua Estrangeira e estar matriculado no ensino médio. A pesquisa tem por objetivo investigar questões de atenção na habilidade de leitura e suas relações com a capacidade de memória. Muitos estudos mostram que a atenção se relaciona com a amplitude de memória, e é um fator imprescindível para a aquisição de uma língua estrangeira, entretanto, mais pesquisas são necessárias para que melhor possamos entender o papel da atenção e da memória no campo da leitura.

Seu filho(a) desempenhará as seguintes tarefas: (1) realizar dois testes de memória; (2) ler um texto; (3) realizar os exercícios propostos; e (4) responder a um questionário sobre sua experiência educacional e suas impressões ao realizar as atividades. Os procedimentos serão realizados na escola, em período extraclasse, em horários marcados previamente e aplicados pela própria pesquisadora.

Participar da pesquisa não oferece nenhum risco ao seu filho(a). Pelo contrário, as tarefas desenvolvidas durante esta pesquisa enriquecerão os conhecimentos da Língua Inglesa. Além disso, após a coleta de dados, a pesquisadora propiciará um retorno em relação à atuação de seu filho(a) nas tarefas propostas.

Mesmo que seu filho(a) e você(s) tenham consentido participar da pesquisa, e por qualquer razão seu filho(a) não queira mais fazê-lo, ele(a) poderá desistir a qualquer momento, desde que comunique a pesquisadora. Em caso de dúvidas ou sugestões, o contato com a pesquisadora pode ser feito através do seguinte e-mail: cyntiabailer@gmail.com ou dos telefones 3332-0556 ou 9979-0435.

Assinando o consentimento pós-informação, você estará autorizando seu filho(a) a participar de nossa pesquisa. Muito obrigada,

_____	_____	_____
Cyntia Bailer Pesquisadora	Lêda M. B. Tomitch Orientadora	Raquel C.S.F. D'Ely Co-orientadora

Autorização

Eu, _____
(nome completo), autorizo meu filho(a) _____
a participar da pesquisa “Working memory capacity and attention to form and meaning in EFL reading: is there a correlation?” e concordo que os dados coletados sejam utilizados para a realização da mesma.

Gaspar, _____ de _____ de 2011.

Assinatura: _____
RG/CPF: _____

APPENDIX A4 – Practical guide

GUIA PRÁTICO – PROCEDIMENTOS DE PESQUISA
(PESQUISADORA: CYNTIA BAILER)

IMPORTANTE: Os ENCONTROS acontecerão em horário EXTRA-CLASSE, previamente agendados com a pesquisadora.

➔ Termo de Consentimento Livre e Esclarecido ➔ PARTICIPANTES + PAIS
➔ INSTRUÇÕES GERAIS

1 ENCONTRO (todos juntos)

➔ Trazer AUTORIZAÇÃO assinada pelos pais
➔ 2 TESTES DE MEMÓRIA
➔ 2 QUESTIONÁRIOS

2 ENCONTROS (individuais)

➔ TEXTO
➔ QUESTÕES DE COMPREENSÃO
➔ QUESTIONÁRIO

1 ENCONTRO (juntos)

➔ FEEDBACK/ RESULTADOS

1 ENCONTRO (individuais)

APPENDIX B1 – List of the RST sentences

SESSÃO DE TREINO

1 - Caiu o número de profissionais que diziam querer ficar por muito tempo no atual **emprego**. (15 palavras, *Você S/A*, fevereiro de 2011, p.51)

2 - O consumo de proteínas estimula a produção de células dos tecidos ósseos e musculares, acelerando o **crescimento**. (17 palavras, *Superinteressante*, agosto de 2000, versão online)

3 - Adotar uma postura ética eleva tanto o nível de felicidade quanto ganhar um **aumento**. (14 palavras, *Superinteressante*, dezembro de 2010, versão online)

4 - De modo geral, os imigrantes vindos do Terceiro Mundo têm famílias mais numerosas que os **europeus**. (16 palavras, *Veja*, 24 de outubro de 2007, p.120)

5 - Descobriu-se que o grau de identificação com a equipe não tinha relação com as vitórias ou **derrotas**. (17 palavras, *Mente e Cérebro*, maio de 2011, p.41)

6 - Para construir a trama os atores passaram, durante dois meses, por um processo diretamente influenciado pelo **cinema**. (17 palavras, *Mente e cérebro*, maio de 2010, p.11)

7 - O açúcar é uma parte natural da vida humana desde os primórdios de nossa **existência**. (15 palavras, *Veja*, 24 de outubro de 2007, p.11-12)

8 - O consumo isolado de farinha de linhaça não vai baixar os tão desejados pontinhos da **balança**. (16 palavras, *Women's Health*, abril de 2010, p.46)

9 - Não se esqueça de incluir a cidade de onde escreve e telefone para **contato**. (14 palavras, *Mente e cérebro*, maio de 2010, p.7)

INÍCIO

1 - O intelsat-6 foi lançado em 1990, mas nunca funcionou – ficou numa órbita **errada**. (13 palavras, *Veja*, 20 de maio de 1992, p.63)

2 - A iniciativa deve partir da própria pessoa interessada em ter um corpo bonito e **saudável**. (15 palavras, *Veja SC*, 15 de abril de 1992, p.4)

3 - Ele é uma pessoa que gosta de contar a todos o que anda fazendo, nos mínimos **detalhes**. (17 palavras, *Mente e cérebro*, maio de 2010, p.44)

4 - As bactérias degradam as emulsões coloridas do filme, criando imagens que podem ser definidas como **futuristas**. (16 palavras, *Superinteressante*, fevereiro de 1992, p.14)

5 - A padronização agrícola, para atender aos consumidores, ameaça a diversidade biológica do mundo **vegetal**. (14 palavras, *Superinteressante*, julho de 1992, p.10)

6 - Os diálogos acontecem ao mesmo tempo, e cabe ao espectador escolher para onde dirigir sua **atenção**. (16 palavras, *Mente e cérebro*, maio de 2010, p.7)

7 - Para realizar as atividades cerebrais do pensamento, os neurônios tiram energia do oxigênio e da **glicose**. (14 palavras, *Superinteressante*, julho de 1992, p.10)

8 - O truque, portanto, é partir triunfante rumo ao objetivo antes do início da **partida**. (14 palavras, *Mente e cérebro*, maio de 2010, p.24)

9 - Cerca de 250 milhões de pessoas, ao redor do mundo, se encontram na mais profunda **depressão**. (16 palavras, *Superinteressante*, setembro de 1992, p.57)

10 - O repórter não deu grande importância à frase, mas esse parecia ser justamente o segredo do **sucesso**. (17 palavras, *Mente e cérebro*, maio de 2010, p.24)

11 - Uma manifestação estudantil ontem em Brasília foi marcada por atritos com a **polícia**. (13 palavras, *Folha de S. Paulo*, 17 de setembro de 1992)

12 - Mostra a capacidade do homem em transformar coisas simples em obras de arte, através da **dedicação**. (16 palavras, *Superinteressante*, setembro de 1992, p.3)

13 - A expressão refere-se à tentativa de conciliar o progresso com a preservação da **natureza**. (14 palavras, *Veja*, 3 de junho de 1992, p.34)

14 - Cada volume traz textos inéditos escritos por psicólogos e psicanalistas, todos especialistas no **assunto**. (14 palavras, *Mente e cérebro*, maio de 2010, p.8)

15 - Pesquisa do Sebrae aponta que o novo salário mínimo deve provocar uma onda de **demissões**. (15 palavras, *Folha de S. Paulo*, 17 de setembro de 1992)

16 - Se o Brasil pretende ir ao espaço sem pedir licença, não pode dispensar um programa de **foguetes**. (17 palavras, *Superinteressante*, setembro de 1992, p.10)

17 - O médico deve levar em conta a idade, número de filhos e saúde do **paciente**. (15 palavras, *Folha de S. Paulo*, 17 de setembro de 1992)

18 - Soube que o marido não ganhou o direito de protestar contra o abandono em momento tão **delicado**. (17 palavras, *Superinteressante*, setembro de 1992, p.4)

19 - Nós pedimos para o mundo falar e a mensagem soou alta, clara e extraordinariamente **perfeita**. (15 palavras, *Veja*, 3 de junho de 1992, p.98)

20 - A obra custou caro demais, a utilidade é incerta e o resultado final, **polêmico**. (14 palavras, *Veja*, 23 de setembro de 1992, p.60)

21 - É a primeira vez que se consegue em órbita a ovulação e fertilização de espécies **animais**. (16 palavras, *Veja*, 23 de setembro de 1992, p.61)

22 - Os fabricantes de microcomputadores estão criando produtos com novas tecnologias, a preços mais **atraentes**. (14 palavras, *Folha de S. Paulo*, 23 de setembro de 1992)

23 - Pesquisadores descobrem que o antílope das pradarias norte-americanas é o mais resistentes dos mamíferos **terrestres**. (15 palavras, *Superinteressante*, julho de 1992, p.37)

24 - O neandertal tinha testa curta e grossa, mandíbula forte, de queixo curto, e seus ossos eram **pesados**. (17 palavras, *Superinteressante*, julho de 1992, p.37)

25 - Reconhecer a importância da identidade social abre as portas para novas possibilidades de **reflexão**. (14 palavras, *Mente e Cérebro*, maio de 2011, p.43)

26 - Às vésperas do fim da reserva da informática, cresce a pressão por novos privilégios e **favores**. (16 palavras, *Veja*, 23 de setembro de 1992, p.80)

27 - Seu público eram as pessoas que olham muito para a pechincha e pouco para a **qualidade**. (16 palavras, *Veja*, 23 de setembro de 1992, p.83)

28 - O Brasil reforça sua presença no milionário clube da telefonia celular com o anúncio de novos **editais**. (17 palavras, *Veja*, 23 de setembro de 1992, p.85)

29 - Quando o cineasta dá rédea solta ao puro amor pelas imagens, o filme arrebata os **sentidos**. (16 palavras, *Folha de S. Paulo*, 23 de setembro de 1992)

30 - Na catarata, a vítima perde a visão gradualmente porque as células do cristalino tornam-se mais **opacas**. (16 palavras, *Superinteressante*, fevereiro de 1992, p.9)

31 - É difícil acreditar no acidente que interrompeu a arrancada do trem voador japonês, rumo às rotas **comerciais**. (17 palavras, *Superinteressante*, fevereiro de 1992, versão online)

32 - Os conservadores usaram e abusaram das teses de perversidade, da futilidade e da **ameaça**. (14 palavras, *Folha de S. Paulo*, 23 de setembro de 1992)

33 - Elas mostraram sinais de rotas das caravanas de mercadores, que levaram os pesquisadores à **cidade**. (15 palavras, *Superinteressante*, junho de 1992, p.10)

34 - Cartão-postal sob suspeita: radiação eletromagnética das antenas da Avenida Paulista pode afetar a saúde **humana**. (15 palavras, *Superinteressante*, junho de 1992, versão online)

35 - O investidor pode estar procurando a segurança do ouro, um investimento tradicional, neste momento de crise **política**. (17 palavras, *Folha de S. Paulo*, 23 de setembro de 1992)

36 - As fêmeas dos escorpiões só deixavam os abrigos dez vezes por ano, no **máximo**. (14 palavras, *Superinteressante*, agosto de 1992, p.8)

37 - O caso de Jill continua sendo estudado por especialistas que buscam soluções para doenças relacionadas à **memória**. (17 palavras, *Mente e cérebro*, maio de 2010, p.16)

38 - Os satélites ajudam os oceanógrafos a descobrir a temperatura da água em diversos locais do **planeta**. (16 palavras, *Superinteressante*, agosto de 1992, p.5)

39 - Nos casos de históricos de vida sedentária, evitar esportes anaeróbicos que exigem melhor condicionamento **físico**. (15 palavras, *VIP EXAME*, junho de 1992, p.19)

40 - Catástrofes à parte, a maior atração da viagem são a própria Galáxia e seus incríveis **habitantes**. (16 palavras, *Superinteressante*, agosto de 1992, p.24)

41 - O computador mostrou que, mesmo sem se quebrarem, alguns capacetes transmitem muita energia mecânica para a **cabeça**. (17 palavras, *Superinteressante*, agosto de 1992, p.30)

42 - A saúde instável do presidente serviu como outro elemento psicológico do ataque de nervos do **mercado**. (16 palavras, *Veja*, 23 de setembro de 1992)

43 - É a primeira vez que o Brasil vende tênis em quantidades expressivas no **exterior**. (14 palavras, *Veja*, 23 de setembro de 1992, p.84)

44 - O resto é luz do céu, claridade que desce da lua prateando a superfície **gelada**. (15 palavras, *VIP EXAME*, junho de 1992, p.44)

45 - O IBGE lançou um Atlas que mostra trezentas e três espécies de animais ameaçadas de **extinção**. (16 palavras, *Folha de S. Paulo*, 23 de setembro de 1992)

46 - O equipamento tem memória que permite dar ao usuário detalhes sobre eventuais defeitos em processos **industriais**. (16 palavras, *Folha de S. Paulo*, 23 de setembro de 1992)

47 - Os bosques de mangues, regados pelas marés, garantem comida farta para a fauna dos **oceanos**. (15 palavras, *Superinteressante*, maio de 1992, p.25)

48 - Hoje, quando o planeta é visto de cima pelos satélites, seus contornos não têm mais **segredo**. (16 palavras, *Superinteressante*, maio de 1992, p.34)

49 - Mesmo sem saber o índice de queda nas vendas, desvalorizou as ações da **empresa**. (14 palavras, *Veja*, 23 de setembro de 1992, p.86)

50 - Para os oitenta milhões de telespectadores brasileiros, a televisão significa lazer acessível e **barato**. (14 palavras, *Veja*, 23 de setembro de 1992, p.92)

51 - É preciso desmontar os motores em terra para prever as falhas, trabalho que consome tempo e **dinheiro**. (17 palavras, *Superinteressante*, julho de 1992, p.10)

52 - O paciente precisa de ressuscitação cardiorrespiratória o mais rápido possível, feita por pessoas **treinadas**. (14 palavras, *Folha de S. Paulo*, 28 de setembro de 1992)

53 - Segundo Senna, a chuva fez com que o desgaste dos pneus fosse excessivo na **corrida**. (15 palavras, *Folha de S. Paulo*, 28 de setembro de 1992)

54 - O povo com certeza irá ocupar as ruas para mostrar aos deputados o que querem seus **eleitores**. (17 palavras, *Folha de S. Paulo*, 28 de setembro de 1992)

55 - O telefone celular pode ser usado em qualquer ponto da cidade coberto por uma **célula**. (15 palavras, *Folha de S. Paulo*, 28 de setembro de 1992)

56 - Grandes quantidades de sal tornam a água mais pesada ou densa, diminuindo, em consequência, seu **volume**. (16 palavras, *Superinteressante*, julho de 1992, p.17)

57 - Como seres civilizados, deixamos as cavernas nas últimas glaciações, no início da Idade da Pedra **Polida**. (16 palavras, *Superinteressante*, agosto de 1992, p.73)

58 - A desvalorização é o que mais dói no orgulho nacional e no bolso de suas **vítimas**. (16 palavras, *Veja*, 23 de setembro de 1992, p.78)

59 - Não existe uma regra para definir a melhor hora para dar uma pausa no **trabalho**. (15 palavras, *Você S/A*, fevereiro de 2011, p.78)

60 - Os efeitos do sal na pressão das artérias dependem de outros minerais no **organismo**. (14 palavras, *Superinteressante*, fevereiro de 1992, p.15)

APPENDIX B2 – List of words to be recalled (RST)

TRAINING SESSION

1 – emprego
2 – crescimento
3 – aumento
4 – europeus
5 – derrotas
6 – cinema
7 – existência
8 – balança
9 – contato

START

1 – errada
2 – saudável
3 – detalhes
4 – futuristas
5 – vegetal
6 – atenção

7 – glicose
8 – partida
9 – depressão
10 – sucesso
11 – polícia
12 – dedicação
13 – natureza
14 – assunto
15 – demissões

16 – foguetes
17 – paciente
18 – delicado
19 – perfeita
20 – polêmico
21 – animais
22 – atraentes
23 – terrestres
24 – pesados
25 – reflexão
26 – favores
27 – qualidade

28 – editais
29 – sentidos
30 – opacas
31 – comerciais
32 – ameaça
33 – cidade
34 – humana
35 – política
36 – máximo
37 – memória
38 – planeta
39 – físico
40 – habitantes
41 – cabeça
42 – mercado

43 – exterior
44 – gelada
45 – extinção
46 – industriais
47 – oceanos
48 – segredo
49 – empresa
50 – barato
51 – dinheiro
52 – treinadas
53 – corrida
54 – eleitores
55 – célula
56 – volume
57 – Polida
58 – vítimas
59 – trabalho
60 – organismo

APPENDIX B3 – Written instructions for the RST

INSTRUÇÕES TESTE DE MEMÓRIA DE TRABALHO: RST

Uma série de frases soltas será apresentada a você na tela do computador em português. Cada vez que uma dessas frases for mostrada, leia a frase em voz alta e tente memorizar a última palavra da frase. As frases foram divididas em grupos, separados por uma ficha com pontos de interrogação. Cada vez que uma ficha dessas aparecer, busque na memória e diga em voz alta todas as últimas palavras daquele grupo, exatamente na ordem em que foram mostradas. O número de frases em cada grupo vai aumentando progressivamente. Para que você possa entender o procedimento e tirar suas dúvidas, será feito um treinamento inicial.

APPENDIX B4 – Scoring sheet for the RST

READING SPAN TEST

Participant: _____

Training Session

2 = _____ _____

3 = _____ _____

_____

4 = _____ _____

_____ _____

Start

Sets of 2 sentences

1º set	2º set	3º set

Sets of 3 sentences

1º set	2º set	3º set

Sets of 4 sentences

1º set	2º set	3º set

Sets of 5 sentences

1º set	2º set	3º set

Sets of 6 sentences

1º set	2º set	3º set

APPENDIX B5 – Participants' scores on the RST

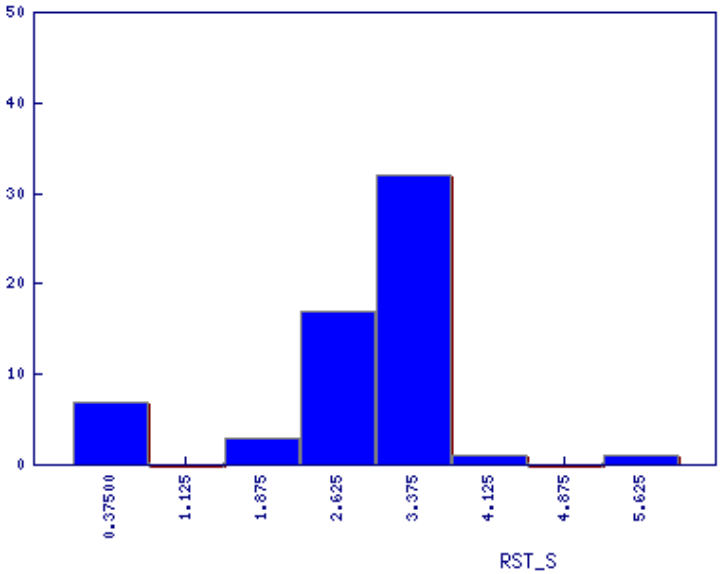
PARTICIPANT	RST_S	RST_L	CONDITION
1	**3.5***	3.5	CONTROL
2	3.0	3.0	EXPERIMENTAL
3	0	2.0	CONTROL
4	**3.5**	3.5	EXPERIMENTAL
5	0	2.0	CONTROL
6	2.5	2.5	CONTROL
7	2.5	2.5	EXPERIMENTAL
8	3.0	3.0	CONTROL
9	2.5	2.5	EXPERIMENTAL
10	**3.5**	3.5	EXPERIMENTAL
11	0	2.0	CONTROL
12	2.5	2.5	EXPERIMENTAL
13	0	2.0	CONTROL
14	0	2.0	CONTROL
15	3.0	3.0	CONTROL
16	**3.5**	3.5	EXPERIMENTAL
17	2.5	2.5	EXPERIMENTAL
18	3.0	3.0	CONTROL
19	3.0	3.0	EXPERIMENTAL
20	3.0	3.0	EXPERIMENTAL
21	0	2.0	CONTROL
22	2.0	2.0	CONTROL
23	**3.5**	3.5	EXPERIMENTAL
24	2.5	2.5	CONTROL
25	2.5	2.5	CONTROL
26	3.0	3.0	CONTROL
27	2.0	2.0	CONTROL
28	**6.0**	6.0	EXPERIMENTAL
29	3.0	3.0	EXPERIMENTAL
30	**3.5**	3.5	EXPERIMENTAL
31	2.5	2.5	CONTROL
32	3.0	3.0	EXPERIMENTAL
33	2.5	2.5	CONTROL

34	3.0	3.0	EXPERIMENTAL
35	3.0	3.0	CONTROL
36	2.5	2.5	EXPERIMENTAL
37	3.0	3.0	CONTROL
38	**3.5**	3.5	EXPERIMENTAL
39	0	2.5	EXPERIMENTAL
40	3.0	3.0	CONTROL
41	2.0	2.0	CONTROL
42	2.5	2.5	CONTROL
43	2.5	2.5	EXPERIMENTAL
44	**3.5**	3.5	CONTROL
45	2.5	2.5	CONTROL
46	3.0	3.0	CONTROL
47	3.0	3.0	CONTROL
48	**4.0**	4.0	CONTROL
49	3.0	3.0	EXPERIMENTAL
50	**3.5**	3.5	CONTROL
51	3.0	3.0	EXPERIMENTAL
52	2.5	2.5	CONTROL
53	**3.5**	3.5	EXPERIMENTAL
54	2.5	2.5	EXPERIMENTAL
55	2.5	2.5	EXPERIMENTAL
56	3.0	3.0	EXPERIMENTAL
57	**3.5**	3.5	EXPERIMENTAL
58	3.0	3.0	EXPERIMENTAL
59	3.0	3.0	EXPERIMENTAL
60	3.0	3.0	EXPERIMENTAL
61	2.5	2.5	EXPERIMENTAL

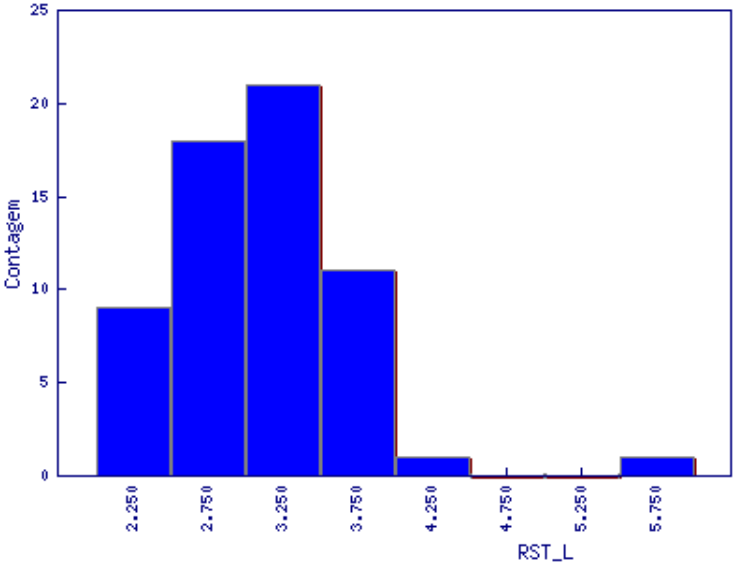
*Scores in bold indicate that these participants were classified as high spans

APPENDIX B6 – Histograms and box plot for the RST scores

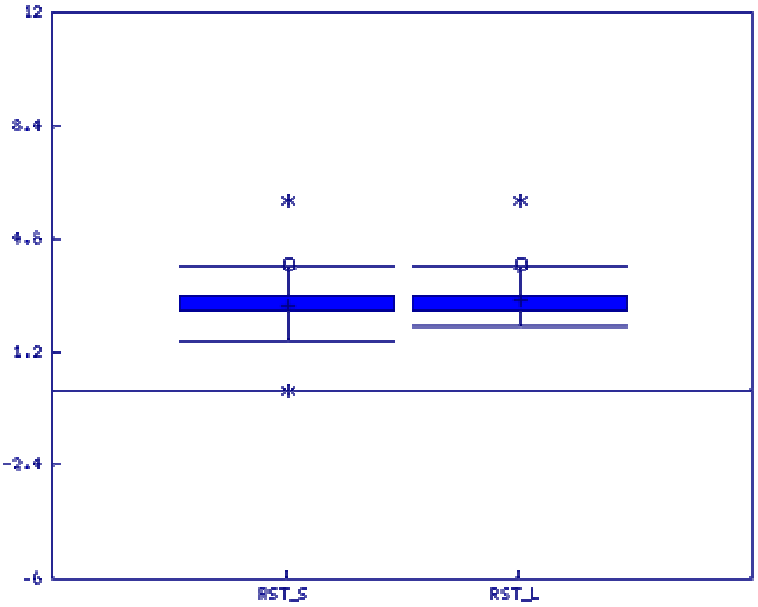
Histogram: RST_S scores



Histogram: RST_L scores



Box Plot: RST_L and RST_S scores



APPENDIX C1 – List of operation-word strings (OSPAN test)

SESSÃO DE TREINO

1 – (9 ÷ 3) - 2 = 2 ? **Lábio**
2 – (8 ÷ 4) - 1 = 1 ? **Ficha**

3 – (6 ÷ 2) + 1 = 4 ? **Jóia**
4 – (6 x 3) - 2 = 11 ? **Grito**
5 – (4 x 2) + 1 = 9 ? **Saia**

6 – (10 ÷ 2) + 4 = 9 ? **Cofre**
7 – (2 + 3) + 3 = 8 ? **Lenda**
8 – (7 + 3) - 2 = 8 ? **Pilha**
9 – (3 - 1) + 1 = 1 ? **Noite**

10 – (9 – 1) ÷ 2 = 4 ? **Perna**
11 – (3 x 5) - 2 = 12 ? **Classe**
12 – (4 x 3) - 3 = 10 ? **Granja**
13 – (2 + 7) + 4 = 12 ? **Loja**
14 – (10 – 4) ÷ 2 = 4 ? **Carne**

INÍCIO

BLOCO 1

1 – (10 ÷ 2) - 3 = 2 ? **Carta**
2 – (10 ÷ 10) - 1 = 2 ? **Lençol**
3 – (7 ÷ 1) + 2 = 7 ? **Terra**

4 – (3 ÷ 1) - 2 = 3 ? **Papel**
5 – (2 x 1) - 1 = 1 ? **Avó**
6 – (10 ÷ 1) + 3 = 13 ? **Tinta**
7 – (9 x 2) + 1 = 18 ? **Guerra**
8 – (9 ÷ 1) - 7 = 4 ? **Chuva**

9 – (8 x 4) - 2 = 32 ? **Fila**
10 – (9 x 3) - 3 = 24 ? **Água**
11 – (4 ÷ 1) + 1 = 4 ? **Maçã**

12 – (10 ÷ 1) - 1 = 9 ? **Ferro**
13 – (8 x 4) + 2 = 34 ? **Jornal**

BLOCO 2

14 – (6 x 3) + 2 = 17 ? **Feira**
15 – (6 ÷ 3) + 2 = 5 ? **Lago**
16 – (6 x 2) - 3 = 10 ? **Fogão**
17 – (8 ÷ 2) + 4 = 2 ? **Lixo**
18 – (8 ÷ 2) - 1 = 3 ? **Dedo**

19 – (9 ÷ 1) - 5 = 4 ? **Balde**
20 – (6 ÷ 2) - 2 = 2 ? **Ladrão**
21 – (7 x 2) - 1 = 14 ? **Rocha**
22 – (6 x 2) - 2 = 10 ? **Padre**

23 – (2 x 2) + 1 = 4 ? **Jardim**
24 – (7 x 1) + 6 = 13 ? **Leite**

25 – (3 ÷ 1) + 3 = 6 ? **Braço**
26 – (10 ÷ 1) + 1 = 10 ? **Cobra**
27 – (4 x 4) + 1 = 17 ? **Fita**
28 – (3 x 3) - 1 = 8 ? **Irmão**

BLOCO 3

29 – (3 x 1) + 2 = 2 ? **Telha**
30 – (4 ÷ 2) + 1 = 6 ? **Vinho**
31 – (5 ÷ 5) + 1 = 2 ? **Foto**

32 – (2 x 3) + 1 = 4 ? **Mala**
33 – (9 ÷ 3) - 2 = 1 ? **Bruxa**
34 – (10 ÷ 2) - 4 = 3 ? **Álbum**
35 – (5 ÷ 1) + 4 = 9 ? **Dente**
36 – (10 x 2) + 3 = 23 ? **Vidro**

37 – (7 ÷ 1) + 6 = 12 ? **Trilha**
38 – (3 x 2) + 1 = 6 ? **Feijão**

39 – (6 x 4) + 1 = 25 ? **Nuvem**
40 – (9 ÷ 3) - 1 = 2 ? **Calça**
41 – (8 ÷ 1) - 6 = 4 ? **Pato**
42 – (9 x 1) + 9 = 1 ? **Festa**

APPENDIX C2 – Written instructions for the OSPAN

INSTRUÇÕES TESTE DE MEMÓRIA DE TRABALHO: OSPAN

Uma série de operações matemáticas simples será apresentada a você na tela do computador. Você lerá a operação em voz alta e a realizará mentalmente. Na tela, após a operação, aparecerá um ponto de interrogação, que significa que você deverá julgar se o resultado mostrado está correto ou não. Na sequência, aparece uma palavra em português, que você lerá em voz alta e deverá memorizar. Feito isto, na nova tela você verá uma nova operação matemática e uma nova palavra, e o procedimento se repetirá. Cada vez que aparecer uma tela branca com pontos de interrogação, busque na memória as palavras que apareceram e as diga em voz alta, exatamente na ordem em que foram mostradas. Seu desempenho no teste depende do julgamento correto do resultado dos cálculos matemáticos e das palavras lembradas na sequência apresentada.

O teste está dividido em três blocos, com conjuntos de duas, três, quatro e cinco sequências de operações matemáticas acompanhadas de palavras.

Para que você possa melhor entender o funcionamento do teste, possa tirar possíveis dúvidas, e também se familiarizar com os procedimentos, será feito um treinamento inicial.

APPENDIX C3 – Scoring sheet for the OSPAN

OPERATION SPAN TEST

Participant: _____

Training Session

2 = ( ) _____ ( ) _____
3 = ( ) _____ ( ) _____
( ) _____
4 = ( ) _____ ( ) _____
( ) _____ ( )_____

5 = ( ) _____ ( ) _____
( ) _____ ( ) _____
( ) _____

Start

Bloco 1

( ) _____
( ) _____
( ) _____

( ) _____
( ) _____
( ) _____
( ) _____
( ) _____

( ) _____
( ) _____
( ) _____

( ) _____
( ) _____

Bloco 2

( ) _____
( ) _____
( ) _____
( ) _____
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( ) _____
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( ) _____
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( ) _____
( ) _____
( ) _____
( ) _____

Bloco 3
( ) _____
( ) _____
( ) _____

( ) _____
( ) _____
( ) _____
( ) _____
( ) _____

( ) _____
( ) _____

( ) _____
( ) _____
( ) _____
( ) _____

APPENDIX C4 – Participants' scores on the OSPAN

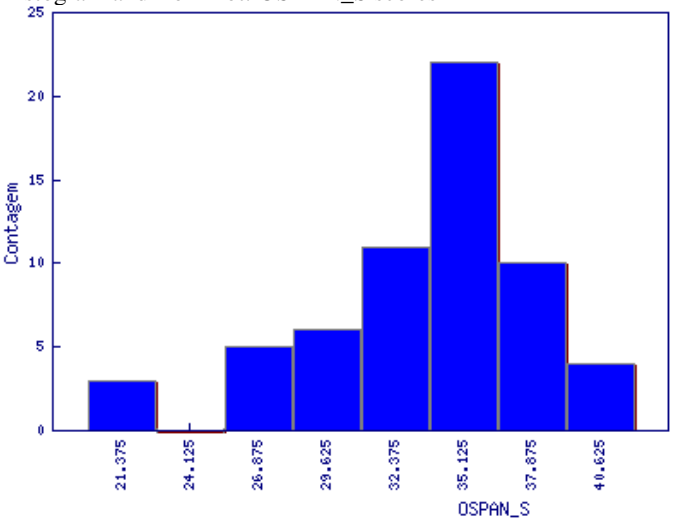
PARTICIPANT	OSPAN_S	OSPAN_L	OSPAN_LC	CONDITION
1	35	35	35	CONTROL
2	20	20	28	EXPERIMENTAL
3	34	34	35	CONTROL
4	34	34	37	EXPERIMENTAL
5	28	28	33	CONTROL
6	30	36	30	CONTROL
7	33	39	33	EXPERIMENTAL
8	30	30	38	CONTROL
9	35	37	35	EXPERIMENTAL
10	36	38	36	EXPERIMENTAL
11	36	36	37	CONTROL
12	33	34	34	EXPERIMENTAL
13	22	23	22	CONTROL
14	33	33	35	CONTROL
15	**39***	39	39	CONTROL
16	30	31	32	EXPERIMENTAL
17	37	39	38	EXPERIMENTAL
18	32	32	34	CONTROL
19	**38**	39	40	EXPERIMENTAL
20	37	37	37	EXPERIMENTAL
21	33	34	35	CONTROL
22	22	26	25	CONTROL
23	**42**	42	42	EXPERIMENTAL
24	31	32	31	CONTROL
25	34	36	34	CONTROL
26	34	36	34	CONTROL
27	**41**	41	41	CONTROL
28	34	35	34	EXPERIMENTAL
29	36	37	36	EXPERIMENTAL
30	**40**	41	40	EXPERIMENTAL
31	33	34	37	CONTROL
32	36	37	36	EXPERIMENTAL
33	30	30	32	CONTROL

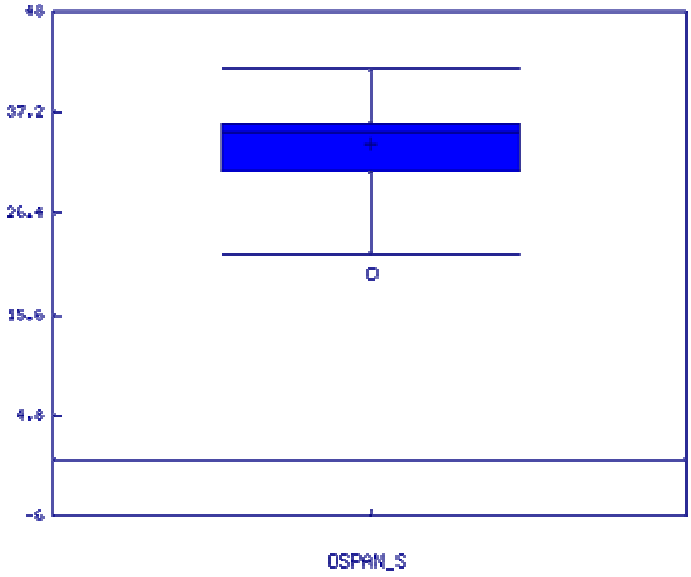
34	**39**	39	40	EXPERIMENTAL
35	**39**	41	39	CONTROL
36	31	32	33	EXPERIMENTAL
37	35	36	38	CONTROL
38	**38**	38	39	EXPERIMENTAL
39	29	30	34	EXPERIMENTAL
40	26	26	27	CONTROL
41	**39**	39	39	CONTROL
42	36	37	38	CONTROL
43	**38**	38	38	EXPERIMENTAL
44	35	36	38	CONTROL
45	35	36	35	CONTROL
46	36	37	36	CONTROL
47	**41**	41	41	CONTROL
48	28	30	30	CONTROL
49	35	37	35	EXPERIMENTAL
50	36	37	36	CONTROL
51	35	35	35	EXPERIMENTAL
52	33	33	33	CONTROL
53	35	37	35	EXPERIMENTAL
54	30	32	30	EXPERIMENTAL
55	28	29	31	EXPERIMENTAL
56	27	27	32	EXPERIMENTAL
57	**38**	39	38	EXPERIMENTAL
58	36	37	37	EXPERIMENTAL
59	36	37	36	EXPERIMENTAL
60	33	33	37	EXPERIMENTAL
61	31	34	31	EXPERIMENTAL

*Scores in bold indicate that these participants were classified as high spans

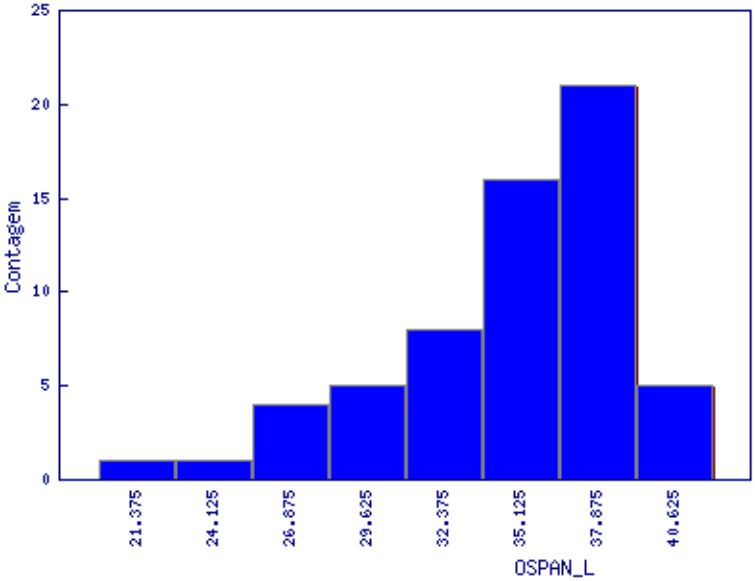
APPENDIX C5 –Histograms and box plots for the OSPAN scores

Histogram and Box Plot: OSPAN_S scores

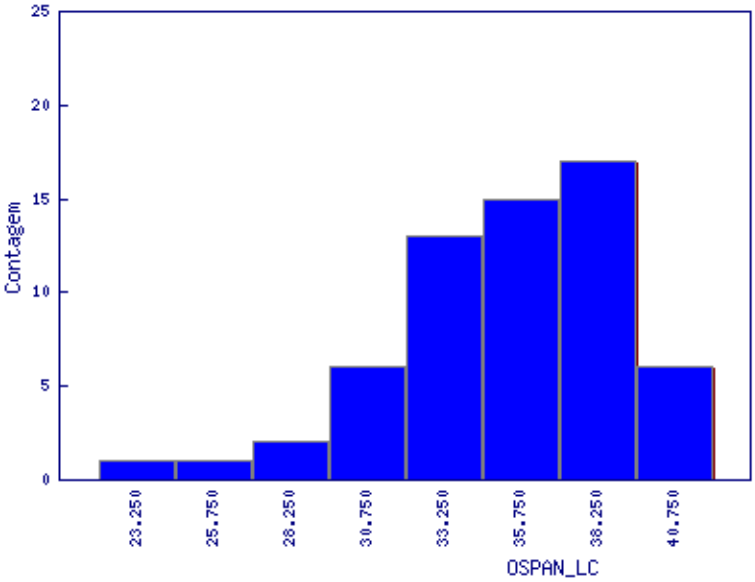




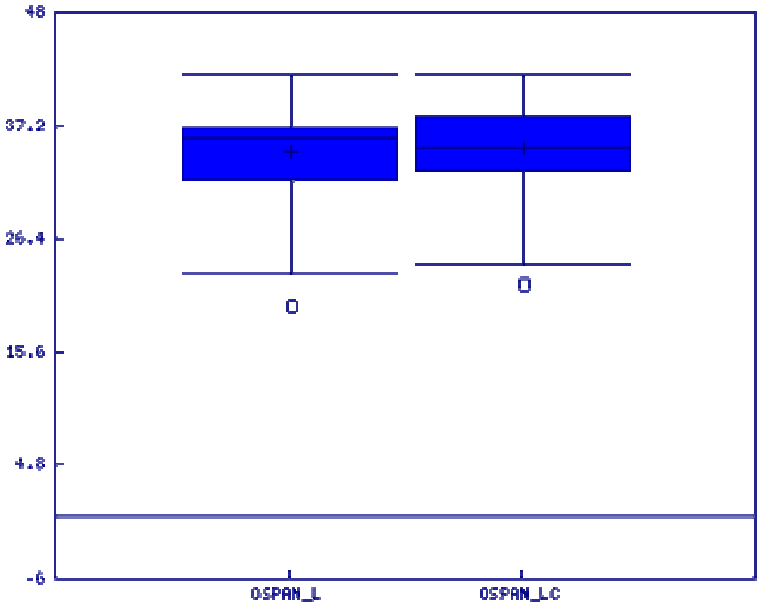
Histogram: OSPAN_L scores



Histogram: OSPAN_LC scores



Box Plot: OSPAN_L and OSPAN_LC scores



APPENDIX D1 – Retrospective questionnaire 1st WM test

QUESTIONÁRIO (Pós-1º teste de memória)

NOME: _____
IDADE: _____

1) VOCÊ CONSIDERA SUA MEMÓRIA BOA? VOCÊ CONSEGUE FAZER VÁRIAS COISAS AO MESMO TEMPO? CASO SUA RESPOSTA SEJA SIM, DÊ EXEMPLOS.

_____
_____
_____
_____

2) VOCÊ CONSEGUE PRESTAR ATENÇÃO EM DUAS COISAS AO MESMO TEMPO (POR EXEMPLO: PRESTAR ATENÇÃO NA EXPLICAÇÃO E ESCREVER)?

_____
_____
_____

3) COMO VOCÊ SE SENTIU REALIZANDO O TESTE PROPOSTO? COMENTE. _____

_____
_____
_____
_____
_____

4) O QUE VOCÊ FEZ PARA MEMORIZAR AS ÚLTIMAS PALAVRAS? VOCÊ UTILIZOU ALGUMA ESTRATÉGIA? QUAL? _____

_____
_____
_____
_____
_____
_____

MUITO OBRIGADA

APPENDIX D2 – Retrospective questionnaire 2nd WM test

QUESTIONÁRIO (Pós-2º teste de memória)

NOME: _____

IDADE: _____

1) O QUE VOCÊ ACHOU DO TESTE PROPOSTO? COMO VOCÊ SE SENTIU DURANTE A REALIZAÇÃO? COMENTE.

_____
_____
_____
_____
_____

2) O QUE VOCÊ FEZ PARA MEMORIZAR AS ÚLTIMAS PALAVRAS? VOCÊ UTILIZOU ALGUMA ESTRATÉGIA? QUAL? _____

_____
_____
_____
_____
_____
_____

3) VOCÊ REALIZOU DOIS TESTES DE MEMÓRIA, QUAL DELES FOI MAIS DIFÍCIL? POR QUÊ?

_____
_____
_____
_____
_____
_____
_____

4) GOSTARIA DE DEIXAR ALGUMA SUGESTÃO? _____

_____
_____
_____
_____

MUITO OBRIGADA

APPENDIX E1 – Text

What did[15] you do all day?

I work for a newspaper. I usually go to work by car. Sometimes, however, I go by bus. I like riding on the bus because I can talk to people and listen to their ideas and stories. Some stories are amazing, like the one I am going to tell you now.

One afternoon a man arrived home from work to find total chaos in his house. His three children were outside, still in their pajamas. They were playing with empty food boxes in the front yard. The door of his wife's car was open, and the front door of the house was open, too.

"Where is Mom?", the man asked.

"Inside the house", the children answered.

The man entered the house and looked around – everything was a big mess. A lamp was knocked over, the rug was out of place. In the front room the TV screen showed a cartoon channel and there were toys on the floor. In the kitchen, dishes filled the sink, breakfast food was spilled on the counter, dog food was spilled on the floor.

He quickly headed up the stairs, stepping over toys and items of clothing, looking for his wife. She was in the bedroom, still in her pajamas, reading a novel.

She looked up at him, smiled and asked about his day.

He looked at her, confused, and asked, "What happened here today?"

She smiled again and answered, "You know every day when you come home and ask me 'What did you do all day?".

"Yes?", he replied surprised.

She answered, "Well, today I didn't do it".

By Phil J. Garrett

[15]Forms in red correspond to the verbs participants from the experimental condition should highlight, circulate or underline during reading.

APPENDIX E2 – Control group instructions

INSTRUÇÕES: **GRUPO 1** (CONTROL)

A pesquisadora lerá com você todas as etapas que você realizará durante esta fase da pesquisa. Ao final da leitura, você poderá tirar suas dúvidas. Durante a realização das atividades, a pesquisadora não poderá tirar dúvidas ou ajudar de forma alguma. SILÊNCIO É CRUCIAL.

1 – Você receberá um texto para ler. Este texto está todo em inglês. Você deve tentar entendê-lo com as palavras que você conhece. Em relação às palavras desconhecidas, você provavelmente conseguirá entender o significado pelo contexto. Você terá dez minutos para isso. Durante esse tempo, leia o texto quantas vezes forem necessárias para a compreensão. IMPORTANTE: mesmo que você leia em menos de 10 minutos, você terá que ficar com o texto, não poderá ir para o próximo passo. Aproveite bem o tempo para ler, reler e refletir sobre o texto.

2 – Ao término dos 10 minutos para leitura, os textos serão recolhidos. Será entregue uma folha com os exercícios de compreensão. Nela, há 11 questões discursivas em português para checar seu entendimento. Por favor, leia a pergunta com atenção e responda de forma clara, em português. Você terá todo o tempo necessário para resolver as questões. Por favor, não copie do seu colega. Caso você não saiba responder alguma questão, não tente chutar, deixe-a em branco. IMPORTANTE: O objetivo da pesquisa só será alcançado se você a realizar seriamente, com seus conhecimentos.

3 – Quando terminar de responder, entregue a folha de exercícios. Então, você receberá um questionário para responder. Suas respostas auxiliarão a pesquisadora a entender os resultados. IMPORTANTE: seja claro, completo e escreva com letra legível.

OBRIGADA PELA COLABORAÇÃO,
Cyntia Bailer.

APPENDIX E3 – Experimental group instructions

INSTRUÇÕES **GRUPO 2** (EXPERIMENTAL)

A pesquisadora lerá com você todas as etapas que você realizará durante esta fase da pesquisa. Ao final da leitura, você poderá tirar suas dúvidas. Durante a realização das atividades, a pesquisadora não poderá tirar dúvidas ou ajudar de forma alguma. SILÊNCIO É CRUCIAL.

1 – Você receberá um texto para ler. Este texto está todo em inglês. Você deverá circular ou sublinhar todos os verbos no passado que você encontrar (por exemplo: ate, liked). Além disso, você deverá ler o texto para compreensão. Você deve tentar entendê-lo com as palavras que você conhece. Em relação às palavras desconhecidas, você provavelmente conseguirá entender o significado pelo contexto. Você terá dez minutos para isso. Durante esse tempo, leia o texto quantas vezes forem necessárias para a compreensão e preste atenção nos verbos no passado. IMPORTANTE: mesmo que você leia em menos de 10 minutos, você terá que ficar com o texto, não poderá ir para o próximo passo. Aproveite bem o tempo para ler, reler e refletir sobre o texto.

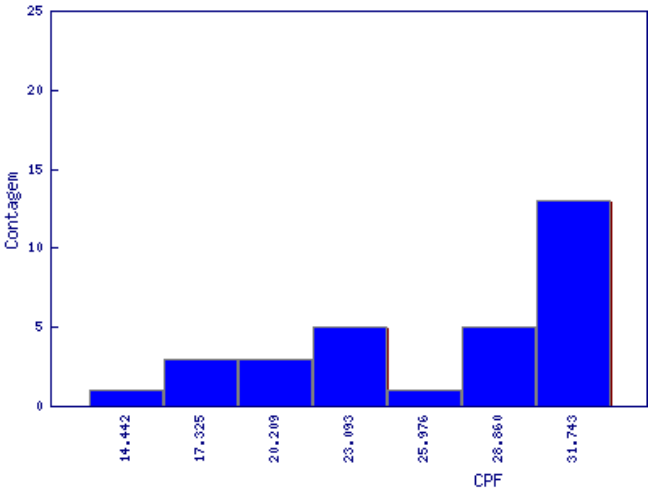
2 – Ao término dos 10 minutos para leitura, os textos serão recolhidos. Será entregue uma folha com os exercícios de compreensão. Nela, há 11 questões discursivas em português para checar seu entendimento. Por favor, leia a pergunta com atenção e responda de forma clara, em português. Você terá todo o tempo necessário para resolver as questões. Por favor, não copie do seu colega. Caso você não saiba responder alguma questão, não tente chutar, deixe-a em branco. IMPORTANTE: O objetivo da pesquisa só será alcançado se você a realizar seriamente, com seus conhecimentos.

3 – Quando terminar de responder, entregue a folha de exercícios. Então, você receberá um questionário para responder. Suas respostas auxiliarão a pesquisadora a entender os resultados. IMPORTANTE: seja claro, completo e escreva com letra legível.

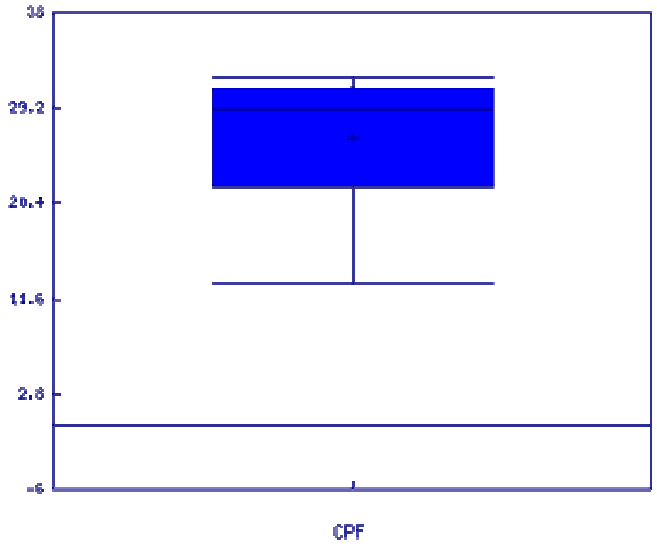
OBRIGADA PELA COLABORAÇÃO, Cyntia Bailer.

APPENDIX E4 – Histogram and box plot for the Form Recognition Task

Histogram: Scores on the form recognition task (CPF: correct past forms)

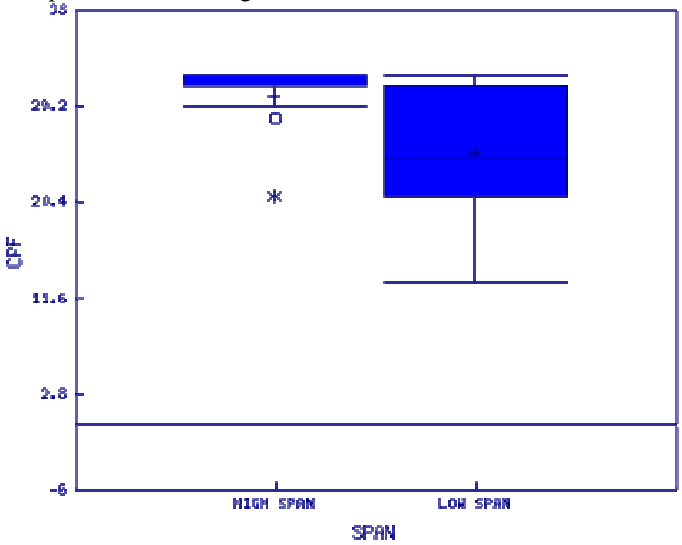


Box Plot: Scores on the form recognition task (CPF: correct past forms)

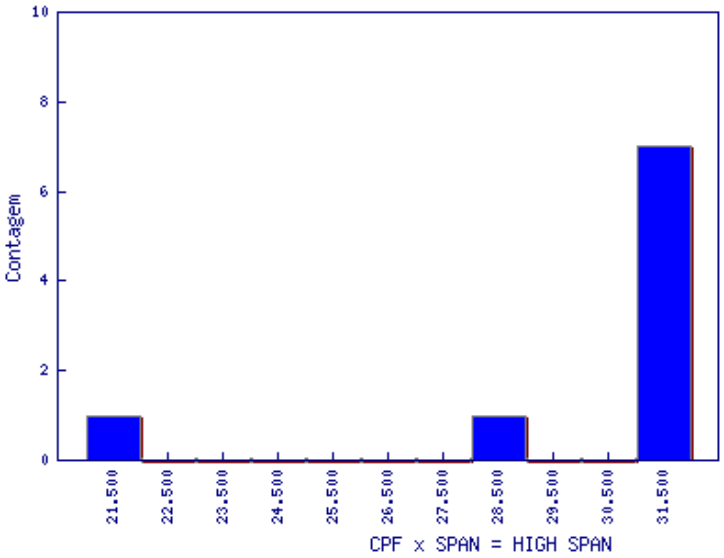


APPENDIX E5 – Box plot and histograms for the Form Recognition Task (higher/lower spans)

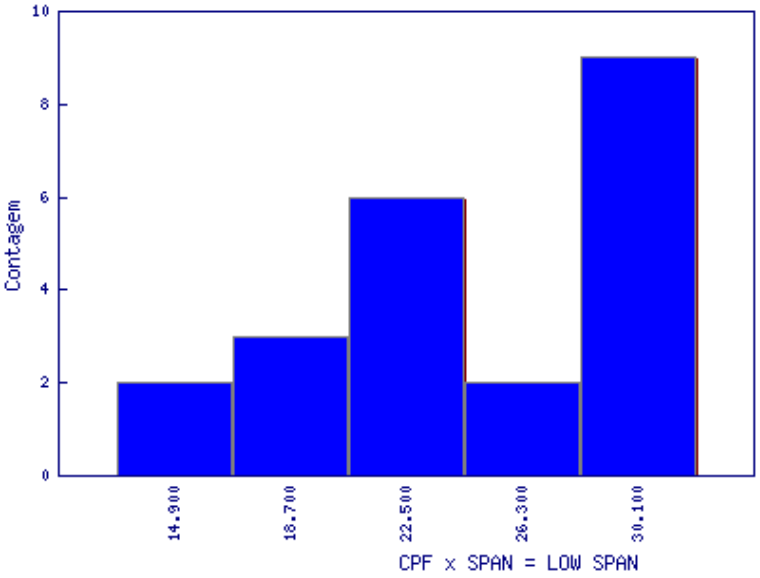
Box plot: CPF according to WMC



Histogram: CPF x Higher spans



Histogram: CPF x Lower spans



APPENDIX F1 –Comprehension questions sheet

1) O texto que você leu se trata de uma crônica. Geralmente, uma crônica registra uma observação ou uma impressão de um narrador sobre fatos cotidianos que podem ter acontecido com ele próprio ou com outras pessoas. No caso desta crônica, o fato aconteceu com o autor ou com outra pessoa? Se sua resposta for outra pessoa, quem é e como o narrador ficou sabendo da história?

_____
_____
_____

2) Onde o narrador trabalha? Sabe-se que ele costuma ir de carro, mas às vezes usa outro meio de transporte para ir ao trabalho. Qual é?

_____
_____

3) Como estava a casa (da história) quando o homem chegou do trabalho? Você sabe por quê?

_____
_____
_____

4) Onde estavam as crianças? O que estavam fazendo?

_____
_____

5) O homem estava surpreso com a situação e perguntou onde estava a mãe deles. Qual foi a resposta das crianças?

_____
_____
_____

6) Ao entrar em casa, o homem encontrou tudo no seu devido lugar? Justifique sua resposta.

_____
_____
_____

7) Onde o homem encontrou sua esposa? O que ela estava fazendo? Como estava vestida?

_____
_____
_____

8) Ele estava feliz ou furioso em vê-la assim? Justifique.

_____
_____
_____

9) O que o homem costuma perguntar à esposa quando chega em casa todos os dias? Qual foi a resposta daquele dia?

_____
_____
_____

10) Explique o porquê de a situação ter acontecido.

_____
_____
_____
_____
_____

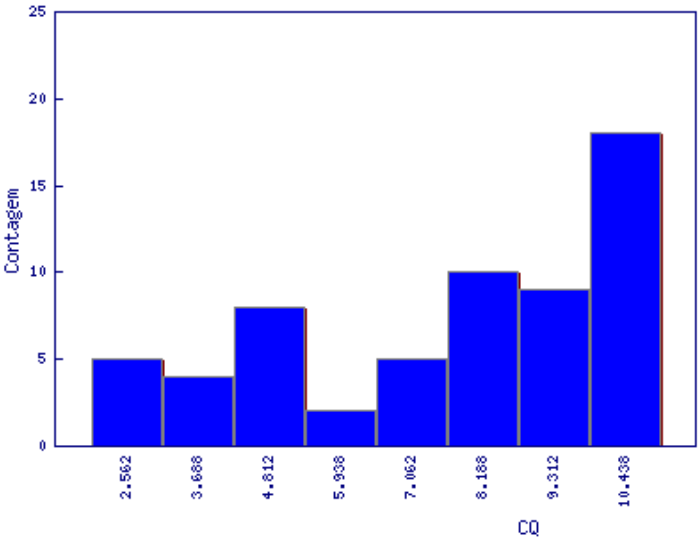
11) Observe a figura a seguir. Você usaria esta figura para representar a situação que desencadeou o episódio relatado na crônica que você leu? Se não, o que você mudaria? Justifique.

_____
_____
_____
_____
_____

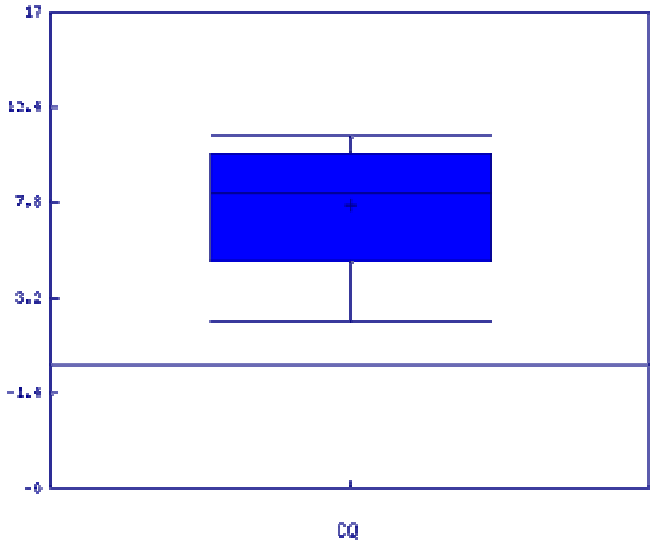
Participante: _____

APPENDIX F2 – Histogram and box plot for the Comprehension Questions

Histogram: Comprehension Questions

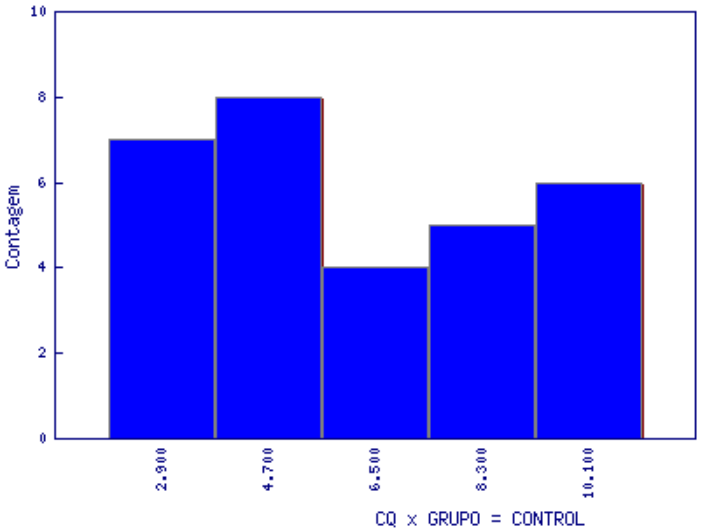


Box Plot: Comprehension Questions

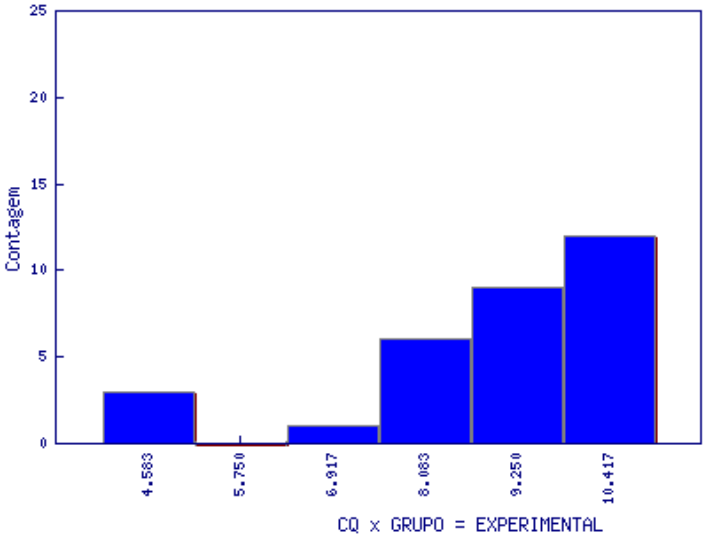


Appendix F3 – Histograms and box plot for the Comprehension Questions (groups)

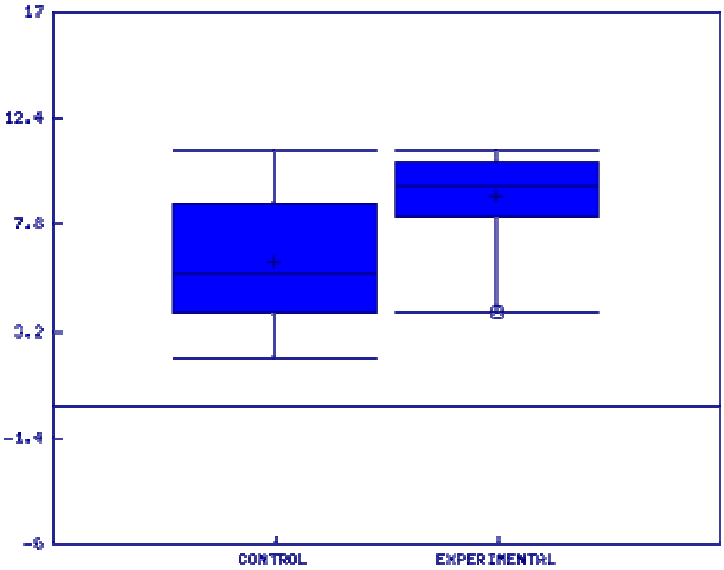
Histogram: Comprehension Questions in the Control Group



Histogram: Comprehension Questions in the Experimental Group

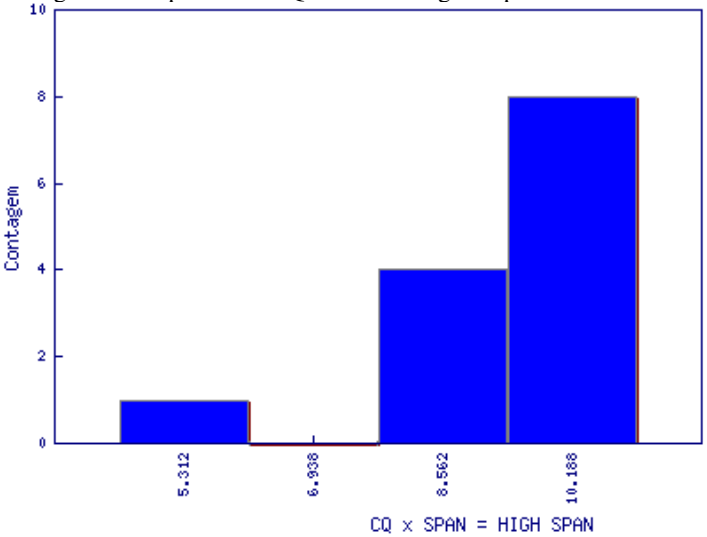


Box Plot: Comprehension Questions x Attentional conditions

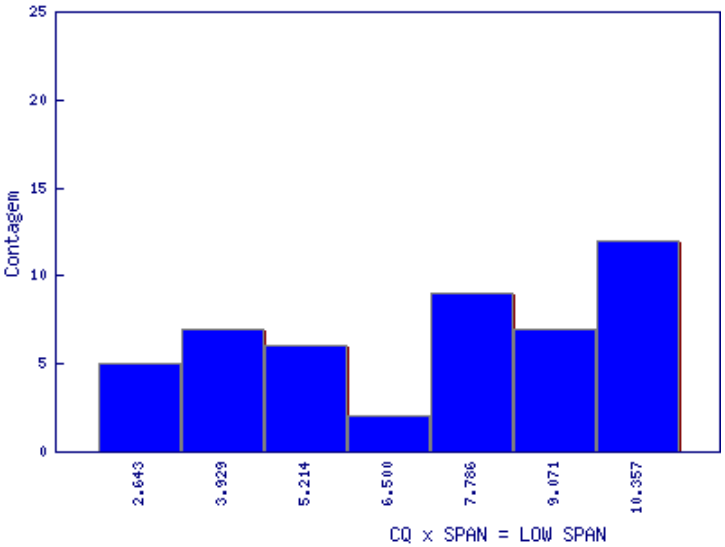


APPENDIX F4 – Histograms and box plot for the Comprehension Questions (higher/lower spans)

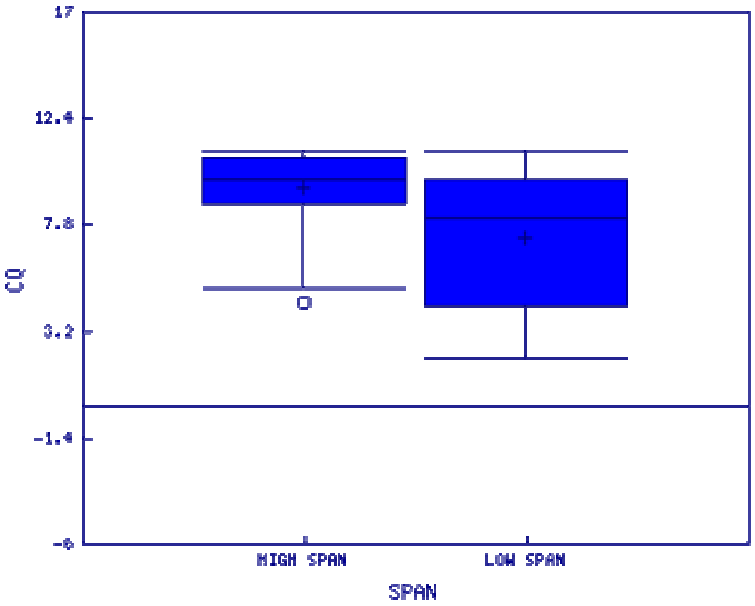
Histogram: Comprehension Questions x Higher Spans



Histogram: Comprehension Questions x Lower Spans

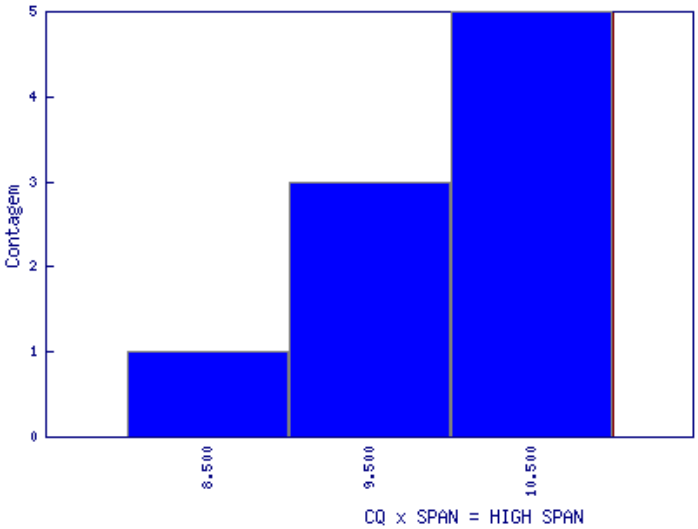


Box Plot: Comprehension Questions x Higher/Lower Spans

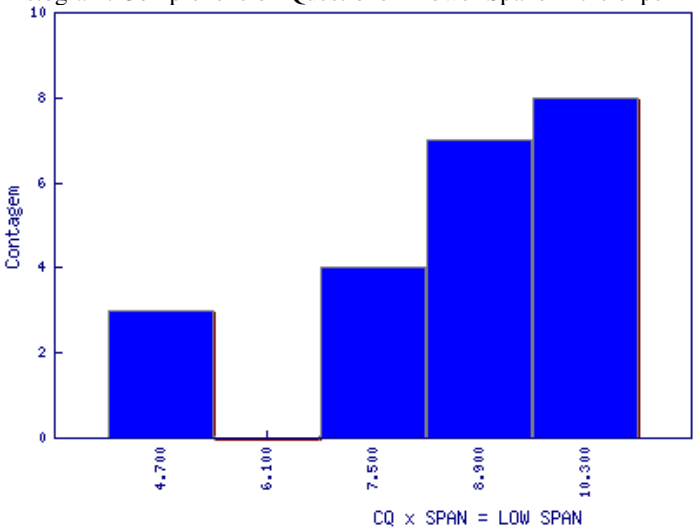


APPENDIX F5 – Histograms and box plot for the Comprehension Questions (experimental group x higher/lower spans)

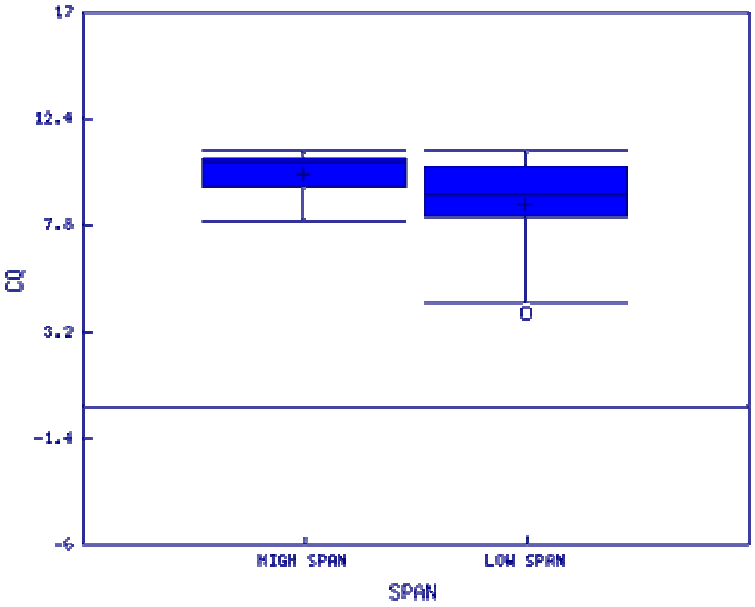
Histogram: Comprehension Questions x Higher Spans in the experimental group



Histogram: Comprehension Questions x Lower Spans in the experimental group



Box Plot: Comprehension Questions x Higher/Lower Spans in the experimental group



APPENDIX G1 – Retrospective questionnaire (control group)

QUESTIONÁRIO
(PÓS-ATIVIDADE DE LEITURA – GRUPO CONTROLE)

NOME: _____
IDADE: _____

HÁ QUANTO TEMPO VOCÊ ESTUDA INGLÊS? CASO VOCÊ FREQUENTE UM CURSO EXTRACLASSE, ESPECIFIQUE HÁ QUANTO TEMPO. _____
_____
_____

VOCÊ GOSTA DE INGLÊS? VOCÊ SE INTERESSA EM APRENDER ESTA LÍNGUA? CASO POSITIVO, QUAIS SÃO AS RAZÕES QUE LEVAM VOCÊ A APRENDER ESTA LÍNGUA?_____
_____
_____
_____
_____

COMO VOCÊ SE SENTIU REALIZANDO AS ATIVIDADES PROPOSTAS? COMENTE CADA PASSO: A LEITURA DO TEXTO E A TAREFA DE COMPREENDÊ-LO, E AS QUESTÕES DE COMPREENSÃO. _____
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EM RELAÇÃO ÀS PALAVRAS DESCONHECIDAS, O QUE VOCÊ FEZ PARA DAR CONTA DE ENTENDÊ-LAS? AINDA QUE TENHA TENTADO ENTENDÊ-LAS, HOUVE PALAVRAS QUE VOCÊ NÃO CONSEGUIU ATRIBUIR SIGNIFICADO? ESSAS PALAVRAS DESCONHECIDAS DIFICULTARAM SUA COMPREENSÃO DO TEXTO, E A TAREFA DE RESPONDER ÀS PERGUNTAS PROPOSTAS? _____

_____
_____
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_____

DE QUAL PARTE VOCÊ MAIS GOSTOU: DO TESTE DE MEMÓRIA, DA LEITURA DO TEXTO OU DOS EXERCÍCIOS DE COMPREENSÃO? POR QUÊ? _____

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_____
_____
_____

HOUVE ALGUMA COISA QUE, EM SUA OPINIÃO, LHE ATRAPALHOU PARA REALIZAR AS ATIVIDADES PROPOSTAS? _____

_____
_____
_____
_____

VOCÊ GOSTARIA DE DEIXAR ALGUMA SUGESTÃO? _____

_____
_____
_____

MUITO OBRIGADA

APPENDIX G2 – Retrospective questionnaire (experimental group)

QUESTIONÁRIO
(PÓS-ATIVIDADE DE LEITURA – GRUPO EXPERIMENTAL)

NOME: _____
IDADE: _____

HÁ QUANTO TEMPO VOCÊ ESTUDA INGLÊS? CASO VOCÊ FREQUENTE UM CURSO EXTRACLASSE, ESPECIFIQUE HÁ QUANTO TEMPO. _____
_____
_____

VOCÊ GOSTA DE INGLÊS? VOCÊ SE INTERESSA EM APRENDER ESTA LÍNGUA? CASO POSITIVO, QUAIS SÃO AS RAZÕES QUE LEVAM VOCÊ A APRENDER ESTA LÍNGUA?_____
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COMO VOCÊ SE SENTIU REALIZANDO AS ATIVIDADES PROPOSTAS? COMENTE CADA PASSO: A LEITURA DO TEXTO E A TAREFA DE COMPREENDÊ-LO, E AS QUESTÕES DE COMPREENSÃO. _____
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SEUS CONHECIMENTOS PRÉVIOS DE PASSADO SIMPLES LHE AJUDARAM A ENTENDER MELHOR O TEXTO? _____

_____
_____
_____

EM RELAÇÃO ÀS PALAVRAS DESCONHECIDAS, O QUE VOCÊ FEZ PARA DAR CONTA DE ENTENDÊ-LAS? AINDA QUE TENHA TENTADO ENTENDÊ-LAS, HOUVE PALAVRAS QUE VOCÊ NÃO CONSEGUIU ATRIBUIR SIGNIFICADO? ESSAS PALAVRAS DESCONHECIDAS DIFICULTARAM SUA COMPREENSÃO DO TEXTO, E A TAREFA DE RESPONDER ÀS PERGUNTAS PROPOSTAS? _____

_____
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_____

DE QUAL PARTE VOCÊ MAIS GOSTOU: DO TESTE DE MEMÓRIA, DA LEITURA DO TEXTO OU DOS EXERCÍCIOS DE COMPREENSÃO? POR QUÊ? _____

_____
_____
_____
_____
_____

HOUVE ALGUMA COISA QUE, EM SUA OPINIÃO, LHE ATRAPALHOU PARA REALIZAR AS ATIVIDADES PROPOSTAS? _____

_____
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_____
_____

VOCÊ GOSTARIA DE DEIXAR ALGUMA SUGESTÃO? _____

_____
_____
_____

MUITO OBRIGADA

APPENDIX H1 –Explanatory text about memory

Pesquisadora/Teacher Cyntia Bailer
_____ de 2011

Memória: algumas considerações

O que nos faz lembrar de uma detalhada história ocorrida no passado? Como deixamos fluir naturalmente as frases complicadas de longas canções? Por que nunca nos esquecemos o caminho de casa?

Nestes exemplos, a memória arquiva e recupera informações advindas de nossas experiências. A palavra memória tem sua origem etimológica no latim e significa a capacidade de reter e/ou readquirir ideias, imagens, expressões e conhecimentos adquiridos anteriormente, reportando-se às lembranças.

A memória é uma faculdade cognitiva extremamente importante porque ela forma a base para a aprendizagem. Se não houvesse uma forma de armazenamento mental de representações do passado, não teríamos uma solução para tirar proveito da experiência. Assim, a memória envolve um complexo mecanismo que abrange o arquivo e a recuperação de experiências, portanto, está intimamente associada à aprendizagem, que é a habilidade de mudarmos o nosso comportamento através das experiências que foram armazenadas na memória; em outras palavras, a aprendizagem é a aquisição de novos conhecimentos e a memória é a retenção daqueles conhecimentos aprendidos.

Esta intrigante faculdade mental forma a base de nosso conhecimento, estando envolvida com nossa orientação no tempo e no espaço e nossas habilidades intelectuais e mecânicas. Assim, aprendizagem e memória são o suporte para todo o nosso conhecimento, habilidades e planejamento, fazendo-nos considerar o passado, nos situarmos no presente e prevermos o futuro.

Como estimular, melhorar nossa memória? Primeiro vamos conhecer dados importantes:

A capacidade de armazenar informações está ligada à capacidade física do cérebro (saúde e bem-estar) e à capacidade de organizar dados durante o processo de aprendizagem. Ambas as capacidades estão unidas à qualidade do sono. Grosso modo, temos três tipos de memória. A memória de trabalho é temporária e limitada em sua capacidade (Já aconteceu com você ouvir o número de telefone ditado por alguém, mas em poucos segundos ser incapaz de se lembrar de parte ou de todos

aqueles números?). A memória de curto de prazo seleciona tudo aquilo que é mais importante e passa para a memória de longo prazo enquanto estamos dormindo. Por este motivo, pessoas que têm distúrbios do sono como insônia, sonambulismo e apnéia, têm mais dificuldade de concentração e mais problemas de esquecimento. Nesses casos, ajuda médica é indispensável.

Lembrar das coisas também está ligado à habilidade de armazenamento e ao interesse sobre o assunto. Se uma pessoa não gosta de uma determinada matéria da escola, provavelmente terá muita dificuldade em aprendê-la e memorizá-la, pois seu cérebro descarta as informações relacionadas por considerá-las não importantes.

Pesquisas comprovam que não existe relação direta entre inteligência e memória. Conforme Iván Izquierdo, um neurocientista brasileiro, é mais inteligente a pessoa que sabe como acessar a informação do que a pessoa que procura guardar toda a informação na cabeça, o que é sempre impossível.

Enfim, como melhorar minha memória?

Existem muitas coisas que você pode fazer para melhorar a sua memória, entre as quais o uso de determinadas técnicas mentais, e os cuidados com a nutrição e os medicamentos. Seguem algumas dicas:

✓ Estimular a memória: utilize ao máximo a sua capacidade mental. Desafie o novo. Aprenda novas habilidades. Se você é destro, tente escrever com a mão esquerda. Se você é canhoto, tente escrever com a direita. Se você escova os dentes com a mão direita, tente com a esquerda. Aprenda um novo idioma. Aprenda a dançar, a tocar um instrumento. Jogue xadrez e preencha palavras cruzadas. Novas atividades estimulam os circuitos neurais do cérebro a crescerem. Também faça exercícios simples como recordar fatos do dia-a-dia (o que comeu no almoço, o que aprendeu na escola, o que ocorreu no último capítulo da novela, etc.)

✓ Prestar atenção: não tente guardar todos os fatos que acontecem, mas focalize sua atenção e se concentre naquilo que você achar mais importante, procurando afastar de si todos os demais pensamentos. Uma sugestão de exercício: pegue um objeto qualquer, por exemplo, uma caneta e se concentre nela. Pense sobre suas diversas características: seu material, sua função, sua cor, sua anatomia, etc. Não permita que nenhum outro pensamento ocupe a sua mente enquanto você estiver concentrado na caneta.

✓ Relaxar: é praticamente impossível prestar atenção se você estiver tenso ou nervoso. Procure pensar positivo, estar bem consigo mesmo. Uma sugestão de exercício: prenda a respiração por dez segundos e vá soltando-a lentamente.

✓ Associar fatos a imagens, fatos a ideias: é uma forma muito eficiente de memorizar grande quantidade de informação. O método de repetição ajuda no arquivamento de informações, pois faz o cérebro crer que aquela informação é importante e por isso, armazena-a. Associar ideias cria um sistema de conexões, o que faz você lembrar de uma coisa quando esquece de outra.

✓ Visualizar imagens: observe figuras com os "olhos da mente". Uma sugestão: feche os olhos e imagine um bife frito, grande e suculento. Sinta o aroma e a maciez da carne. Imagine-se cortando a carne com uma faca e um garfo e saboreando-a. Se a sua boca se encheu de água enquanto você visualizou esta cena, então você fez um bom trabalho! Dica: repita este exercício com outros alimentos, lugares, objetos.

✓ Alimentação: algumas vitaminas são essenciais para o funcionamento apropriado da memória, entre elas, a tiamina, o ácido fólico e a vitamina B12, importantes para o metabolismo dos neurotransmissores. São encontradas no pão e cereais, especialmente os integrais, nos vegetais, legumes e frutas. Uma boa alimentação é a bem balanceada entre proteínas, gorduras e açúcar, sendo rica em vitaminas.

✓ Água: ajuda a manter o bom funcionamento da memória. Comece a tomar 2 litros de água por dia e você sentirá a diferença.

✓ Atividade física: exercícios feitos regularmente trazem benefícios importantes para o processo de memorização. Uma simples caminhada diária é o suficiente.

✓ Sono: 8 horas de sono por dia é fundamental para o descanso do cérebro. Durante o sono profundo, o cérebro se desconecta dos sentidos e processa, revisa e armazena a memória. A insônia leva a um estado de fadiga crônica e prejudica a habilidade de concentrar-se e armazenar informações.

✓ Dicas importantes: crie o hábito de tomar notas, organizar-se (como fazer uma lista de tarefas diárias, usar uma agenda). Assim como nossos

músculos, nosso cérebro necessita ser exercitado. Procure estimular seus sentidos: olfato, paladar, tato, visão e audição. Pratique "fitness cerebral", mantenha seu cérebro em forma! Conforme vamos envelhecendo, nossas funções mentais vão declinando, porém a velocidade com que esse declínio ocorre pode ser diminuída se estimularmos a memória e os nossos sentidos. Procure identificar os ingredientes dos alimentos pelo gosto e pelo cheiro. Faça isso diariamente e procure recordar ao fim do dia. Procure identificar as pessoas pela voz ao telefone, memorize números de telefone, relembre ao fim do dia as pessoas com quem você falou.

Descobrir o tipo de memória que você possui também é extremamente útil para selecionar o melhor método de estudo. Há pessoas que têm memória visual e, portanto, precisam estudar usando a leitura, os desenhos e os esquemas gráficos para serem bem-sucedidos no armazenamento de conteúdo. Para outros, a memória é auditiva e, por isso o conteúdo a ser memorizado deve ser verbalizado, os textos devem ser lidos em voz alta e discutidos com outras pessoas. O último tipo de memória é o cinestésico, relacionado aos movimentos que devem ser feitos para associar idéias.

Agora, você já sabe o que fazer, e também o que não fazer. Ansiedade e nervosismo são absolutamente prejudiciais para o bom funcionamento da memória e, por esse motivo, devem ser controlados com exercícios de respiração. Essa é uma maneira eficaz de se evitar os famosos "brancos" e lapsos de memória. Você conseguirá aprimorar sua memória usando-a. Ler é sem dúvida o melhor e mais completo exercício, pois envolve a memória visual, a memória auditiva, a memória linguística, tudo processado em micro-segundos.

Então, para conservar ou melhorar sua memória, a melhor maneira é EXERCITÁ-LA!

Referências consultadas

<http://www.brasilescola.com/dicasdeestudo/como-educar-a-memoria.htm>
<http://www.drauziovarella.com.br/EstacaoSaude/Player/5204/memoria-e-esquecimento>
<http://www.equipevoluntaria.org.br/portal/index.php/a-arquitetura-da-mente/>
<http://www.cerebromente.org.br/n01/memo/memoria.htm>
Entrevista com Iván Izquierdo, concedida ao programa Autografando, da TV Feevale, disponível em <http://www.youtube.com/watch?v=kl9ljT6tJP4>,
Vídeo: Estimule a memória e o cérebro, uma produção de Veja.com, disponível em <http://www.youtube.com/watch?v=_exVMrYdLeM>

APPENDIX H2 – Predominant channel of communication test

Pesquisadora/Teacher Cyntia Bailer
_____ de 2011

Descobrindo seu canal de comunicação predominante:

O sistema representativo humano é formado pelos diferentes canais, através dos quais representamos informações internamente: Visual (visão), Auditivo (audição) e Cinestésico (sensação corporal). O canal predominante é aquele que é normalmente usado para pensar de forma consciente e organizar as vivências.

Para cada uma das perguntas abaixo existem três respostas. Gastando poucos segundos com cada pergunta, escolha a que lhe parecer mais natural.

1) Eu gostaria mais de fazer esse exercício:
a) por escrito
b) verbalmente
c) realizando tarefas

2) Eu gosto mais de ganhar um presente:
a) bonito
b) sonoro
c) útil

3) Eu tenho mais facilidade de recordar nas pessoas:
a) a fisionomia
b) o nome
c) as atitudes

4) Eu aprendo mais facilmente:
a) lendo
b) escutando
c) fazendo

5) Atividades que mais me agradam:
a) fotografia/pintura
b) música/oratória
c) escultura/dança

6) Na maioria das vezes, eu prefiro:
a) observar
b) escutar
c) fazer

7) Ao recordar momentos felizes, me vêem à mente:
a) as cenas
b) os sons
c) as sensações

8) Nas férias, eu gosto mais de:
a) visitar lugares bonitos
b) repousar em lugares silenciosos
c) participar de atividades

9) Eu valorizo nas pessoas principalmente:
a) a aparência
b) o que elas dizem
c) o que elas fazem

10) Eu percebo que alguém gosta de mim:
a) pelo jeito de me olhar
b) pelo jeito de me falar
c) pelas atitudes que manifesta

11) Meu carro preferido tem que ser principalmente:
a) novo/bonito
b) silencioso, para eu poder conversar ou ouvir música
c) espaçoso/bem equipado

12) Quando vou comprar alguma coisa, eu procuro:
a) olhar bem o produto
b) ouvir o vendedor
c) experimentar

13) Eu tomo decisões com base:
a) no que vejo
b) no que escuto
c) no que sinto

14) O que em excesso mais me incomoda é:
a) muitas pessoas no mesmo lugar
b) luminosidade
c) barulho

15) Característica que mais me agrada:
a) colorido
b) afinado
c) saboroso

16) Num espetáculo, eu valorizo mais:
a) a iluminação
b) a fala, o talento de convencer, comover
c) a gesticulação

17) Enquanto espero uma pessoa, eu procuro:
a) observar o ambiente/ler
b) ouvir música/escutar conversas
c) andar/mexer com as mãos

18) Eu me entusiasmo mais quando os outros:
a) mostram
b) falam
c) fazem

19) Ao consolar alguém, eu procuro:
a) mostrar um caminho
b) levar uma palavra de conforto
c) oferecer dinheiro

20) O que me dá mais prazer:
a) visitar uma exposição
b) assistir a um espetáculo musical
c) brincar num parque de diversões

FAZENDO AS CONTAS

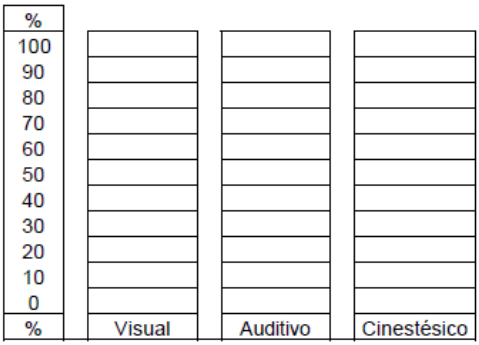
Agora conte quantas vezes você indicou cada letra e multiplique cada total por cinco. Dessa forma você terá o percentual de seu canal preferido:

A) VISUAL __ x 5 = _____

B) AUDITIVO __ x 5 = _____

C) CINESTÉSICO __ x 5 = _____

Vamos visualizar seu resultado num gráfico?



Preencha o gráfico de barras ao lado até o percentual em cada canal de comunicação.

Seu maior placar indica o seu canal predominante. Seu menor placar mostra em que aspecto você poderia melhorar na sua comunicação, aumentando consequentemente o seu potencial comunicativo.