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# READING DIGITAL TEXTS IN L2: WORKING MEMORY CAPACITY, TEXT MODE, AND READING CONDITION ACCOUNTING FOR DIFFERENCES IN PROCESSES AND PRODUCTS OF READING

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Orientadora: Profa. Dra. Lêda Maria Braga Tomitch

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Esta Tese foi julgada adequada para obtenção do Título de "Doutora em Estudos da Linguagem" e aprovada em sua forma final pelo Programa de Pós Graduação em Inglês.

Florianópolis, 04 de dezembro de 2017.

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To my beloved parents, Miguel and Maria, who believed education could be the most invaluable legacy to be passed on.

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## ABSTRACT

There is solid empirical evidence that working memory capacity (WMC) as an individual difference phenomenon can account for differences in the processes and products of reading in demanding situations. Bearing this in mind, the main purpose of this study was to examine how low- and high-WMC readers construct meaning from digital linear and nonlinear hypertext reading and what types of inferences are generated during reading in L2 for different purposes: *to criticize/give opinion* and *to summarize*. The theoretical background that supported this study is based on previous research by Linderholm and van den Broek (2002), van den Broek (2001), Gagné et al. (1993), and van Dijk and Kintsch (1983). The study was conducted with 30 students from an undergraduate English language course at a university in Brazil. The methodological procedures included a demographic questionnaire and online measures such as pause and retrospective protocols, note taking, highlighting, rereading, link access, and reading time; as well as offline measures which included post-reading tasks and a self-evaluation questionnaire. WMC was measured with the Reading Span Test devised in Portuguese by Tomitch (1995/2003) and participants were split into two groups: low-WMC and high-WMC readers. Verbal reports were transcribed and categorized according to the framework by Linderholm and van den Broek (2002). Results were quantitative and qualitatively analyzed. As far as qualitative results are concerned, even though there is no significant result at $\alpha$=.05 in the types of inferences generated in each condition, the $\alpha$= .1 suggests a trend that is backed up by previous research. That is, both WMC groups adjust strategies to achieve learning goals in more demanding reading situations such as *reading to summarize* and reading in the hypertext mode. Both groups made more metacognitive comments when *reading to summarize* and when reading in the hypertext mode, but the high-spans outperformed the low ones. The low-WMC group showed more misunderstandings in both reading purposes and associated, elaborated and evaluated more when *reading to criticize*, processes that demands less from the cognitive system. There is a significant result of moderate correlation between reading time and *reading to summarize* for the low-WMC group. Post-reading scores did not have a statistically significant correlation with the reading purpose. Qualitative analyses identified that a specific instruction was found to have little effect on most participants, who revealed to have relied more on prior knowledge than on the specialized opinion to express their

views in the post-reading criticize condition. Further analyses suggest that by being proficient and highly functional undergraduate readers, both groups found ways to cope with the demands of the nonlinear hypertext reading by avoiding clicking on links, taking notes, highlighting and rereading. Pedagogical implications stem from the study and suggest that educational contexts should consider the inclusion of digital reading in web-based reading space to ensure that students can progressively become literate in different text modes. Teacher scaffolding on the development of critical reading and summarization are also suggested.

**Keywords**: reading, working memory, text mode, inference generation, strategy

NUMBER OF WORDS: 51,134

## RESUMO

Evidências empíricas sólidas sugerem que a capacidade de memória de trabalho (CMT) como um aspecto de diferenças individuais está relacionada a diferenças no processo e no produto da leitura em situações de maior demanda. A partir disso, o principal objetivo deste estudo foi analisar como leitores com maior e menor CMT constroem significado ao ler textos digitais, linear e hipertexto não-linear, e quais inferências são geradas durante a leitura em L2 com propósitos diferentes: *para criticar/expressar opinião* e *para resumir*. O arcabouço teórico que conduziu o presente estudo tomou por base pesquisas de Linderholm e van den Broek (2002), Gagné et al. (1993) e van Dijk e Kintsch (1983). O estudo foi realizado com 30 alunos de um curso de graduação de uma universidade pública no Brasil. Os procedimentos metodológicos utilizaram um questionário demográfico e medidas *online* (durante a leitura) tais como: protocolo de pausa e retrospectivo, anotações, destaques no texto, releitura e tempo de leitura; como também medidas *offline* (após a leitura) que incluem tarefas pós-leitura e questionário de auto-avaliação. A CMT foi mensurada com o teste de alcance de memória em leitura desenvolvido em português por Tomitch (1995/2003) e os participantes foram alocados em dois grupos: um grupo com maior e outro grupo com menor CMT. Os protocolos verbais foram transcritos e categorizados de acordo com o quadro de inferências e estratégias de Linderholm e van den Broek (2002). Os resultados foram quantitativa e qualitativamente analisados. Embora análises estatísticas relativas à geração de inferências em cada condição não tenham apresentado resultado significativo no $\alpha$=.05, ajustes ao $\alpha$= .1 sugerem que há uma tendência que é corroborada por pesquisas anteriores. Assim, verificou-se que ambos os grupos de CMT adaptam suas estratégias no intuito de aprender em situações de leitura de maior demanda como ao ler para resumir e também ao ler hipertexto não-linear. Ambos os grupos fizeram mais comentários metacognitivos ao ler para resumir e ao ler hipertexto, mas os leitores com maior CMT superaram o outro grupo. O grupo de menor CMT demonstrou mais momentos de falta de compreensão em ambos os propósitos de leitura e fez mais associações, elaborações e avaliações ao *ler para criticar*, uma vez que esses processos demandam menor esforço cognitivo. Percebeu-se uma correlação significativa moderada entre o propósito de leitura *ler para resumir* e o tempo de leitura no grupo de menor CMT. Os escores das tarefas pós-leitura não apresentaram correlação significativa com o

propósito da leitura. Análises qualitativas identificaram que uma instrução específica teve efeito na minoria dos participantes e que a maioria se utilizou mais de conhecimento prévio do que de opinião especializada para emitir opinião na condição *ler para criticar*. Outras análises sugerem que, sendo os participantes alunos de um curso de Letras, ambos os grupos analisados encontraram estratégias compensatórias para lidar com as dificuldades da leitura de texto não-linear por meio de medidas que incluem: anotar, sublinhar/negritar, evitar clicar em links e fazer releitura. Por último, sugestões pedagógicas advindas do estudo propõem que a prática de leitura em contextos educacionais passem a considerar a inclusão da leitura digital em ambientes da Internet para que os estudantes possam se tornar letrados em diferentes modalidades de texto. Sugere-se, ainda, um monitoramento em contextos de ensino no desenvolvimento da leitura crítica e do resumo.

**Palavras-chave**: leitura em L2, memória de trabalho, modalidade de texto, geração de inferências, estratégias

NÚMERO DE PALAVRAS: 51,134

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## LIST OF ACRONYMS

α – Alpha level
L1 – First language
L2 – Second language
M – mean
N – Number of participants
p – Probability of significance
P1, P2, etc. – Participant 1, Participant 2, etc
rs – Spearman's correlation coefficient
RST – Reading span test
SD - Standard deviation
UFSC – Universidade Federal de Santa Catarina
SNS – Social networking sites
WM – Working memory
WMC – Working memory capacity

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# 1 INTRODUCTION

## 1.1 CONTEXT OF INVESTIGATION

Discussing reading comprehension comprises the discussion of the effects that technology has exerted on humans. Being the written system a technology in itself and which has become part of everyday practice, its impact on human cognition is not conceived as an influence of a technological tool any longer, but of a task which demands some cognitive effort like several others that require planning, reasoning, interpreting, and abstracting. It remains unclear so far whether one technology (written system) which is embedded in another (the digital environment) can place demands on the reader's cognitive system.

In the beginning of the 21st century, several trends have shaped the nature of reading and its practice. The research community started to look at the reading practice in classrooms and at the actual function of this activity on an everyday basis. The need to look at different occurrences of texts and the typical reading situations demanded to consider multiple informational texts such as hypermedia, hypertexts, blogs, text messages and other non-traditional forms of written texts.

Digital texts have impacted the way people read and this in turn has contributed to an important shift in reading research. Digital texts are presented in electronic environments such as computers in several formats, being the most popular ones in the portable document format (PDF), in the hypertext markup language explanation format (HTML), or in the document format (DOC). One characteristic of the digital environment is the diversity of features it may incorporate by being electronic. Those features via linkage devices can increment interconnection to other media such as images, audio, and video and other written texts outside the page, making a single page text become a *hypertext*. Besides incorporating new features such as interactivity, nonlinearity, availability of information, and the combination of written text and other media, its dynamicity may have contributed to less in-depth and sustained reading.

The availability of information in the digital space and the increase of time that people spend reading electronic media have brought about more freedom and choices to increment the experience as well as have impacted sustained and engaged reading due to its navigational features (Liu, 2005). In this regard, it is paramount to investigate the recent change in the acts of reading, which involve Internet reading situations and other digital and hypertext environments.

Considering hypertext as a nonlinear[1] electronic environment in which written texts or other media are interconnected, it is possible to claim that both agency of the reader and complexity of the process play important roles in the reading activity. Being an interactive connection to other texts outside the text being read by means of electronic links, along with the sense of freedom, research has pointed to cognitive overhead during navigation and the nonlinear course of reading, an aspect that is peculiar to the digital environment (Kamil & Cho, 2009; DeStefano & LeFevre, 2007).

However, linearity or nonlinearity in digital text reading may as well be defined by readers' characteristics, as traditional printed texts may likewise be read in a nonlinear way when multiple documents are involved.

It is still an arena of much debate to consider that the relation between nonlinear digital text and reader is mediated by an environment full of tentative and uncertain interactions. In this sense, Afflerbach and Cho (2009) discuss the challenges presented by this new form of literacy: "While readers can apply the strategies that work for traditional forms of reading, in hypertext, the reader-text(s) interactions may be more complex and demanding" (p. 81).

One aspect of cognitive overhead generally approached in studies related to reading in the area is the working memory capacity (Zumbach & Mohraz, 2008). Working memory is an important construct that intends to explain how individuals vary in the way they cognitively process and store information during activities of high demands. Research on working memory capacity limitations regarding complex tasks has informed reading comprehension in both traditional printed text and nonlinear hypertext in the readers' mother tongue (L1) as well as in second language (L2) (Alptekin & Erçetin, 2009; Fontanini, 2007; Tomitch, 2003; Torres, 2003; Miyake & Shah, 1999; Just & Carpenter, 1992). There is also a substantial body of empirical evidence that support the claim that the innovative characteristic of hypertext has led research to consider the burden imposed on the reader concerning the greater control over the information he/she encounters and the sequence of reading to follow (Lee & Tedder, 2003; 2004; Macedo-Rouet, Rouet, Epstein, & Fayard, 2003; Charney, 1994; Conklin, 1987, among others).

[1]The ortography *nonlinear* follows the North American spelling system with the same meaning of *non-linear* in the British spelling system : "1.Not arranged in a straight line" "2. Not sequential or straightforward." Retrieved from: https://en.oxforddictionaries.com/definition/us/nonlinear

Following the discussion on reading as a general construct, it is still debatable how working memory capacity can affect reading comprehension in L2 as well. Based on Zwaan and Brown (1999) we can assume that a certain level of L2 and general skill on reading are necessary for higher level inferential comprehension and situation-model construction. Not only do L2 non-fluent readers[2] lack efficient lexical and syntactic processes, they also lack the pragmatic and strategic processes which are compromised by the lack of resources of the central executive, being working memory capacity (hence WMC) a predictor of success in L2 reading (Rai, Loschky, Harris, Peck, & Cook, 2011).

Being inference generation either a deliberate or an automatic act on the part of the reader or both, it seems reasonable to ask how it relates to strategy use. According to previous research, readers select and adjust their attention according to what they want to accomplish and to the importance of some information in the text in detriment of others (van den Broek, Rapp, & Kendeou, 2005; van den Broek, Lorch, Linderholm, & Gustafson, 2001; Magliano, Trabasso, & Graesser, 1999; Narvaez, van den Broek, & Ruiz, 1999).

Providing that research considering linear printed texts has informed most inference generation investigations in the last decades, and considering that research on digital reading still needs further analysis, the relations I intend to develop in this study refer to how individual differences such as working memory capacity can be related to differences in the process and product of linear and nonlinear hypertext reading comprehension in English as an L2.

## 1.2 IDENTIFICATION OF THE PROBLEM

The role working memory plays in reading comprehension has gained prominence with research focusing on the limited capacity of this system as performing various activities at the same time: decoding, accessing vocabulary meaning, integrating propositions within and across sentences, integrating new and previous knowledge, making inferences and interpreting are all activities which take part within the constraints of a system which is limited (Tomitch, 2003; Miyake & Shah, 1999; Just & Carpenter, 1992).

[2]Adjectives referring to readers when addressing specific studies maintain the term used by the cited researchers and those adjective will vary: e.g.: skilled reader, better reader, proficient/non-proficient reader.

All these factors: low-level processes, schema activation, proposition encoding, interpretation across sentences and links, inference and critical comprehension of a text happen almost at the same time and within the limited capacity of working memory (Fontanini, 2007; Tomitch, 2003).

Studies that draw on the reader's prior knowledge and the relation between topic interest, number of links in hypertext reading, text coherence, and comprehension have contributed to the understanding that hypertext research has still a great array of issues to tackle (Erçetin, 2010; Madrid, Oostendorp, & Melguizo, 2009; Calisir, Eryacizi, & Lehto, 2008; Fontanini, 2007; Salmerón, Kintsch, & Canãs, 2006; Potelle & Rouet, 2003) . However complementary or conflicting they may seem, a whole lot of relations remain untouched. To mention a few, relations between readers' WMC and the generation of inferences during online[3] reading, which enables them to construct a coherent mental model of text helping them to be critical towards ideas conveyed in linear text and across multiple nodes of a nonlinear hypertext. Last but not least, grounded relations between WMC and the ability to recall arguments as a result of different reading purposes and according to the demands of a complex reading environment such as the hypertext, still have to be made.

In sum, the present study tried to investigate whether there any differences in reader's approach to the text (considering the reader's strategic behavior), in comprehension (considering inference generation and recall of arguments), and in reading time between low- and high-WMC readers when reading linear digital and nonlinear hypertexts under different reading purposes (reading to criticize and reading to summarize).

## 1.3 SIGNIFICANCE OF THE STUDY

Consistently supported by empirical studies, issues pertaining to the differences between linear and nonlinear hypertext reading still hold. The role of coherence in inference generation and comprehension at local and global levels (Waniek, 2012; Potelle & Rouet, 2003; Charney, 1994; Leventhal, Teasley, Instone, & Farhat, 1992); studies relating

[3]The term *online* in being used within the perspective of inference generation theory meaning the moment the text is being read (the process), as opposed to *offline*, which means after the act of reading is complete (the product). Further explanations are provided in the subsection 2.5.2.

WMC and linear versus nonlinear reading ( Fontanini, 2007; Lee & Tedder, 2003; Wenger & Payne, 1996), and strategy use in hypertext reading (Cho, 2011; Calisir et al., 2008; Madrid et al. 2009) are all variables that point to some dissimilarities between linear texts and nonlinear hypertext reading. The aforementioned empirical studies demonstrated that those differences exist, being in favor of hypertext or not.

Based on previous studies on inference generation, the assumption that different reading purposes result in different outcomes is common ground. Specifically, when reading to study, readers tend to resort to more effortful strategies that will result in learning goals, such as paraphrasing and repeating the text. When reading for entertainment, readers tend to feel freer to elaborate and associate more, drawing on personal opinions more often (Linderholm & van den Broek, 2002).

With attention to the integration of propositions that occurs across links and nodes, which is the case of hypertext reading, it remains untouched what types of inferences, according to the framework proposed by Linderholm and van den Broek (2002), are generated, what strategies readers employ considering linear digital and nonlinear hypertext reading, issues addressed by this research.

## 1.4 OBJECTIVES AND RESEARCH QUESTIONS

The main purpose of this study is to examine reading of linear digital and nonlinear hypertexts by low- and high-WMC readers of English as an L2. I intend to analyze, via the employment of a mixed-method approach in an exploratory manner, how low- and high-WMC readers construct meaning from linear and nonlinear hypertexts and how reading purpose can affect both the process and product of reading in different conditions: reading to criticize/give opinion and to do a summary. In order to pursue the main objective of this study, the following research questions are proposed:

*RQ1:*What types of inferences, as proposed by Linderholm and van den Broek (2002), are generated in verbal reports by low- and high-WMC readers in each condition- summarizing and criticizing/giving opinion in each text mode: linear digital and nonlinear hypertext reading?

RQ2: How is the reader's WMC related to the ability to recall arguments in each text mode, linear digital and hypertext, as measured by the post- reading tasks in both conditions reading to criticize/give opinion and reading to summarize?

RQ3: How is WMC related to reading time in each condition, reading to criticize/give opinion and reading to summarize?

RQ4: What is the effect of the specific instruction to consider the issuers in the post-reading criticize/give opinion task?

*RQ5:* What reading strategies are deployed in each condition: digital linear and digital nonlinear hypertext; for criticizing/giving opinion and for summarizing?

## 1.5 ORGANIZATION OF THE DOCTORAL DISSERTATION

This study is organized in 5 chapters encompassing the following issues:

Chapter 1 presents the introduction, contextualizes, problematizes and discusses the importance of the topics addressed in the study and introduces the objectives and research questions.

Chapter 2 brings important conceptualizations around which the study is conducted and reviews recent empirical studies on reading and working memory, reading in L2, literal and inferential comprehension, digital linear and nonlinear hypertext and Internet reading, local and global coherence and situation model construction, inference generation and strategy use.

Chapter 3 details the participants of the study, instruments and materials and general procedures to collect data. Procedures for organizing and analyzing data are also presented.

Chapter 4 brings the results and discussion for each research question and qualitative analyses are provided by triangulation of data.

Chapter 5 concludes the study by summarizing results and pointing to limitations and suggestions for future research and teaching.

# 2 REVIEW OF THE LITERATURE

To understand the complexity of the reading process and the relation of differing elements that take part in this activity, namely the reader's WMC, text mode, reading purpose, considered in this study, this chapter consists of the following six main sections: i) Reading comprehension from a cognitive perspective, including working memory and reading in L2; ii) New forms of reading: hypertext and Internet; iii) Local and global coherence and situation model construction; iv) Gagné, Yekovich, and Yekovich's (1993) framework; v) Inference generation and strategy use: a framework of analysis; and vi) Concepts of critical reading and summarization.

## 2.1 READING COMPREHENSION: A COGNITIVE VIEW

The investigation of the reading process by psycholinguists focusing on learning to read as a more natural process started to develop in the late 1960s, inspired by Chomsky's hard-wired view of language acquisition, and consequently of reading. Reading started to be viewed in contexts of meaningful use, different from the behaviorist view of learning as a conditioning act (Alexander & Fox, 2004). A shift to a more learner-centered or a learning-centered view increased interest in internal mental structures and attention started to be drawn to the human mind. Alexander and Fox complement that "concurrent with this view of reading as natural process, investigations into the inferred mental structures and processes of reading in relation to performance took shape" (p. 39). Learning to read began to be seen as an active search for meaning, an arrival at comprehension sought by the reader within a language rich-environment.

Cognitive roots, however, under the construct of prior knowledge, changed the gaze from a more innate and natural process of reading to a more information-processing view of the task. As advocated by Samuels and Kamil (1984), information processing theory in reading views the reader as a communication channel who, through sensory organs (eyes and ears, and also the brain) takes information, transforms, stores (in long-term and short-term memory), retrieves and uses this information when necessary. Readers' prior knowledge, their allocation of attention, their interpretations and recall of text, memory and strategic processing subside comprehension, which predicts reading performance

(Tomitch, 2009; Alexander & Fox; 2004; Tomitch, 2003; Gagné et al., 1993).

Samuels and Kamil (1984) refer to Rumelhart's (1977) prominent research in the cognitive area which described the reading process as an interaction between the low level (knowledge of orthographic features and lexical knowledge) and the high level (syntactic and semantic knowledge), influencing one another. In line with this view, Stanovich (1980) proposed the interactive-compensatory model, which allows a deficient level (low or high) to compensate for one another in the sense that a low language proficient reader may use context and prior knowledge to help make sense of the text (Samuels & Kamil, 1984).

It is Rumelhart's (1980) *The building blocks of cognition* and the theoretical construct of schemata that has most influenced current models of reading and research (Alexander & Fox, 2004). According to Alexander and Fox, even those who propose alternative explanations for the structure of human knowledge and the processing of information cannot deny the principles of schema theory.

Any attempt to describe the reading process must take into account the influences of the historical context in which the model was developed. Research considering memory and attention emerged after the mid-1960s and even within the cognitive psychology perspective different factors involved in the experiments (subjects, tasks, materials, context) have influenced and contributed to the different models of reading (Samuels & Kamil, 1984).

From this shift towards the reader's central role in the reading process, research has shown and suggested that instruction or intervention to aid the learner in the classroom setting can modify procedures towards reading (Tomitch, 2009; Tomitch, 2003, Tomitch, 2000). In this regard, research on text-processing strategies have empowered readers, guiding them to a more scaffolded approach to the text, yet developing more autonomous readers toward a self-questioning attitude. To a certain extent, benefits from explicit instruction on reading strategy may produce endurable results, but not all reading situations and not all strategies seem to be transferable to differing reading purposes, for all readers, neither are they applicable to the various text types and different contexts (Andrade, Gil, & Tomitch, 2012; Alexander & Fox, 2004; Linderholm & van den Broek, 2002; van den Broek, Lorch, Linderholm, & Gustafson, 2001).

Considering that the act of reading requires the combination of at least four elements: reader (prior knowledge or motivations), text (type of text, coherence), activity (to focus on general/specific information),

and situation (reading to do a test or to debate, to mention a few), current perspectives on reading tend to consider that comprehension is a result of interaction between those elements (Fox & Alexander, 2009).

As regards the demanding interaction between text and reader, it is essential to discuss the role working memory plays in the complex task of building meaning from reading considering the limitations of the cognitive system, relations to be further developed in the next subsection.

### 2.1.1 Reading and working memory

Research focusing on the limitations of working memory stems from the need to look at the memory system and how it works as performing various activities at the same time. Reading as a complex activity involving several factors, such as low-level processes, schema activation, proposition encoding, interpretation, and inference generation is enhanced by this limited capacity system called *working memory* (hence WM) (Tomitch, 2003; Miyake & Shah, 1999; Lorch & O'brien, 1995; Just & Carpenter, 1992).

According to Baddeley (2010), the term Working Memory was coined in 1960 by Miller, Galanter and Pribram and used in 1968 by Atkinson and Shiffrin to mean a short-term system which acts as a working memory in the flow of information in and out of long-term memory and being of central importance for learning. Initially proposed as a unitary system by Atkinson and Shiffrin, WM is an important construct which was fully described by Baddeley and Hitch (1974) as a non-unitary system and has been further developed and reinstated by several researchers, such as Baddeley and Logie (1999); Baddeley (2010); Cowan, (1999, 1988), among others. As stated by Baddeley and Logie (1999),

> Our definition of working memory is that it comprises those functional components of cognition that allow humans 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 (pp. 28-29).

Baddeley and Hitch's (1974) initial model proposed a *central executive*, conceived as a controlling mechanism, and its two "slave"

systems: the *phonological loop*, responsible for verbally coded information; and the *visuospatial sketchpad*, in charge of spatial information. Differently from Atkinson and Shiffrin's model, this non-unitary system conceptualizes the interactivity among its components in the sense that they act in parallel processing (Baddeley, 2010).

The subcomponents of the central executive have constraints related to the amount and duration of activation. The original model proposed by Baddeley and Hitch (1974) comprised both control processes and storage. However, in more recent versions of the model, Baddeley and Logie (1999) have proposed that the storage capacity is subject to that capacity of a given slave system, and the total storage capacity is achieved via access to long-term memory.

The storage capacity of the multi-component model was finally incremented by Baddeley (2000) with a supplementary component called *episodic buffer* in charge of assembling information from WM and long-term memory. Baddeley (2010) describes the episodic buffer as,

> […] capable of holding multidimensional episodes or chunks, which may combine visual and auditory information possibly also with smell and taste. It is a buffer in that it provides a temporary store in which the various components of working memory, each based on a different coding system, can interact through participation in a multidimensional code, and can interface with information from perception and long-term memory (p. 138).

The episodic buffer is considered to have a limited capacity and its passive store allows for only four chunks or episodes.

Another construct of WM that is widely discussed in the literature is Cowan's (1999, 1995, 1988) embedded-processes model. According to this model, "working memory refers to cognitive processes that retain information in an unusually accessible state, suitable for carrying out any task with a mental component" (Cowan, 1999). In Cowan's model, controlled attention is seen as an enhancement in the processing of some information, filtering out any other simultaneously available information and this enhancement is given by the central executive and it is effortful. In this sense, WM is seen as a complex construct which involves the information accessed for a particular task. In Cowan's words, WM involves: "a) memory in the focus of attention; b) memory out of the focus of attention but temporarily activated and; b) inactive

elements of memory with sufficiently relevant retrieval cues" (p. 67). This embedded system presupposes three hierarchically activated faculties: long-term memory, active memory as a subset of long-term memory, and the focus of attention as a subset of active memory.

In Cowan's model, processing limits vary according to the different faculty. The focus of attention has its limitation in terms of capacity, while activation is limited by time. Under unfavorable conditions, these limits are crucial to determine performance in conditions where features of items are too similar. The control of the focus of attention by the central executive is one way to activate information in memory. Due to its capacity limited features, the amount of information that can stay activated at a given time is greater than the capacity of attention. Both voluntary and involuntary mechanisms determine the focus of attention and this control is given by the central executive, being the involuntary processes an automatic recruitment of attention.

The prevailing aspect in Cowan's model is the complexity that underlies the WM system. The assumption is that different features in a complex task may become active or under the focus of attention according to the usefulness and efficiency of the representation, due to the limited attentional capacity. The focus of attention will call upon the features necessary to accomplish the task at hand, but memory can also be activated out of the focus of attention or awareness.

Just and Carpenter (1992) discuss the role of working memory in language comprehension in the storage of "intermediate and final products of a reader's or listener's computations"(p. 122) as they integrate ideas from a sequence of spoken or written words. The authors explain that individual differences regarding WMC constrains comprehension and these differences vary from person to person. Their model proposes that comprehension task difficulties impose the differentiation between the *total capacity explanation* and the *processing efficiency explanation*. While processing efficiency differences are apparent and do not depend on the total demand of a task, the total capacity hypothesis explains the capacity limitations that affect performance in tasks of high demand. In high demands, individuals with shorter WMC cannot process quickly nor store intermediate products as the task demands exceed the available supply. Therefore, Just and Carpenter (1992, p. 143) complement that "… individuals differ systematically in the effort that they have to expend to perform a task and that different tasks consume different amounts of resources in several domains besides language comprehension".

Heitz, Unsworth, and Engle (2005) propose a WMC dissociating between controlled and automatic processing. In their model, controlled processing is subject to attentional, thus effortful, capacity limitation. Attentional control is a voluntary cognitive act which suppresses prepotent responses that are not relevant to the task at hand. Attentional control is the mechanism that prevents information to decay over time or due to interference. In this respect, it is the capacity-limited executive control that voluntarily employs attention, and the WMC of an individual and his/her attention control do not depend on the difficulty of the task, but rather on the need to control attention or not. Basically, in Heitz et al.'s model, WMC is the ability that reflects to what extent one can control attention in tasks that involve interference from competing information, at the same time one is able to maintain information available even in "…interference rich contexts as well as block irrelevant, distracting information" (p. 66).

Heitz, Unsworth, and Engle's (2005) view of WM seems to best explain the complex interplay between controlled and automatic recruitment of attention when it comes to understand reading in complex environments such as the digital space and is the model to which this piece of research adheres to. Considering the present variables, namely reading for a specific purpose, selecting specific issues to evaluate, report on processes and strategies, make decisions on whether to click on links or not, following links and going back to the primary text, among other activities, it seems reasonable to predict the enhancement of controlled attention.

In essence, narrowing down to the complexity of the reading task and the working memory capacity, according to Daneman and Carpenter (1980) the challenge lies in the fact that the reader needs to engage in storage and processing of pragmatic, semantic, and syntactic information, disambiguating, parsing, and integrating preceding and subsequent text. The authors complement by stating that information that enters WM may have come from different sources. It can be perceptually encoded from the text and sufficiently activated to be retrieved from long-term memory as well as it may have been the result of a comprehension process. The authors further emphasize that, being a system of limited capacity, as discussed above, WM may lose information through decay or displacement, with time and amount of additional information being the main constraints. Storage and processing compete for WM resources and that explains individual differences in reading comprehension.

In their seminal paper, Daneman and Carpenter (1980) propose that good readers form rich chunks with many concepts and relations from preceding parts of the text, so that they reduce the load on WM optimizing its functions for subsequent processing. As a consequence, they integrate concepts and relations within and across sentences.

The development of the Reading Span Test (RST) has helped correlate individual memory spans with reading comprehension, the results being that high-span readers are also better comprehenders. The RST is similar to the traditional digit span (total amount of numbers) and word span (total amount of words) recalled. While in those tests storage is tackled, in the RST the trade-off between processing demands of sentence comprehension is incremented by the storage component. To better illustrate, in the RST a subject is required to read a set of sentences and recall the final word of each sentence. The number of sentences within a set is increased from trial to trial until the subject fails to recall a word within a set. The capacity for processing sentences and still recall final words is related to the subject's working memory span (Daneman & Carpenter, 1980). The measure devised by Daneman and Carpenter split readers in two groups: low-spans were able to recall final words of two and a half sets (out of six) and high-spans could recall beyond this limit[4].

Considering the construct of reading as a process of propositions assembly within and across sentences, an integration of low and high level processes, schema activation, inference generation, and the need to store information across sentences and paragraphs, the relations that can be drawn are that WM mediates the process, and each individual's capacity to store information is what defines better readers (Tomitch, 2003; Miyake & Shah, 1999; Lorch & O'brien, 1995; Just & Carpenter, 1992).

Still, considering that new challenges impose new attitudes from the reader, another aspect to consider in this wide spectrum is language proficiency as an important variable that interacts with comprehension processes in reading, an issue to be discussed further in the next subsection.

[4]The method presented is considered a strict method. A lenient method splits the groups in low-, medium-, and high-spans considering the total number of words recalled. Generally, participants are split in two groups: upper- and lower-third scores, considering only the extreme scores (Friedman & Miyake, 2005; Linderholm & van den Broek, 2002).

### 2.1.2 Working memory and reading in L2

As previously discussed, reading is an activity which demonstrates a great deal about the central role of the memory system in attention allocation, integration and processing of information.. In this sense, Cognitive Psychology and Psycholinguistics have explained how the world around us is perceived and the way this perception is used to develop skills such as remembering, solving problems and integrating information to achieve learning, speaking, and its relation to the activity of reading. (Bruning, Schraw, Monica, & Ronning, 2004; Just & Carpenter, 1992).

The role WM plays in reading comprehension has gained prominence with research focusing on the limited capacity of this system as performing various activities at the same time: Decoding, accessing vocabulary meaning, integrating propositions within and across sentences, integrating new and previous knowledge, making inferences and interpreting are all activities which take part within the constraints of a system which is limited (Tomitch, 2003; 1999; Miyake & Shah, 1999; Tomitch, 1996; Lorch & O'brien, 1995; Just & Carpenter, 1992).

According to Carrell (1988), the psycholinguistic model of reading has helped understand and discuss reading in L2, when Goodman (1971) described reading as a "psycholinguistic guessing game" in which the reader builds meaning from the graphically encoded message. Goodman highlights that the reader brings his/her experience along with his/her language and thought development. In this sense, a good reader relies on his/her prior knowledge to deal with linguistic information and draws on predictions to make meaning from text (Tomitch, 2009; Tomitch, 2003, Carrell, 1988).

According to Scarammuci (1995), even though research in L2 has grown, it is undeniable that abstract models of reading in the mother tongue (L1) still help shape and inform research and teaching in L2. Goodman's theory as well as Rumelhart's and Stanovich's have influenced research in L2 since the 70s. An interaction between bottom-up (data-driven) and top-down (conceptually-driven) approach to reading began to guide practice in the L2 classroom and research on memory and attention regarding the reading activity began to emerge.

The teaching of reading in L2 can be said to have gained relevance when L1 reading theorists shifted focus from the structure of language to the role the reader played in information processing. Reading as a top-down process and later on approaches that drew on an

interaction between top-down and bottom-up processes, along with the communicative teaching method in the late 1970s, became important components of L2 teaching. In this sense, individual differences such as language background, prior knowledge, schemata, comprehension monitoring and reading strategies, as well as issues on how L2 reading might be different from L1 reading, started calling academic attention (Carlo& Sylvester, 1996).

Looking at research from the cognitive perspective, some important studies on reading comprehension have contributed to enrich research in the area of reading, more specifically reading in L2, and aspects that consider individual differences, regarding WMC, text structure, text mode and language proficiency, among other variables (Bailer, Tomitch, D'Ely, 2013; Bergsleithner, 2012; Fontanini, 2007; Tomitch, 2003; Torres, 2003; Zwaan & Brown, 1999; Harrington & Sawyer, 1992).

Torres (2003) studied the relationship between WMC and the reader's main idea construction both in L1 and L2 and their strategy use. The Reading Span Test in Torres' research was conducted in both L1 (Portuguese) and L2 (English). Results indicated that the RST in L1 can be positively correlated to reading comprehension in L1 as well as in L2. Other important results that emerged from the study are that, when reading in L1, high-working memory readers used integrative strategies while the low-working memory ones relied on predictions, failing to update content after finishing reading, and thus, not being able to revise and/or test prior knowledge against textual information. Main idea construction is positively correlated to WMC in both, L1 and L2 conditions. Concluding, the results also pointed out the differences in strategy use in both reading situations (L1 and L2) by both high- and low-span readers: comprehension monitoring was used by low-span readers in L2, while the same strategy was more present in high-span readers in L1, with the crucial difference that high-spans were able to take fix-up measures to overcome the problem.

More recent studies have been conducted focusing on L2 proficiency and WM in order to understand reading in a more specific way. One of these is by Van den Noort, Bosch, and Hugda (2006) which investigated how WMC interacts with foreign language proficiency in speakers of Dutch as L1, German as L2 and Norwegian as the third language (L3), the last to be acquired. Their results show that there are differences in the way the participants performed between L1, L2, and L3. According to this study, the WM resources of an individual diminishes from L1 to L2 and from L2 to L3 and so does

their language proficiency, suggesting that WM and FL proficiency interact. We can relate the findings to the following conclusion: the less proficient the speaker or reader is in a given language, be it in L2 or L3, the more resource cost this is going to have on her/his WM

With specific relevance to the present study is the research conducted by Alptekin and Erçetin (2009) as their experiment taxed both literal and inferential comprehension in both low- and high-span readers. The purpose of their study was to compare performance of L2 readers on two RSTs that measured storage and processing. Important insights came out as WMC can be considered to predict L2 reading performance. In this sense, literal comprehension can be related to WMC only for readers with low L2 proficiency, as they tend to rely more on text-based processing. Consequently, inferential comprehension can be said to correlate well with WMC in the L2 reading situation.

An important study conducted by Linck, Osthus, Koeth, and Bunting (2013) bring evidence to the correlation between WM and L2 processing and proficiency. The authors provide a meta-analysis of 79 samples of published research on WM and conclude that: "WM is an important component of the cognitive processes underlying bilingual language processing and performance on measures of L2 proficiency" (N/P). However, Linck et al. point out that further understanding is still to be built considering domain-general cognitive control mechanisms and their relations to specific language processes, such as L2 processing and proficiency development.

Taking the above studies into consideration, the present study sets out to further investigate the relationship between WMC as measured by the RST and reading in L2 in conditions of high cognitive demand, such as hypertext and online Internet reading.

Discussion provided by research investigating new forms of literacy and comprehension processes in challenging reading environments are further detailed in the next subsection.

## 2.2 NEW FORMS OF LITERACY: HYPERTEXT AND INTERNET READING

The availability of texts on the Internet not only has expanded the access to texts, but has also motivated the interest in writing and sharing information. As this tendency has grown, the interconnection of texts, documents and other media, such as sound, video and images define the nonlinearity of texts in the networked world.

The origins of the concept of hypertext date back to 1945 when Vannevar Bush is credited with first describing hypertext (Conklin, 1987). In his article, Bush introduces a machine called Memex for browsing through a large library, personal notes, photographs and sketches as a solution for the spreading of scientific literature and "augmenting the human intellect" (Foltz, 1993). As presented by Conklin, with several screens, it provided "a labeled link between any two points in the entire library" (p. 20).

Later, in 1963/1968, Engelbart, influenced by Bush's ideas developed a more sophisticated system, called Augment, combining television images and other input devices that could connect statements within files and between files. It was the first hypertext implemented on a computer system (Foltz, 1993). Ted Nelson (Nelson' Xanadu Project), a contemporary of Engelbart's, coined the term "hypertext" with the concept of unifying the literary environment on a global scale (Conklin, 1987).

However important it might be for research in hypertext, Ribeiro (2008) asserts that even though Vannevar Bush is traditionally recognized as the first idealizer of the hypertext concept, his ambitious Memex seems far from resembling the features of hypertext as presented today. According to the author, the idea of a hypertextual machine was a worldwide endeavor which was only able to be accomplished by Berners-Lee in 1989 with the creation of the "world wide web". Several scientists who did not even have contact, either among themselves or to Bush's idea, had also contributed to that. Thus, contends Ribeiro, Bush idealized a dispenser in which to store information, which did not have the semantic relationship or the dynamicity peculiar to the contemporary hypertext documents.

According to Conklin, Randall Trigg wrote the first PhD thesis on hypertext in 1983 describing the Textnet system as a semantic network: "A semantic network is a knowledge representation scheme consisting of a directed graph in which concepts are represented as nodes, and the relationships between concepts are represented as the links between them" (Conklin, 1987, p. 37).

For a better understanding of the characteristics that make up a hypertext, some contemporary definitions are necessary in order to clarify the stance of the debate. Hypertext is defined as "[…] a computer-mediated text in which highlighted words or titles enable readers to interactively determine the order and level of detail by serving as links to other excerpts or documents of supporting information" (Lee & Tedder, pp. 767-768, 2003). Kamil and Chou (2009) define hypertext

as a “text that is linked electronically with other information outside the text being read” (p. 290). The links lead to additional information which can elaborate the current text and give support to the reader. Rasmussen (2007), as presented by Afflerbach and Cho (2009), describes hypertext as “ made of blocks of text – in the form of written text, pictures, video and sound, chained together by electronic links” (p. 81). This view considers both the Internet reading situations as well as other hypertext environments, such as hypermedia, which is defined as an “augmentation of hypertext and multimedia” (Moos & Marroquim, 2010) or a combination of written text and other types of media (Erçetin, 2010).

Hahnel, Goldhammer, Naumann, and Kröhne (2016) define hypertext on the World Wide Web as “a huge information space, separated in several pages. Pages within a hypertext (referred to as “nodes”) are interconnected and accessible through hyperlinks” (p. 487). The authors emphasize the invisibility of a huge amount of information which is not presented on a specific page, but is organized in such a way that the reader needs to locate and select those segments that serve a specific purpose. In the hypertext theory nodes are denominated “lexia”, a reading unit or a section of text.

Hypertexts are generally described as composed of nodes and links which serve as paths to follow according to one’s purpose. According to Rouet, Levonen, Dillon, and Spiro (1996), the organization of information in hypertext form a network of nodes (lists of items, paragraphs, pages) which are related by links (for semantic associations, definitions, examples or any other relation necessary between two passages).

However similar hypertexts and Internet texts might seem regarding their linkage of information from outside the text being read, Coiro (2011) proposes a differentiation between those two text modes. According to the author, *hypertexts*, in the way several studies refer to, are those texts with digital information that are linked within a bounded electronic system such as a CD-ROM encyclopedia or a library database. On the other hand, *Internet texts* are those found in the open Internet and this type of reading is a different source of complexity as they demand an interaction with a more “dynamic open-ended information system” which is in constant change.

One can conclude that hypertexts can be defined by their aspect of having connections to other texts or media and being online or not is the difference between more or less freedom and options to the reader. Therefore, Internet reading does not exclude the use of the term

hypertext, neither the demands of the first would exclude or diminish the complexity of the latter. As far as dynamicity is involved, other characteristics of digital texts are next presented.

### 2.2.1 Linearity, nonlinearity, and the outcomes of reading comprehension

Definitions of hypertext consider its nonlinearity and its linkage aspect. Holt and Howell (1992) define hypertext as "non-linear electronic documents in which information, text or graphics, is represented as a network of nodes connected by links" (p. 169). If taken in isolation the expression *nonlinearity* does not clarify the nature of hypertexts. To understand its meaning, it seems important to depart from a definition of *linearity*.

For the purpose of this study, I will consider *linearity* as defined by Fontanini (2007): " linearity is related to the surface level of texts, that is, to the straightforward sequence of interrelated words, phrases, paragraphs" (p. 43). To complement this definition, I find it necessary to recover the operational definition under which reading is conceived in the present study. If we take Daneman and Carpenter's (1980) view that the complexity of the reading task lies in the fact that the reader needs to engage in storage and processing of pragmatic, semantic, and syntactic information, disambiguating, parsing, and integrating preceding and subsequent text, I contend that a certain hierarchy exists, leading to a relation among propositions, sentences and other portions of text (preceding and subsequent). To complement this view, I draw on another view which encompasses decoding, accessing vocabulary meaning, integrating propositions within and across sentences, integrating new and previous knowledge, making inferences and interpreting (Tomitch, 2003; Miyake & Shah, 1999; Tomitch, 1996; Gagné et al. 1993). However, it is still unclear whether the traditional reading order, taking the traditional definition of the act of reading in most cultures as happening from left to right and from the top of the page downwards is the mode that best contributes to a mental representation of text. Several factors have to be considered to interfere in the process.

Proceeding with the definitions, hypertexts are defined as *nonlinear* for containing links and nodes in which information is conveyed by the writer and accessed by the reader according to the latter's choices and needs. Thus, to the traditional characterization of reading - decoding, word recognition, sentence literal comprehension,

inferential comprehension, and comprehension monitoring - let us add a new feature of complexity: decision making in the creation of paths to follow through the text (Shapiro & Niederhauser, 2004). The latter activity may influence the mental activity, directly when having to make decision when a link is available or indirectly affecting information integration when following a link detaches the reader from related parts of a text (DeStefano & LeFevre, 2007).

In this context, the role of the reader has expanded as dramatically as have the functions of texts. Fox and Alexander (2009) classify the reader's activity, in a model called Transitional Extension, as "constructing meaning while connecting across texts; creating individual navigational path through links; considering author; responding interactively, building collaborative understanding" (p. 233). In this framework, the text is still static, but it is also fluid, as it is presented in different modalities of, as put by the authors, "single or multiple linked propositional networks" (p. 233).

The linkage of information in nonlinear ways allows for different content representation devices peculiar to hypertexts such as embedded links, menus, hierarchical or networked concept maps, and these representations may have impact on comprehension of hypertext contents (Potelle & Rouet, 2003).

According to Holt and Howell (1992), the author of a hypertext imposes his/her mental model of the information on the text leaving little for the reader but to build a similar mental model to guarantee an efficient navigation. This lack of limitations on how the information is organized may result in problems for readers if the mental model is not clear for the writer him/herself. Thus, the non-sequential feature of hypertexts differentiates them from standard linear texts in the sense that information is not organized in a single order by the author (Foltz, 1996).

Charney (1994) discusses specific characteristics peculiar to hypertexts based on Kintsch and van Dijk (1978), van Dijk and Kintsch (1983). According to the author, readers build a mental representation of the information in the text in a hierarchical manner. By reading successive sentences, ideas are linked to this hierarchical representation via repeated concepts. The more the same arguments are developed, elaborated on, reused, the text becomes more cohesive, easier and better structured, and more meaningful, thus leading to a better mental representation. This quality is directly related to the order in which the propositions are read and the important concepts are reinstated. In this sense, argues Charney, a disorganized text, in which arguments are

disjointly linked, the reader must either retrieve earlier propositions which contain related arguments from memory or infer some relations between what has been read to some previous part of the text. From this perspective, nonlinear texts tend to interfere in the mental representation usually described in the process of reading linear texts. As Charney (1994) complements, "Both retrieval and inferencing are relatively costly processes in terms of time and effort" (pp. 09-10).

However, as important as the sequences and connections among sentences, some other aspects contribute to a coherent representation of a text and add on to the reader's actual learning from reading. As stated by Charney, the first aspect is that appropriate connections between ideas are made if the sentences that contain the ideas are close to each other. Therefore, coherent sequences of sentences, paragraphs, sections and signals that relate these ideas make a text easier to read. The second aspect relies on the organization of high-level ideas that should be clearly signaled, such as, informative title, headings, overviews and topic sentences. Other features, such as, repetition or reference to previous discussion via reminders are also seen to contribute to an easier reading. A final aspect to consider, according to Charney, is to follow a familiar structural pattern or genre. Otherwise, any innovative text structure should be explicitly announced to the reader.

The innovative characteristic of hypertext has led research to consider the burden imposed to the reader concerning the greater control over the information they encounter and the sequence to follow. A role which was exclusively on the writer's hands is now shared with the reader: selecting topics, deciding on their sequence without the help of traditional discourse cues, to mention a few (Charney, 1994).

According to Fontanini (2007), an easy integration of information depends on text features such as logical, chronological or syntactic order so different parts can be combined to build a coherent mental representation. In this sense, coherence can be more negatively affected taking into account the nature of hypertexts where information can be randomly displayed by the writer and randomly accessed by the reader (Fontanini, 2007).

Contrary to the nonlinearity position, Rouet and Levonen (1996, p. 14) claim that "there is no absolute boundary between linear text and hypertext". The authors highlight that even printed texts have nonlinear features (e.g.: table of contents, index, footnotes) or even types of texts such as technical texts, textbooks, manuals which embed pictures, graphics, tables and other features. The practice of consulting a dictionary while reading can be considered a nonlinear reading process

(Rouet & Levonen, 1996). In this sense, what makes the process linear or not is also part of a reader's choice.

Even though some books such as dictionaries and encyclopedias do not require linear reading, associative connections are typical characteristics of electronic texts or hypertexts (Foltz, 1993). The associative connections suggested by the author of the text and selected by the reader allow for a dynamic representation of hypertexts. When discussing the agency of the reader in the electronic environment, it is common sense that in hypertexts readers control the sequence or paths to follow (Lee & Tedder, 2003). The advantages of hypertext over linear or traditional forms of reading, to mention a few, include new possibilities for reading and retrieval, information structuring, customized documents, modularity and consistency of information (Conklin, 1987).

However, beyond helping the reader on adding to the text, Kamil and Chou (2009) argue that these features place demands on the reader as they need to make decisions on interrupting the linear course of the task and explore links.

According to Lee and Tedder (2003), there is still no consensus as to whether hypertext reading may place cognitive overload on some readers. Thirteen years after this assertion, doubts still reside on the organizational structure of information, which is in constant development by the hypertext theory, and other aspects involved in studies that consider this text mode. Among some of the features that may influence comprehension and learning lie affective factors, domain or previous knowledge, experience of learner or digital literacy, long-term comprehension and memory (Freund, Kopak, & O'Brien, 2016; DeStefano & LeFreve, 2007). Freund et al. (2016) assert that even though studies have pointed to

> […] lower levels of text comprehension associated with digital reading as compared with print […] it is not clear if this is an effect of the digital display of text or a function of reading behaviours that are more prevalent online, such as browsing, speed reading or non-linear reading. Efforts to compare comprehension outcomes of print and digital reading are complicated by the wide variation in measures employed and the many possible interaction effects of perceptual, ergonomic and cognitive factors within testing environments (pp. 80-81).

Even though the reading of hypertexts has become a common practice due to the spread of material being published online, due to its infancy compared to reading of the traditional linear printed text research, there is little research focusing on the effect of this kind of learning experience (Lee & Tedder, 2003) compared to studies on processing of linear discourse (Wenger & Payne, 1996). If on one hand research has pointed to the advantages of hypertext reading due to its dynamicity, on the other hand, Conklin (1987) asserts that the "disorientation problem"- a problem which is not peculiar to hypertexts, but that can get worse in an electronic environment - can hinder the traditional flow of reading. Along with disorientation, Conklin brings up the issue of cognitive load pertaining to hypertext reading: "The additional effort and concentration necessary to maintain several tasks or trails at one time" (p. 40). Macedo-Rouet, Rouet, Epstein, and Fayard (2003) also corroborate the assumption that hypermedia learning leads to disorientation and cognitive load as more effort is needed to comprehend a text.

As discussed earlier in this chapter, the limitations of our cognitive system, more specifically the WMC limitations, have been thoroughly researched (Tomitch, 2003; Miyake & Shah, 1999; Tomitch, 1996; Lorch & O'Brien, 1995; Just & Carpenter, 1992). Storage and processing compete for WM resources and that explains some of the individual differences in reading comprehension (Daneman & Carpenter, 1980).

Comprehension difficulties due to processing load, as argued by Foltz (1996), are a result of poor inference generation when the role of coherence is taken into account. Macro-coherence is not always present in the relation between links in a hypertext. Foltz points out that even though a hypertext writer may code all links, it is hard to cohere each possible section to which the reader may jump, unless some kind of measure is taken to control jumps between links that are not related.

As we have described earlier in this subsection, being new forms of literacy, hypertexts provide links with other texts, and therefore, independently of being these features an advantage or disadvantage in the processing of information, they surely are different from those features in traditional linear discourse and basic differences between linearity and nonlinearity and their dimensions still have to be stablished (Zumbach & Mohraz, 2008; Wenger & Payne, 1996).

Regarding the text modes considered in the present study, a digital text without hyperlinked text information, also known as *linear digital text*, and a digital text with hyperlinked text information, also

called *nonlinear hypertext* will be used as two distinct environments for the stimulus texts.

To further discuss the internal organization of hypertexts, the following subsection summarizes the most common types of hypertext structures discussed in the literature and the implications of such organizational aspects to comprehension.

### 2.2.2 On the structure of hypertext

The structure of hypertexts, also known as content representation in hypertext, may have some influence on the outcome of reading, but different research, with different purposes, tasks and participants has contributed to different results (DeStefano & LeFreve, 2007; Chen & Rada, 1996).

With the purpose of specifying what type of hypertext I am considering in this discussion, some definitions and classifications are deemed necessary. Specific models have been used to structure hypertext and the ones largely discussed in the reading literature are the *structured overview* and the *unstructured overview* (Dee-Lucas & Larkin, 1995), models that largely rely on the bounded electronic system (as briefly discussed in section 2.3).As defined by Dee-Lucas and Larkin, "In the structured overview, the spatial layout of the titles indicated the superordinate and subordinate relations among text units (also classified as hierarchical) . The unstructured overview presented the titles as an alphabetized list" (p. 432), with no explicit connections. Potelle and Rouet (2003) add a third model in their study, called networked map, which connects the main topics with semantic links. These semantic links may be cause-effect, category-example, and item-definition (DeStefano & LeFreve, 2007).

Hofman and van Oostendorp (1999) conducted a study on the effects of a structural overview (a hierarchically organized map or an ordered list of topics)on hypertext reading and the construction of a situation model in low and high prior knowledge readers. The results showed that those readers with low prior knowledge who read the hypertext with the structural overview scored higher on the macrostructure of the text, suggesting that they paid little attention to the microstructure of the text. On the other hand, high-knowledge readers used prior knowledge to build situation models, no matter the way the text was presented.

Lee and Tedder (2003) used three types of text formats to explore the effect of text format on low- and high-WMC readers' recall:

the traditional text, the structured hypertext, and the networked hypertext. The results point to the interpretation that hypertext reading may cause disorientation in low-WMC readers, causing overload in cognitive processing and leading to an over-simplification of the information. Low- WMC readers showed better results than high-WMC readers in the traditional text condition, remembering more from linear traditional text than from hypertext.

In a subsequent study, Lee and Tedder (2004) tested other three formats in their investigation: scrolling text, expanding hypertext, and paged hypertext. While scrolling text is defined as linear information presentation without hyperlinks, Lee and Tedder define the other two as follows: "… paged hypertext contained hyperlinks connecting pages in a manner that wherever a term existed in the text, a link was presented. The expanding hypertext refers to a hypertext with links that insert more detailed information in place" (p. 172). The researchers considered WMC and previous hypertext experience on the ability to read the three formats. They concluded that low previous experience with hypertext led to least disorientation in the expanding format compared to the paged hypertext format. On the other hand, participants who reported having high experience with hypertext also reported having disorientation with scrolling text. WMC influenced the recall scores as well. Those who were low in WMC produced better recall scores when reading scrolling texts than when reading paged hypertext.

Potelle and Rouet (2003) also studied the effect of prior knowledge and three different structures of hypertexts on inference generation: *hierarchical map*, a *network map,* and an *alphabetic list*. Their studyfound no effect of content representation on the comprehension of high prior knowledge students. They concluded that readers with high prior knowledge were able to generate high-level bridging inferences in any of the three types of content representations. However, the network map was not as helpful to low knowledge readers as the hierarchical map. Still other studies concluded that hierarchical structures seem to contribute to a more efficient browsing than alphabetical index (Simpson & McKnight, 1990) and to an improved comprehension at a more global level by low knowledge participants (Potelle & Rouet, 2003). On the other hand, performance measures were not significantly correlated to the use of hierarchical structures (Leventhal, Tesley, Instone, & Farhat, 1992) and do not contribute to comprehension at a local level (Potelle & Rouet, 2003).

Shapiro and Niederhauser (2004) posit that usually well-defined structures (hierarchies) favor beginning students and help remember

factual knowledge, but the design of such hierarchical features should always provide some challenge so as not to make readers passive. On the other hand, ill-structured hypertexts may be beneficial for advanced learners, contributing to a deeper learning process, active strategies and allowing for coherence to be built by the reader within the system.

Amadieu, Tricot, and Mariné (2010) conducted a research on the cognitive processes involved in comprehension, navigation and disorientation with different types of hypertext structures, connecting them to the reader's prior knowledge. Results showed that hierarchical structures are related to coherence and diminish conceptual disorientation, whereas network structures demand more processes and, hence, affect comprehension. Therefore, prior knowledge is an important variable in favor of comprehension performance in any type of hypertext structure.

Waniek (2012) studied the coherent representations in hypertext as seen to affect reading comprehension, as incoherent linking structures break the expectations and needs of the reader and the flow of the reading process. They concluded that hypertext linking structures can affect comprehension at a macro-level (semantic relations of information at different text nodes)

Notably, research on different structural features of hypertext may blur the attempt to interpret the process by unifying characteristics so as to oversimplify the discussion. Studies have tried to come to grips with defining the advantages and disadvantages of reading considering the different modes of text presentation available in contemporary society.

An important interpretation of the different results discussed above, and restating Charney's (1994) arguments favoring a coherent organization of propositions in a text, leads us to conclude that the more developed and elaborated the arguments are, the better structured the text becomes, which ends up in a better mental representation. These results corroborate the assumption that individual differences, such as prior knowledge, working memory capacity, and text mode as well as several other factors are variables that may affect reading comprehension and influence higher order inference generation(to be discussed further in section 2.5).

An overview of both advantages and disadvantages of hypertext reading considering other aspects is deemed important in order to understand what can influence readers' strategy use and to what extent inference generation can be affected by such an environment. In this

sense, more research review analyzing other correlations in reading performance in hypertext is provided next.

### 2.2.3 Other features considered in studies on hypertext reading

Wenger and Payne (1996) studied the specific processes underlying comprehension and retention of hypertext information comparing them to those processes involved in traditional linear text. Under the light of two theoretical constructs, WMC limitations and material appropriate processing, Wenger and Payne analyzed the effect of working memory load as concurrent tasks (control, digit and spatial) were performed during reading. Wenger and Payne could not show a reliable difference between reading comprehension for hypertext versus linear text. Results showed that differences in processing hypertext and linear text do not lie on the overall demand, but on demands for use of relational information.

Fontanini (2007) examined the relationship between WMC and differences in L2 reading comprehension considering both traditional linear text and hypertext. Participants read texts in L2 English and were of different nationalities: Brazilian and Chinese undergraduate students. By means of different instruments, comprehension questions, qualitative questions, recalls of propositions, and contradictions, Fontanini concluded that performance of low-span readers was impacted by text mode. Hence, low-span's performance in the activities proposed was impaired in hypertext when compared to linear text. As WMC was taken into account, cognitive demands of hypertext is said to interfere in the mental representation of text, as measured by contradictory information. The important finding of Fontanini's study is that there are many aspects that should be taken into account when considering L2 reading. Among them, WMC, the mode of text presentation, the reader's first language are a few variables that can influence the mental representation of text (Fontanini, 2007; Fontanini & Tomitch, 2009).

DeStefano and LeFevre (2007) analyzed 38 empirical studies published between 1990 and 2004 to verify the influence of hypertext features on cognitive processing during comprehension. The authors concluded that the demands of decision making and visual processing in hypertext hampered reading performance, being influenced by WMC and prior knowledge. The analysis of such a considerable amount of studies allowed for a conclusion that structural features of hypertext can also contribute to a more or less cognitive load during hypertext reading.

Naumann, Richter, Christmann, and Groeben (2008) conducted an experiment in which 64 undergraduates were sorted out in three groups. Each group received either a cognitive or a metacognitive or no strategy training. Groups were sorted in high-spans or reading skill and navigational behavior with training , low-spans or reading skill with either training or no strategy training. As predicted, learners high on WMC or reading skill benefited from strategy training regarding the learning results and the quality of their navigational performance. On the other hand, low on WMC and reading skills had a worse performance in both training conditions compared to the control, meaning that WMC may have impacted the employment of learning strategies.

Several other features relating hypertext characteristics and individual differences help us understand the intricate relationship between reader-computer interaction in reading comprehension. In the study of Salmerón, Kintsch, and Cañas (2006) , hypertext is seen as beneficial for high prior knowledge readers as they make better use of embedded links and are able to construct a more coherent representation of the text . However, Erçetin (2010) found no effect of prior knowledge on text recall in L2 reading, whereas the same study revealed a significant main effect of topic interest on text recall. Clinton and van den Broek (2012) found positive relationship between topic interest and recall or accurate answers to comprehension questions.

Reading order of text sections is affected by readers when reading hypertext and this in turn affects comprehension depending on the reader's prior knowledge (Calisir, Eryazici, & Lehto, 2008). Reading order is also seen as affecting the situation model construction and learning from hypertext in the study of Madrid, van Oostendorp, and Melguizo (2009). The authors analyzed the effects of number of links on cognitive load and learning from hypertext reading and concluded that link suggestions can affect learning, but no effect on learning was found in relation to the number of links. A high text coherence reading order seemed to have affected cognitive load and learning in a positive way, though.

To conclude this section, several aspects have been considered involving hypertext reading. To summarize, these aspects include, among others, the effects of hypertext structure and prior knowledge on text comprehension, inference generation and learning (Amadieu et al. 2010; Salmerón et al. 2006; Shapiro & Niederhauser, 2004; Potelle & Rouet, 2003; Hofman & Oostendorp, 1999), relations among linking structures, WMC and comprehension (Waniek, 2012; Madrid et al.

2009), WMC and comprehension, retention and mental representation of text (Fontanini, 2007; Wenger & Payne, 1996); WMC, reading skill and strategy training (Naumann et al., 2008); hypertext reading in L2 (Fontanini, 2007; Erçetin, 2010); and also effects of reading order and prior knowledge on comprehension (Calisir et al., 2008).

In the next section, I will discuss how local coherence can contribute to inference processes at both the micro and macro levels of processing grounded in consistent empirical research with traditional linear reading.

## 2.3 LOCAL AND GLOBAL COHERENCE AND SITUATION MODEL CONSTRUCTION

Discourse comprehension has been described by discourse psychologists and models which are widely referred to in the area have been those by van Dijk and Kintsch (1983) and Kintsch and van Dijk (1978).

Kintsch and van Dijk (1978) describe comprehension in oral as well as in written language as overlapping processes. In their comprehension model, the authors propose that complex processes work in a parallel fashion, interacting with little effort of the system.

As discussed earlier in this chapter, readers combine local and global relationships of propositions to build a hierarchically structured mental representation of the information in the text (Kintsh & van Dijk, 1978; van Dijk & Kinstch (1983). In this manner, semantic coherence is attributed to the text taking into account some aspects such as local and global inferences. Local coherence comprises the "semantic relationships between the successive sentences of the discourse" (p. 150). Lehman and Schraw (2002) describe local coherence as " when text information is related unambiguously to text segments that precede and follow it" (p. 738). In contrast, global coherence is the ability of the reader to build text wide inferences by integrating ideas in the text into a situation model (Lehman & Schraw, 2002).

Thus, a group of sentences is considered coherent if there is fact relationships relating them, that is, a fact can either be a condition *for* another fact or a consequence *of* another fact (van Dijk & Kinstch, 1983). Semantic relationships are not only mediated by textual information, but also by world knowledge or episodic memories (personal experiences). Van Dijk and Kintsch further develop the definition of coherence subdividing it into a general one which pertains to the "relations between propositions as expressed by the sentences of a

discourse, relative to some possible world(s), and relative to some set of knowledge or other cognitive information" (p. 150). The other subdivision takes into account the (inter) subjectivity as discourse comprehension encompasses culturally, socially or personal contexts of memory which, in van Dijk and Kintsch's own words, "make coherence relative to cultures, groups, and persons" (p. 150).

In this latter model, local semantic coherence is related to global coherence of the discourse. Thus, discourse referents, predicates or properties of individuals, sequences of actions or events will be organized according to global or macrostructures.

Van Dijk and Kintsch describe sentence understanding as a processing of the sentences surface structures in form of propositions. Information that comes from the interpretation of text and from memory (semantic and episodic) is processed in cycles so as to update and relate the old and the new one. In this cyclical process, new propositions may enter the buffer and new relationships are made. In this sense, local coherence is strategically organized in proposition sequences. Therefore, local and global coherence structures are combined and mixed with knowledge, pragmatic and communicative strategies (van Dijk & Kinstch, 1983).

According to Kintsch and van Dijk's (1978) model, discourse comprehension involves two levels within semantic processing: 1) the *microstructure level,* which refers to the local level of discourse, that is, meaning portrayed in individual propositions and their relations; and 2) the *macrostructure*, which characterizes discourse as a whole, that is, the global meaning of the text. Macrostructures allow for inferential processes and they reflect the gist of a text, its essential points.

Based on the models proposed by Kintsh and van Dijk (1978) and van Dijk and Kinstch (1983), Charney (1994) advocates for the organization of information in hypertexts in a cohesive way, claiming that the order of propositions encountered by the reader and other features such as repetition and development of concepts are crucial for the quality of the mental representation. Both retrieval and inferencing are costly processes that require time and effort from the reader as they encounter arguments with no clear link to nearby sentences. As highlighted by Charney, " they must either retrieve from memory earlier propositions that contain one or more of the arguments, or they must infer some link between the sentence and some part of their representation of the text" (p. 09).

Based on the discussion above, one can reason that, to establish coherence at a global level, that is, at the macrostructure level, the

reader needs to be able to attribute meaning to the text by following a certain organizational pattern, previously set by the writer (through cohesive devices or not) to integrate information and also by cyclically relating old and new information at a global level so as to have a gist of the text.

In essence, as shown in the previous section, new forms of reading require new concerns from the writer and reader to guarantee that coherence is established. In this respect, some aspects need to be accounted for such as organization of information so as to guarantee construction of a mental model intended by the writer, via cohesive devices or not (Kintsch & Franzke, 1995). On the part of the reader, several aspects may crucially interfere in his/her construction of meaning, among those lie purpose for reading, individual differences, language proficiency and, ultimately, text mode, all foci of the present study. Deficiency in some of those aspects may also determine the employment of a set of strategies to accomplish the purpose, as the next subsection further details.

## 2.4 GAGNÉ, YEKOVICH, AND YEKOVICH (1993) – A FRAMEWORK FOR DISCUSSING LITERAL COMPREHENSION, INFERENTIAL COMPREHENSION AND MONITORING

Gagné et al. (1993) developed a framework to describe a model of reading which organizes information in a stage-like progression, comprising the differences on how skilled and less skilled readers differ. The so called *component processes* are split in three major elements, namely, *conceptual understanding*, *automated basic skills*, *and strategies.*

Conceptual understanding encompasses declarative knowledge of vocabulary, text schemas, and topics (prior knowledge). The automated basic skills (procedural knowledge) involve the decoding skills and literal comprehension (lexical access and parsing) leading to an integration of words in order to form propositions, summarization, and elaboration. Finally, strategies refer to the reader's approach to the process depending on his/her goals. According to Gagné et al., it is closely related to the skilled reader and his/her ability to select strategies, check objectives, and remediate.

In summary, Gagné et al.'s four components of the reading process, *decoding, literal comprehension, inferential comprehension,* and *comprehension monitoring* that underlie procedural knowledge, are said to work in parallel. *Decoding*, as the word suggests, refers to

"cracking a code", to use Gagné et al.'s own term. It is subdivided into the subcomponents, *matching* and *recoding*. Matching refers to relating *the* printed word to a representation in long-term memory, its meaning and sound. Being an automatized process, it evolves as one develops reading skills. Declarative knowledge on perceptual features such as letters, phonemes and morphemes, the low-level knowledge, are called upon in this subprocess. Gagné et al. explain that: "the matching process uses 'chunks' that correspond to the largest perceptual patterns a reader knows" (p. 270). In the recoding process, print is recoded in sounds, which in turn activate meaning. It also draws on declarative knowledge of phonemes, syllables, and morphemes. It is an automatized process, as long as vocabulary is familiar to the reader and deautomatized with unfamiliar or lengthy words.

One important aspect to mention is that within the constraints of the working memory system, processes such as decoding, matching, and recoding must become automatic so that the other higher level processes, e.g. inferential comprehension, may take place.

The next component process in Gagné et al.'s framework, *literal comprehension*, is comprised of two subcomponents: *lexical access* and *parsing*. In lexical access, meanings of words are stored in lexicons (mental dictionaries) which are stored as declarative knowledge. It works in conjunction with the previous process, decoding. Appropriate word-context is selected by a skilled reader in an automatic fashion. In this sense, literal comprehension is said to combine both automated skills and conceptual understanding, thus being crucial for inferential comprehension. Finally, parsing is what governs the process of word meanings and their combination to form meaningful ideas in the string of words in a sentence. Gagné et al. contend that: "The parsing processes use the syntactic and linguistic rules of a language for putting words together to form meaningful ideas" (p. 272). These meaningful ideas can be represented not only by words, but also by phrases, word order, word endings, and other features that contribute
to the proposition assembling, the meaningful relationship between and among words in the reading process.

A higher component in the framework, *inferential comprehension*, requires a deeper understanding of the information in the text. The processes involved in this component are: *integration*, *summarization*, and *elaboration*. *Integration* is the subcomponent that connects propositions together. It occurs within and across sentences and paragraphs (Tomitch, 2003; 1996; Daneman & Carpenter, 1980). It requires cognitive resources as it does not always occur in an automatic

level. This is what differentiates a skilled from a less skilled reader and leads to the next level of the process, namely *summarization*. This "overall" or "macro structure" of the main ideas of a passage summarizes and contributes to inferences that are drawn from explicitly and implicitly stated assumptions resulting from connections among large amounts of information. Skilled readers draw on procedural knowledge to summarize a text by looking at topic sentence, words or phrases that signal a summary statement. These readers also rely on declarative knowledge, that is,on schemas for text structures of different types of text to form summaries and integrate text ideas in a macro level fashion, which contributes to a coherent mental model of the text and a better situation model construction (van Dijk & Kintsch, 1983; Kintsch & van Dijk, 1978). Finally, *elaboration* processes add to the coherent meaning representation achieved during integration and summarization by relating prior knowledge to it. According to Gagné et al., elaborations increase the probability of information to be remembered and used later on, as it connects new information to previous, acquired information, guaranteeing transfer of knowledge and allowing readers to go beyond the written text and also helping remembering the content of the text later.

Within the procedural knowledge proposed by Gagné et al., the last component process, *comprehension monitoring*, also seen as a high-level process within the frame (Tomitch, 2011), refers to metacognition, or the reader's awareness of his/her cognitive processes and the necessary effort to accomplish a goal. Depending on the reader's goal, it might be that the approach to a text either narrows down to a specific word, sentence, a specific piece of information, which is achieved via skimming, or it requires a broader view of the entire text, in which case scanning is more appropriate. Therefore, *selecting strategies, checking goal,* and *remediating* refer to the procedures under which the reader is going to accomplish a task and bring fix up measures in case the objective is not being accomplished.

Restating the main objective of this study, how do the component processes, namely inferential comprehension, more specifically criticizing and summarizing, and comprehension monitoring take place in cognitively demanding situations such as nonlinear hypertext reading?

## 2.5 WORKING MEMORY AND INFERENCE GENERATION – BASIC CONCEPTS

Inference is a process which guides any kind of interpretation in everyday life. From a plain conversation between two or more people, to trying to understand an accident scene, to reading, a great deal of information is inferred from what is not explicitly stated, be it in written or oral discourse. Vonk and Noordman (1990) define inferencing as a process in which the reader grasps more than what is explicitly expressed in a text and complement by saying that "the representation also contains information that is implied by the text: information that the writer supposes the reader will compute from the text and that the writer therefore leaves implicit" (p. 447).

According to Baretta, Tomitch, McNair, Lim, and Waldie (2009), drawing inferences in reading is a constructive cognitive process as the reader, in the search for meaning, goes beyond the text by formulating hypotheses and evaluating them against explicit text information. In line with this view, understanding a text requires that a reader activates and applies world knowledge in conjunction with strategies that are relevant to build inferences to construct a coherent mental representation of the information being read (Tomitch, 2009; Tomitch, 2003; Magliano, 1999; van Dijk & Kintsch, 1983; Kintsch & van Dijk, 1978). Inference generation in reading research has inspired various hypotheses and different models and categorizations have emerged in the last decades (DuBravac & Dalle, 2002; Linderholm & van den Broek, 2002; Van den Broek et al., 2001; Graesser, et al., 1995; Graesser & Kreuz, 1993). Investigations on kinds of inferences and measures have been used since about 1970 and a common challenge has been finding empirical measures to research the processes and the products of inferences (McKoon & Ratcliff, 1990). In this regard, Magliano and Graesser (1991, as cited in Magliano, 1999), proposed a combination of methodologies to account for inferences generated during and after reading is completed. The same way, Pressley and Afflerbach (1995) suggested that inferences may be drawn by the reader at any time during the process of reading. Therefore, measures that include verbal reports, post-reading tasks and other behavioral measures have been used in more recent studies in reading comprehension.

According to van den Broek (1990), successful reading depends on "the construction of a functional, coherent representation of the text in memory" (p. 423). It is necessary that the reader understands the individual events in the text as well as the relationship among those events, ideas and states described.

Vonk and Noordman (1990) defined text understanding as a "coherent representation of the information in a text" (p. 447). This

representation also refers to information that is implicitly stated by the author/writer and inferencing is conceptualized as the computation of this implicit information.

According to Magliano (1999, p. 55) much of the debate about inference generation has been about:

> (a) what inferences are necessary for achieving text coherence, (b) the extent to which readers generate inferences that are not necessary for achieving coherence, and more recently (c) what processes are involved in making inferences available to a reader. Although there has been much progress, the debates regarding these issues are far from resolved.

As for the classification of inferences, research with different purposes, in different contexts, with various text types have tried to categorize the cognitive processes that underlie the inference generation activity during reading.

Vonk and Noordman (1990) tried to find the middle course between two extreme views: one referring to all possible inferences allowed by the text and achieved by the reader and the other view of cognitive economy or minimal economy. The authors problematized the lack of consensus regarding the classification of inferences in psycholinguistics. They argued that splitting inferences as *necessary* and *unnecessary* for comprehension is problematic since comprehension is not a monolithic, but a graded concept. Therefore, Vonk and Noordman (1990) classified inferences from a text-analytic point of view, rather than from a psychological perspective. In this sense, the authors proposed that inferences are necessary *versus* possible. On one hand, they assert that "necessary inferences are necessarily true implications of sentences in the text." An example of necessary inference is a presupposition: *Paul is a linguist, but he knows math*. The general idea that linguists do not know math is implied in the two sentences. Inconsistency as a result of poor comprehension emerges from negating the inferences. On the other hand, Vonk and Noordman claim that possible inferences are "more or less likely to be true given the state of affairs in the world" (p. 449). This means that possible inferences "are probably true implications of the sentences", meaning that they need pragmatic knowledge from the reader in order to be generated (p. 450), eg.: *Jack is a bad driver. His car is all scratched.* The two sentences

together imply the cause and result relation that is grasped by the reader's world knowledge.

Keenan, Potts, Golding, and Jennings (1990), based on Just and Carpenter (1987), presented elaborative inferences (forward inferences that relate to what comes next in the text) contrasting them to bridging inferences (or backward inferences), which establish coherence between the present piece of information and the preceding text. An example of forward inference could be: *As you know me, I never leave without an umbrella. That day was not different.* The conclusion that I took an umbrella with me is implied in the first two sentences, what makes the inference of the last sentence an automatic implication. The following example illustrates backward inference: *the mixture was too thick. The spoon broke.* A backward inference established a connection between the mixture and the broken spoon.

Similarly, van den Broek (1990) proposed two directions for inference generation: backward and forward direction. In his process model of reading comprehension, the *causal inference maker*, a model especially related to narrative texts, van den Broek proposed that constraints direct the generation of inferences and these constraints can be of two types: conceptual and procedural. While conceptual knowledge refers to the relations a reader makes between events, procedural knowledge has to do with the limitations of the human processing system. The availability of information is dependent upon these limitations, and the causal inference maker divides the backward inference in three subtypes: connecting inferences, reinstatement, and elaborations. The occurrence of any of these types depends on the information in the text and the processing limitations of the reader. On the other hand, forward inferences are described as non-necessary for comprehension, but ones that can make processing of later events easier. In this respect, forward inferences can be classified in two types: expectations (specific or general) and anticipation.

Van den Broek, Risden, and Husebye-Hartmann (1995) proposed *standards of coherence* in models of reading in order to identify the circumstances in which global and local inferences are generated. The standards vary from individual to individual and also within an individual and by circumstances imposed by the task in experiments, among other aspects. Van Den Broek et al. (1995) concluded that "….readers do not make inferences simply because they are there to be made. Instead, they make backward and forward inferences in order to create a representation that is coherent *vis à vis* the standards of coherence that they employ" (p. 371). The reader's

experience, his/her active and high competence brought to the task of reading in order to meet those standards do play a role in a coherent understanding of text (Cho & Afflerbach, 2017).

In this sense, van den Broek, Rapp, and Kendeou (2005) propose a combination of memory-based with the constructionist processes to account for the reading variables imposed by the readers and the reading situations. According to this view, a memory-based process occurs quite autonomously, while a constructivist process is an active, coherence-building process. The reader will combine both processes to meet the standards he/she had established to accomplish certain goals, adjusting his/her inferential processes in a strategic manner (van den Broek et al., 2005).

As it can be realized, definitions and categorizations vary according to contexts of investigation. Therefore, the several aspects that influence inference generation are going to be discussed in the following subsection.

### 2.5.1 Inference generation – research on text type, reading goals, context, and language proficiency

As has been pointed out earlier in this section, research on inference generation has been quite substantial in the last 40 years. A work which is widely referred to in the field of discourse processing has been that of Trabasso and Magliano (1996a). By analyzing verbal protocols generated during reading of narrative texts, these researchers analyzed the types of information that become available to awareness during reading comprehension and the way this information is used to construct inferences of a text. Based on Trabasso and Suh's (1993; 1989) think-aloud protocols (whose analyses were restricted to inferences and memory operations that occur for each sentence), Trabasso and Magliano used a similar taxonomy to reanalyze relationships between the inferences generated and memory operations during the reading of an entire text. They considered three types of inferences: *explanations* as backward, *associations* as concurrent, and *predictions* as forward inferences (previously identified by Trabasso & Suh, 1993). They found that readers used explanations, associations, and predictions respectively and generated two other unexpected categories: metacomments and paraphrases.

In their study, Van den Broek, Lorch, Linderholm, and Gustafson (2001) included other aspects which they believe affect inference generation: task, WMC, and background knowledge.

However, they emphasized that the way the reader applies their skills and knowledge is dependent upon their goals and purposes. The authors examined the effects of readers' goals (study or entertainment) on inference generation and recall of expository texts. Van den Broek et al. (2001) kept the notion of standards of coherence meaning that when readers perform reading they try to keep certain levels of coherence which determine different inferential processes. These standards will determine the type of inferences that are generated online: "(e.g., reinstatements from prior text, background knowledge inferences, forward/predictive inferences, associations, etc.)…" (p. 1082). In their study, van den Broek et al. used the following eight categories of inferences or strategy processes to analyze think-aloud and free-recall reports: association, backward inference/explanation, predictive inference, paraphrase, evaluation, monitor comprehension, affective response, and text repetitions. According to the authors, these categories were adapted from studies by Trabasso and Magliano (1996) and Zwaan and Brown (1996). Within the scope of standards of coherence proposed by van den Broek et al., the results of their study suggested that readers engage in a combination of different standards depending on the purpose of the task. Due to that aspect, they generated different types of inferences, based on a more or less effortful standard determined by the costs and benefits of the task.

The relation between 'cost and benefit', in fact, was addressed by Vonk and Noordman's (1990) discussion based on 5 experiments. They proposed that some characteristics of the reader need to be considered if online measures are used. Two of those are the reader's knowledge and reading purpose control inferences in a balance between costs and benefits. This balance conforms with van den Broek et al.'s (2001) study, in which the benefit of a more relaxed standard of coherence in the entertainment condition resulted in a less coherent text representation, whereas under the study condition (more effortful task) readers showed a more coherent representation of the text (higher benefit).

In a more recent study, Linderholm and van den Broek (2002) using the same nine categories from the study by van den Broek et al. ( 2001), (to be further explained and detailed in subsection 2.5.4) extended their investigation in order to consider individual differences in different reading purposes. In this version, the researchers proposed that reading skill, as compared to WM measures, may be a factor in the types of inference generation under different reading purpose conditions. The authors' hypothesis was that, during the task of reading,

constraints imposed by the lack of cognitive resources available for keeping global information by less skilled readers, such as reading purpose, affect text representation and the types of inferences would vary between high-WMC and low-WMC readers. The revealing aspect in this study suggests that low-WMC readers adjust their strategies to accomplish the task in the study condition, engaging in a more text-based reading, and resorting to strategies that will result in achieving learning goals. Even though there are differences in the way low- and high-span readers perform cognitive processes and strategies during reading, both types of readers adapt cognitive processes and strategies to fit the reading purpose.

Similar results were found in Gerber and Tomitch's (2008) study with six (4 graduate and 2 undergraduate) students, in their L1 Portuguese, in the same two conditions: study and entertainment. The authors applied Narvez et al.'s (1999) Inference Categorization model and conducted the study with the use of pause protocols (see section 3.3, in Method, for more details on verbal protocols). The results corroborate previous studies (Linderholm & van den Broek, 2002; van den Broek et al, 2001, to mention a few). A greater number of inferences were generated in the study condition, in which case readers produced more explanations, evaluations and repetitions. The first two classes (explanations and evaluations) are generally considered in the literature as more effortful than repetitions, and, therefore, showing more commitment on the part of the reader (van den Broek et al., 2001). Regarding time spent in each condition, reading for study took almost double the time spent in the entertainment condition.

In summary, the standards of coherence model discussed above proposes that readers adjust their cognitive effort to the goal they want to achieve when reading (Vonk & Noordman, 1990). When reading to study, the reader may engage in a more text-based representation, generating more paraphrases and connecting inferences, employing effort to generate more benefits from the task: a better memory of the reading. Conversely, when reading for entertainment, the representation of the text will be more global, associating information from the text to one's own experiences, and making more evaluating comments and associations (Gerber & Tomitch, 2008; Linderholm & van den Broek, 2002; van den Broek et al., 2001; van den Broek et al.,1995).

### 2.5.2 Online and offline inference generation

Discussing the moment when inferences are drawn is as important as nominating the categories. The moments are defined by Graesser and Kreuz (1993) as online (during comprehension) and offline (during a task that refers to comprehension), while Vonk and Noordman (1990) use the terms activation measures (measures of what occurs during reading) and memory measures (measures of inferences at test time).

A possible interpretation from the studies of van den Broek et al. (2001) and Linderholm and van den Broek (2002), discussed in the previous section, in relation to the generation of inferences during think-aloud procedures are that readers adjust processing to achieve the reading purpose. When engaged in verbalizing the process of reading, it is possible that while low-WMC readers do not have available resources to produce meaning and at the same time to select what is appropriate to verbalize or not, high-spans are more able to keep the main objective: learning from reading instead of reporting everything that goes on in their mind.

Graesser and Kreuz (1993) point out that a proper methodology to measure inferences that are truly on-line includes, in fact, a set of methodologies. The authors show that referential inferences, those that refer to local relations within and across sentences, have received the most attention in the field. On the other hand, global inferences, such as author's intent and attitude, that require an interaction among the text, the reader's goals, and his/her world knowledge had been little investigated until that time (Pressley & Afflerbach, 1995; Graesser & Kreuz, 1993), and these more evaluative inferences still have been rarely investigated by means of online measures ( Procailo & Tomitch, 2017). Graesser and Kreuz's intent on tackling this issue refers to the usual debate whether these more global inferences are generated online or offline. In this regard, they propose a combination of methodologies including verbal protocols, which in a complementary manner with other measures, may provide insights into inference categorization.

Magliano and Graesser (1991, as cited in Magliano, 1999) also proposed a combination of methodologies to account for a sound approach in studying inference generation: " The three-pronged approach coordinates theories of discourse processing, verbal inference elicitation methods (e.g., thinking aloud and question answering), and online behavioral measures" (p. 56).

When taking these few studies into consideration, one can assume that when categorizing inferences and evaluating their importance on a more text-base or situation-model construction of a text one has to take

several aspects into consideration. So far, I have addressed a few of them, such as the reader's goals, text type, individual differences (WMC) and also the moment when the inference is measured: during reading (as an online process) or after reading (as a result of memory, or comprehension test).

Based on the research literature provided herein, other aspects such asL2 proficiency and mode of presentation of text may influence the type of inference that is generated as well. For the purpose of the present study, taking into account that its context of investigation is L2 reading, the next step is to discuss the influence of L2 proficiency on inference generation.

### 2.5.3 Inference generation in L2 contexts

For the purpose of the present study, the variable language proficiency in L2 English is controlled inasmuch the participants are students from the end of the fourth semester of an undergraduate course in English which will enable them to either become teachers, translators or interpreters.

The discussion concerning the fluency in L2 considers the possibility of language proficiency playing a role in the verbal reports as a concurrent verbalization taking into account that participants spoke in their L1 Portuguese during the experiment

With specific interest to the present research, investigation regarding inference generation in L2 reading contexts are scarce (Roscioli & Tomitch, 2014). The integrative aspect of the reading process in conceptions such as the combination of conceptual knowledge with procedural knowledge by Gagné et al. (1993); Kintsh and van Dijk's (1978) complex processes working in parallel with little effort of the cognitive system in a combination of levels (microstructure and macrostructure); and inferential comprehension that occurs within and across sentences and paragraphs as advocated by Tomitch (2003; 1996); and Daneman and Carpenter (1980) may be constrained by one or more variables. In summary, inferences may be restricted by reading ability, WMC, knowledge of the target language in L2, and, in the specific context, reading of hyperlinked texts.

Studies such as Alptekin and Erçetin's (2009), already presented in section 2.1, help us understand two complex phenomena involved in reading comprehension: WMC and literal and/or inferential comprehension. It was discussed by the authors that literal comprehension, WMC, and text-based processing are related to the L2

proficiency level. In this sense, inferential comprehension in L2 reading contexts has still to be thoroughly analyzed.

Research based on empirical data corroborates the assumption that WM and world knowledge do play a role in inference generation. However, skilled and less skilled comprehenders differ on the type of inference they make. Nevertheless, Zwaan and Brown (1999) claim that both factors, fluency[5] in L2 and comprehension skill, discussed as separate skills, still cannot contribute much to the understanding of language proficiency and comprehension skill acting together in the construction of a situation-model. Therefore, they bring a relevant discussion on these two factors that might influence the situation-model construction in narrative texts: fluency in the target language (L2) and the reader's comprehension skill in L1.

Zwaan and Brown proposed a study to verify how undergraduate readers draw inferences in narrative texts, both in the first language (English) and L2 (French). For this purpose, the researchers selected students who were sorted in two groups - skilled and less skilled readers - and had them read fables in both their L1 and L2. Based on two procedures: i) think-alouds, which were analyzed under the framework by Trabasso and Magliano (1996a) and is conceived of four types of thoughts that occur during think-aloud tasks (paraphrases, explanations and predictions, and metacomments); ii) and verb recognition list (to test long-term memory, text-base and situation model construction).

When analyzing the data, the authors could notice that skilled comprehenders integrated more information than less skilled ones. Consequently, skilled readers built stronger situation models in long-term memory than those who were less skilled. As L2 non-fluent readers are limited by their lack of efficient lexical and syntactic processes, their ability to integrate information across sentences and to arrive at a coherent situation model is affected. Readers in L1 generated more explanatory inferences, carried over and retrieved previous information from the text and built stronger situation models. Metacomments on comprehension problems were more present in L2. Thus, a certain level of L2 knowledge and skill is necessary for L2 inference generation and situation-model construction.

In order to analyze how inference generation in L2 comprehension varies between expository and narrative texts, DuBravac and Dalle (2002) used a procedure of question-generation with 47

[5]The term "fluency" as being used by Zwaan and Brown (1999) is not defined in their study. It was decided to keep their original term.

undergraduates enrolled in a French as an L2 course. The authors expected that readers would produce more linguistic related questions for expository texts than for narrative ones. On the other hand, they predicted that questions departing from narrative texts would rather tackle more inferential comprehension than literal comprehension. Moreover, expository texts would generate a few number of inference questions and more miscomprehension questions. DuBravac and Dalle used three question types by Pearson and Johnson (1978), namely, scripturally implicit, textually implicit, textually explicit, and created two more questions (linguistic-syntax/semantics- and miscomprehension). In the end, linguistic questions were not considered as they were inconsistent. Results showed that miscomprehension questions to narrative texts were fewer than to expository texts, confirming previous assumptions that narratives would be better comprehended. Overall, results corroborate the hypothesis that readers produce more scripturally implicit questions when reading narratives, which may mean that they have comprehended this genre better as more inferential comprehension questions were identified.

A recent study by Rai, Loschky, Harris, Peck, and Cook (2011) analyzed the effect of stress and WMC (as measured by Ospan), and inferential comprehension by L2 Spanish readers when reading narratives. The stress condition used a camera as an anxiety-provoking stimulus. In their results, WMC predicts overall accuracy and higher WMC showed attention control strategically trading reading speed for comprehension accuracy (processing efficiency *versus* processing effectiveness). On the contrary, low-WMC readers could only show the same behavior under the stressful condition and with less success. It corroborates the assumption that WMC interacts with L2 reading inferential complexity in stressful conditions and its effects are moderated by strategy use.

Roscioli and Tomitch (2014) investigated the influence of genre expectation on inference generation and reading comprehension in English as an FL in undergraduate students when reading expository and narrative texts. By means of pause protocols and reading comprehension questions, results show that participants' genre expectations did not significantly influence their inference generation. However, performance was better in reading comprehension of narrative texts, as measured by post-reading questions.

In summary, one question that arises from the whole discussion so far is why inference generation is important for reading comprehension. First of all, inference generation may reveal the degree

of involvement that the reader employs in the task, which largely depends on goals/questions that they have when approaching the text, text type and genre (Roscioli & Tomitch, 2014). Second, goals/questions are totally idiosyncratic and are regarded as deliberate processes (Graesser & Kreuz, 1993). According to Cho (2011) inferential reasoning is related to an important aspect of reading strategies use, which refers to deliberate effort to accomplish understanding of both explicit and implicit information conveyed in the text.

In the next subsection, I will present the framework by Linderholm and van den Broek (2002) that informed and guided the present research.

### 2.5.4 Inference generation – a framework of analysis

In order to pursue the main objective of the present study, which is to investigate the relations between WMC and types of inferences in two different conditions - reading linear and nonlinear hypertext with the purpose of criticizing or summarizing - I intend to apply Linderholm and van den Broek's (2002) inference generation model (Table 1). Their study replicates previous findings by van den Broek et al.'s (2001) study with the same model and other studies with empirical support to the assumptions that readers adjust their cognitive processes and strategies to accomplish their reading goals. Specifically, when reading for study, they engage in a more effortful task, reading slowly and resorting to strategies that would result in learning goals (repeating the text and paraphrasing). Whereas, when reading for entertainment, readers do it in a faster pace, engaging in cognitive processes that allow for more associations, elaborations, and formulation of opinions.

Reinstating van Dijk and Kintsch's (1983) definition, elaborations are those inferences that are generated when the reader employs his/her topic knowledge to complement details that are not mentioned in the text. In this sense, inferences that contribute to the integration between information in the text and the reader's prior knowledge are positive and help comprehension and retention. However, elaborative inferences can also point to an overreliance on prior knowledge in detriment of text information ending up in deficiency in recalling certain details of the text and may hinder text comprehension (Tomitch, 2003; 1995; van Dijk and Kintsch's, 1983).

While several studies tackle the constraints of the cognitive system in the inference generation process (Caldart, 2012; Narvaez et

al., 1999, Zwaan & Brown, 1999, to mention a few) , only a few of them have tackled the constraints of WMC in this process (Rai et al., 2011; Alptekin & Erçetin, 2009; Linderholm & van den Broek, 2002). With specific interest to the present study, Linderholm and van den Broek's (2002) study can contribute to the hypotheses that WMC can have an influence on the types of inferences generated during expository hypertext reading as this is a reading situation that demands attention control due to interference from various aspects: decision making when encountering a link, integration of information across links, verbalization of information and evaluation in order to express opinion, or global meaning construction with the purpose of summarizing. WMC as a constraint in demanding reading situations has raised solid empirical evidence (Bailer et al., 2013; Alptekin & Erçetin, 2009; Fontanini, 2007; Van den Noort et al., 2006; Torres, 2003; Tomitch, 2003; Daneman & Carpenter, 1980 ) and research has shown that low-WMC readers may not accomplish several complex tasks such as maintaining reading purpose while reading, adjusting strategies to fit the demands of the task, reporting the mental processes underlying the reading task and maintaining global coherence in order to accomplish the purpose. My study, as that of Linderholm and van den Broek's (2002), will rely on verbal reports generated during reading and this instrument may contribute for the inference generation study, as proposed by Graesser and Kreuz (1993). The authors advocate that the extent to which inferences are generated online or offline is an issue still amenable to analysis. In this regard, a combination of methods, including verbal protocols in a complementary manner may provide insights into inference generation categorizations.

The inference generation categorization detailed below presents 9 categories of cognitive processes elicited by readers in different reading situations, with expository texts in different reading purposes.

Table 1

*Reading strategy categories by Linderholm & van den Broek (2002)*

| Inference type | Description |
|---|---|
| Associations | Concepts invoked by the text that are not necessary for comprehension |
| Evaluative comments | Readers' opinions about the text |
| Connecting inferences | Connection of content of the current sentence with meaning form immediately preceding sentence. |
| Elaborative inferences | Content of the current sentence is explained taking into account the reader's background knowledge |
| Predictive inferences | Anticipation of what will come next in the text |
| Reinstatement inferences | Explanation for the current sentence is based on prior text information that is not in the immediately preceding sentence |
| Metacognitive comments | Reflections of the reader's understanding or lack of understanding of the text |
| Paraphrases | The reader changes the current sentences into his/her own words giving a gist meaning of the sentence |
| Text repetitions | Exact wordings of the current sentence |

Departing from the framework above, I intend to verify how these categories or processes apply to reading contexts in a challenging environment such as the hyperlinked text, with the purpose of reading for criticizing/giving opinion and reading for summarizing.

Considering the specific context of the present research which is the hyperlinked text in the reader's L2 English, other categories have emerged and are detailed in the Method section.

As previously discussed, strategies are defined by the reader according to his/her objectives for reading. Whether deliberate or

automatic, it depends on demands from the reader's purpose, the text, the task and the environment of reading. Moreover, all these features are mediated by individual cognitive differences. In the next subsection, I will provide discussions on strategy use, its definitions and relations to reading comprehension.

### 2.5.5 Reading strategy and comprehension monitoring

As discussed in the previous subsection, research on inference generation has shown that reading situations have a great influence on the outcome of different types of inferences that are generated (Linderholm & Van den Broek, 2002; Magliano et al., 1999; Narvaez et al., 1999; Lorch et al., 1995). A reader approaches a text with some specific goal in mind, for instance, to develop an activity (read a recipe to cook), to kill time while on the bus, to do a test, to find out about entertainment for the weekend, among several others. If we consider that reading comprehension is a search for meaning and the type of inference generated during reading depends on factors such as purpose, context and individual differences, we can assume that the way a goal search happens varies and is somehow influenced by the reader's strategies to accomplish his/her aims.

Strategy use in reading has been researched since the 1970's referring to cognitive aspects of information processing and definitions of what *strategies* really mean are controversial since they are usually used interchangeably with *skills* in reading comprehension (Afflerbach, Pearson, & Paris, 2008). To facilitate comprehension, I will first bring definitions of strategy as a deliberate act that the reader deploys to achieve comprehension in reading. Finally, a distinction between *strategy* and *skill* is deemed important in order to clarify misunderstandings between deliberate and automatic aspects of inference generation.

Paris, Lipson, and Wixson (1994) relate strategic behavior in reading to intentions, choices, and efforts. In their view, a strategic behavior means an intention, a purpose on the part of the reader which begins even before the moment she/he meets the text. It means that one alternative is chosen over other possible ones. Thus, a strategic behavior is defined by Paris et al. as: "To us, it seems that three ingredients are required: a capable agent, an attainable goal, and an allowable action that the agent can perform to reach the desirable end state" (p. 789). In the same perspective, Baker and Brown (2002/1984) assert that effective readers have some awareness and control of the cognitive processes

during reading and they monitor their progress according to the goals of the activity.

Based on what has been discussed so far, we can conclude that strategies are goal driven and goals vary across individuals, reading situations, and different settings. Since we consider that awareness and control of the cognitive activities in reading are at play, we can assume that reading involves metacognition. According to Baker and Brown (1984), metacognition involves two separate components: "1) an awareness of what skills, strategies, and resources are needed to perform a task effectively; and 2) the ability to use self-regulatory mechanisms to ensure the successful completion of the task…" (p. 22). These components presuppose checking, planning next move, revising and remediating.

The use of self-regulatory mechanisms in Gagné et al.'s (1993) model is also called *comprehension monitoring* and is part of the procedural knowledge (setting a goal, selecting strategies, checking goal, and remediating).

Gagné et al. assert that *setting a goal* and *selecting a strategy* are part of the initial step when a skilled reader approaches the text. A strategy is selected on the basis of the purpose to be achieved: for instance, read the whole text, skim for specific words, read parts of the text. As a follow up step, *goal checking* and *remediating* account for the needs to check one's goals against achievements during reading. In this perspective, breaks in the normal flow of reading due to word meaning, for example, can cause the remediating process to happen: for instance, going back to a word or expression with double meaning to fix inconsistencies.

When referring to reading, Lorch, Klusewitz, and Lorch (1995) state that strategies are involved in the ways readers process texts as a consequence of cognitive limitations such as working memory capacity. In this sense, reading adjustments to cope with different reading situations may happen without awareness.

However, the remedial procedure may as well be an automatized action in order to solve a problem. According to Afflerbach and Cho (2009), strategies are developed since the reader's initial use when allocation of attention is required. Practice leads to less attention until fluency is achieved and then strategies may become skills. In this sense, the more successful one becomes when using certain reading strategies, the less aware one is that he/she is using them.

As discussion proceeds, separate conceptualizations of each, strategy and skill, are deemed necessary. According to the *Longman*

*Dictionary of English Language and Culture*, strategy is: "2. A particular plan for gaining success in a particular activity" (p. 1312). Skill is defined as: "[A] special ability to do something well, especially as gained by learning and practice" (p. 1240). Attempts like dictionary definitions can help, but may not clarify the confusion made in the reading comprehension literature and do not help in the relation between the two terms.

In order to resolve the inconsistencies between the two terms, Afflerbach, Pearson, and Paris (2008) propose the following definitions for both, strategy and skill:

> Reading strategies are deliberate, goal-directed attempts to control and modify the reader's efforts to decode text, understand words, and construct meanings of text. Reading skills are automatic actions that result in decoding and comprehension with speed, efficiency, and fluency and usually occur without awareness of the components or control involved. (p. 368)

As we can see, the difference between being a deliberate or automatic act lies in the distinction between strategy and skill. This distinction is not always clear- cut since a reader can make use of any of the two, strategy or skill, at any time during reading. According to Afflerbach et al., it all depends on the challenges provided by each reading situation. Being a skilled reader does not guarantee that one is always going to perform the task in a skillful manner. When faced with difficult texts, even experienced readers may have to resort to deliberate, intentional and strategic search for meaning (Andrade, Gil, & Tomitch, 2012). In this sense, readers never stop using some kind of strategy.

At this point, as the nature of the present study calls for, distinctions between reading strategies and navigation strategies can be briefly discussed. Few studies have emphasized the differences in those processes that may account for differences in comprehension: the independent model proposed by Donald L. Leu and his colleagues and the mediation model by Johannes Naumann and his group (Salmerón & García, 2011). In one model, both processes are taken independently, that is, reading skills and navigation strategies act independently on comprehension (Leu et al., 2005). The opposing model, called mediation model, suggests that reading skills have a direct impact on comprehension by acting indirectly on navigation strategies (Naumann et al., 2008). In this sense, Salmerón and García explain that instruction

on reading skills and navigation strategies if taken as isomorphic constructs should be conducted independently when the development of young learners is considered. As previously advocated, it is still debatable to what extent one technology (written language) which is intertwined with another (the digital space) can account for an interplay between strategies in reading *versus* navigation strategies.

The difference between what different readers do to achieve comprehension is dependent upon several characteristics. Several studies have contributed to disclose readers' behavior and strategies. Using highlighting, underlining, rereading, and note-taking are some recurrent actions deployed by all types of readers, depending on the purpose.

Highlighting texts is the most used reading study strategy, according to Li, Tseng, and Chen (2016). However, most studies have focused on the use of paper and pen to read linear text. Studies focusing its use in reading and navigating on nonlinear hypertext are scarce. The authors emphasize that highlighting may aid and direct attention for reviewing and encoding. However, results of their study showed that highlighting hypertext placed cognitive overload on reading and navigation as combined with organizing the highlighted text.

Spending less or more time to read is a metacognitive strategy that readers utilize depending on the reading purpose and reading ability. Linderholm, Cong, and Zhao (2008) found out that low-WMC readers do possess conditional knowledge that different reading purposes require different types of cognitive processing. In their study, the results show that low-WMC readers spent more time reading for studying purposes than the high-WMC group. Even though reading time did not contribute to better scores in recall tests in their study, it suggests that those readers are aware that they should read differently under different reading purposes.

Less skilled readers may spend more time reading in order to be better prepared for a post-reading test, while skilled readers may use other means to improve comprehension: reviewing, highlighting, and moving between multiple texts (Freund, Kopak, & O'Brien, 2016). Spontaneous note-taking during reading and awareness of strategy use are also related to deeper-level and integrated comprehension in intertextual elaboration strategies while reading to construct argument in the study by Hagen, Braasch, and Bråten (2014).

Another aspect to be considered is that strategies are also deployed according to one's personal intentions when approaching a text. McCrudden, Magliano, and Schraw (2010) posit that personal

intentions direct the strategies enacted to meet reading goals, which affect processing of more or less relevant information to that goal, influencing memory. Even upon a given purpose, if a reader assigns relevance to certain text segments rather than to others, those segments that do not fit the reader's task perception may be considered less or non-relevant and learning does not take place.

In summary, metacognitive skills such as awareness and control are characteristics of a successful reading in various reading situations and vary for different readers. The automatic and/or non-automatic status of the process of reading is dependent on deferring factors, such as: stage of the reader's development (beginner or mature reader), individual differences, reading purpose, reading context and type of text or text mode.

Constraints for inference generation, such as individual differences and the context of reading, and the use of strategies to make up for cognitive limitations as well as to attain a specific goal have permeated the discussion so far. The extent to which these constructs may contribute to a better understanding of the reading process in new forms of reading such as the Internet and hypertexts reading are topics to be investigated. As one of the foci of this study touches the challenges provided by reading purpose, I shall next present definitions and conceptualizations on critical reading and summarization, and what is expected from the participants in the two reading conditions to be approached by this study.

## 2.6 CONCEPTS OF CRITICAL READING AND SUMMARIZATION

The discussion provided so far allows us to assume that different purposes for reading determine the steps a reader will follow, the means by which he/she will attain the pre-established goals. Self-monitoring the process of reading to achieve specific goals in demanding tasks is a characteristic of successful readers.

Bearing this in mind, and taking the context of the investigation proposed herein, reading to criticize and reading to summarize, it is essential to conceptualize what these two differing tasks demand from the reader.

Regarding the first reading purpose proposed in this research, reading to criticize, it is important to ponder that inferential comprehension is viewed as a high-level process within the framework proposed by Gagné et al. (1993) as it demands more from the cognitive process. Text-based and knowledge-based information must be

integrated in order to form the situation model of the text (van Dijk & Kintsch, 1983; Kintsch & van Dijk, 1978).

More recent conceptualizations of critical reading taking the cognitive perspective into account consider critical thinking to be crucial for developing a critical reader, as advocated by Douglas (2000), once his/her beliefs will influence how information is processed. Critical thinking and critical reading are regularly related to one another in the literature as the cognitive manipulation of information which demands a higher level of cognitive processes and are classified as elaborative or evaluative processes applied by the reader to analyze the ideas conveyed in a text against his/her own experiences (Sparks & Rapp, 2011; Gómez, 2010; Ghaith & Obeid, 2004, Tomitch, 2000) . Taglieber (2000) stresses that critical reading as well as critical thinking refer to reasoning about ideas, in reading, by interpreting information in the text against background knowledge. This view is complemented by Tomitch (2000) in the introduction to the same issue of *Ilha do Desterro* journal after a close evaluation of seven articles published in issue 38, (2000), entitled *Critical Reading*. Tomitch concluded that the two terms *critical thinking* and *critical reading* share similarities within the cognitive perspective that frame 5 articles in the issue, and that there is a common ground among them, revealed through prevailing concepts: "higher level thinking skills, discovering the deep meaning, inferring, asking questions, classifying, summarizing, synthesizing, problem-solving process, monitor comprehension, apply reasoning, plan, check, anticipate, compute relationships, bringing relevant knowledge into play" (p. 9). All these ideas permeate the studies and relate critical thinking to the act of reading critically.

Sternberg (1986) contends that an attitude is self-regulated by intents to reach pre-established goals, and these features vary among individuals and across reading situations. Higher-order comprehension requires interpretation, analysis and synthesis of information and requires the interpretive, critical and evaluative stance by active cognitive manipulation of information, which may also be external to the text itself (Sparks & Rapp, 2011).

In line with this perspective, Afflerbach, Cho, and Kim (2015) discuss the relation of higher-order thinking to the reader's capability to reason about the text. In this sense, for this deep-level processing to be accomplished, higher-order thinking is required and the reader must engage in complex inferences by combining text information with prior knowledge and by parsing a text into idea units. Afflerbach et al. (2015) state that "readers may engage in subsequent higher-order thinking, such

as that required to question an author's claim, applying what is learned from reading in problem solving, or synthesizing information from a group of texts" (p. 204). For this matter, the authors classify higher-order thinking in reading as goal-directed, responsive, and self-regulated.

Doubts still exist on whether critical reading/thinking can be taught at schools. Taglieber (2000) and Tomitch (2000) assert that they can and should be addressed in any school lesson and reading is an important skill to develop students' critical attitude to exert their citizenship, especially considering L2 contexts.

A more critical approach to reading instruction, in this sense, would take some important steps when discussing what to look at when looking at texts. When selecting a specific text genre, a reader has defined her/his purpose and the context in which it occurs. Therefore, some specific types of text genre may demand a specific approach to critical thinking. In expository texts, for instance, several aspects can be critically evaluated, such as authorship, voices represented in the text, credibility of informants and sources, argumentation, to mention a few. The extent to which the reader is going to look at all or some of those aspects depends on the reading purpose and the completion of the task. According to Sparks and Rapp (2011), evaluation and criticism may happen only after the readers judged the consistency of information in a global level and after they have both "a) comprehended that information and b) evaluated its consistency with the active contents of memory" (p. 243).

Therefore, another issue to be raised is the reader's background knowledge on the topic, as critical thinking is related to the reader's familiarity with the topic being discussed. Finally, the writer's selection of language is one aspect to be taken into account, according to a poststructuralist view, as awareness of language norms and uses at all levels point to an ideological sophistication through which power is exercised.

Teaching critical reading, then, comprises all these aspects and several other steps that can be addressed in classroom instruction, as discussed by Tomitch (2000):

> There is no doubt that in helping our students to become more active and more critical, leading them to analyze, to evaluate, to question, to compare, to construct and to discuss, to mention just a few of the possible actions required in

> active reading tasks, we may succeed in getting our readers to perform a more critical reading of the text and, thus, contribute to the formation of "discursively equipped" readers …" (p. 90).

Thorough evaluation of ideas may be a guided practice in classrooms by means of scaffolding argumentation (Lin, Horng, & Anderson, 2014). Lin et al. contend that students generally do not spontaneously apply their knowledge about argumentation while reading and the use of argument scaffolding contributes to a deeper level of text comprehension and knowledge integration.

In summary, L2 reading classes have a great array of issues to tackle considering the power relationship exerted across various cultures, realities, including the student's own socio-cultural context. In this respect, hypertexts allow for a more dynamic interaction among readers and texts and require a more critical stance, an active response, by selecting navigational paths across links, considering author (Fox & Alexander , 2009), interpreting, evaluating aspects and content of texts, purposes, which influence the best paths to achieve a goal (Afflerbach & Cho, 2009). In this regard, a balanced combination of both literal and inferential comprehension will best contribute to a situation model construction which best reflects the information in the text.

Regarding the second reading purpose of the present research, reading for summarizing, Tomitch (2012) discusses that summarizing is part of our day to day interaction with members of our family, friends, and is part of human nature. As advocated by the author, from reporting our day to a colleague, to discussing a movie with a family member, we tend to summarize for memory constraints reasons and because we need to keep the listener's attention our memory tends to retain only the gist of events. However, according to Tomitch, as everyday events are mostly represented in narrative forms, this is the type of summary which is considered easy. The same does not hold for expository texts, for they are not presented in such a straightforward internal text structure (Tomitch, 2012). Expository texts may vary the structure as they combine different types of argumentations, according to Tomitch, problem/solution, cause and effect, description, classification, definition, and others.

Again, drawing on Gagné et al.'s (1993) model, summarization as this "overall" or "macro structure" of the memory of the main ideas of a passage are inferences drawn from explicitly and implicitly stated ideas that result from connections among large amounts of information. Better

readers use procedural knowledge to summarize a text by looking at topic sentence, words or phrases that signal a summary statement. Skilled readers also rely on declarative knowledge, that is, on previous knowledge, or schemas, for text structures of different text types to summarize and integrate text ideas in a macro-level fashion, which contributes to a coherent mental model of the text and a better situation model construction (van Dijk & Kintsch, 1983; Kintsch & van Dijk, 1978).

For the matter of summarizing texts in general, the following "macrorules" proposed by Brown and Day (1983), as summarized by Tomitch (2012, pp. 79-80) are being considered in the present study: deletion of trivial information; deletion of redundant information; superordination of lists; superordination of actions; selection of a topic sentence; invention of a topic sentence.

To conclude, the two reading purposes to conduct this research were selected based on what undergraduate students mostly do in their academic reading practices. In my view, and based on previous studies, such as the ones by van den Broek, Lorch, Linderholm, and Gustafson (2001) and Linderholm and van den Broek (2002), by analogy with the two reading purposes in their studies (reading for study and reading for entertainment), reading to summarize and to criticize are two distinct reading modes that require different strategies and, thus, stimulate the generation of differing inferences. According to van den Broek et al. (2001), reading for study or preparing for an exam requires some kind of involvement with the internal structure of the text and reveals more paraphrasing and text repetition, more closely related to what is expected in reading to summarize in my study. Whereas reading to criticize may generate more evaluations and emotional involvement with ideas and connections to the reader's own experience, generating more associations and opinions about the text, which is the assumption in van den Broek et al's. (2001) and Linderholm and van den Broek's (2002) studies in the reading for entertainment condition.

## 2.7 SUMMARY

In short, this section presented and discussed recent research in the area of reading and working memory and related important findings from studies in L2 reading. A few working memory models were presented and the most widely used RST was also defined and explained. Reading as an effortful task places demands on the cognitive system and working memory with its limited capacity calls for a control

of attention when reading in more demanding situations such as the digital environment. Following the reasoning of text comprehension, local and global coherence and situation model construction are processes that explain the mental representations of text, which vary from reader to reader and also among reading situations. Literal and inferential comprehension draw on declarative and procedural knowledge and are important steps in comprehending texts. Adding to the traditional forms of printed text, digital linear text and nonlinear hypertext present challenges to the most widely discussed theories in reading comprehension and put forward new tendencies to research and practice suggesting that there is a great amount of issues left to be touched. In essence, automatic or deliberate employment of strategy use is dependent upon the reader's purpose and several other variables account for the way a text is approached. Finally, the two reading purposes addressed in the present study, namely criticize and summarize, are conceptualized.

# 3 METHOD

> Eu que agradeço pela oportunidade de participar de sua pesquisa. Foi incrível o modo com que fui tratado. Tudo aconteceu com muita ética e seriedade e isso me enche de orgulho e esperança. (A testimony from a participant)

In order to investigate how low- and high-WMC readers approach the texts with different reading purposes considering inference generation, reading time, and other strategic behavior when reading to criticize and to summarize in different text modes (digital linear and nonlinear hypertext), the present research was conducted in the following manner: data from 30 participants were collected during reading linear digital and nonlinear hypertexts to examine inference generation and other reading strategies by means of verbal report methodology, post-reading tasks, and other offline measures. In this chapter, the process of research procedures, participants, and instruments of data collection, and data analyses are detailed. In section 3*.1, Participants* are presented; in section 3*.2, Materials*' characteristics are provided; section *3.3* presents the *Instruments* and *Procedures for collecting data*; in section 3.4 *Procedures and criteria for organizing and analyzing data* are thoroughly discussed; and, finally, section 3.4 details the *Data analysis - variables and measures*.

## 3.1 PARTICIPANTS

To develop the study proposed hereby, 30participants from intermediate to advanced level of English (06 for the pilot study and 24 for the actual study) were selected. Their age ranged from 18 to 46 years old, with an average of 23.33 years old (SD= 7.23) . Participants were all undergraduate students of English language, at least in the end of the 4$^{th}$ semester of the *Letras* course, an undergraduate English language course at Universidade Federal de Santa Catarina (UFSC). These students are considered proficient speakers and readers in English as at this stage they are about to complete 50% of the course that lasts 8 semesters. As at the 4$^{th}$ semester they have studied linguistics and literature in English and have written essays and papers in English as a requirement in most subjects, it was expected that the linguistic level in

the stimulus texts would not interfere in the reading comprehension process.

### 3.1.1 Ethics review board

Participants of the present research were first introduced to the study in class upon the allowance of the professor responsible for the class subject. After the researcher presented the general objectives of the study and the procedures, students were invited to participate and those interested in more details informed their e-mail address and phone number. After that, participants were individually informed by e-mail about details in the procedures and received the Consent Form. Participation was voluntary and there was not any financial compensation. As part of academic requirement, participants received 4 hours of course credits (ACCs)[6] for taking part in the experiment.

Participants of both, pilot and actual study, were required to read, fill in and sign a document which is denominated *Termo de Consentimento Livre e Esclarecido* (TCLE), or Consent Form (Appendix A) in two pages, written in the participants' mother tongue Portuguese. The TCLE was sent at least 24 hours prior to the data collection session when it was discussed, doubts resolved and signed.

The proposal, along with its accompanying documents and forms, was approved by the institutional ethics committee (CEPSH-UFSC-CAAE: 54319416.0.0000.0121, Parecer: 1.487.656) prior to data collection.

A Statement of Consent (Declaração de Anuência) (Appendix B) was also sent to the head of the course's department to be read and signed.

### 3.1.2 Participants' profile

An analysis of the demographic questionnaire (Appendix C) allowed the inference of some patterns related to reading habits. Overall,

[6]ACCs (Atividades Acadêmico-científico-culturais) are course credits required by federal regulation, ***Resolução CNE/CP2/2002 – MEC,*** **which states that at least 240 hours of the whole curriculum should be devoted to extra-curricular activities, that is, cultural, scientific, and academic activities, such as research, teaching practice, and extension courses.**
**Retrieved Jan 28, 2016 from.:** http://lle.cce.ufsc.br/docs/ACC.pdf

most of the selected participants have the habit of reading in their L1 Portuguese and in L2 English. Responses regarding reading practice revealed that 14 out of 24 participants (89.16%) read in L1 and L2 on an everyday basis for academic purposes and for entertainment purposes (12 in L1 and 10 in L2). In relation to reading practice in virtual environment for academic purposes 10 participants (41.66%) informed to do it on an everyday basis and 12 (50%) do it occasionally. However, more participants reported to practice reading on virtual environment everyday for entertainment (18 participants – 75%). Eighteen out 24 participants (75%) reported to prefer to read printed texts in academic reading in contrast to 7 (20.16%) who prefer academic reading in virtual environments (except for one participant in this group who reported to read in both text modes). Digital texts are preferred for entertainment purposes for 17 participants (70.83%) and most (91.66%) reported to have 7 points or more of experience reading digital texts in a 1-10 Likert-scale (6 with 7 points, 11 with 8 points, 2 with 9 points, and 3 with 10 points).

These features allow us to interpret the participants' profile in this specific study as readers who routinely read digital texts, but select to print them if more careful reading such as reading articles, book chapters and other reading for academic purposes, which is more cognitively demanding, is required (van den Broek et al., 2001).

## 3.2 MATERIALS

### 3.2.1 The stimulus texts

Two expository texts in L2 English in digital format, one linear and one hyperlinked, with controversial issues were used to collect data (AppendixI).The texts were presented in a computer screen, font size 12, following Darroch, Goodman, Brewster, and Gray's, (2005) suggestions that font sizes should range from 8 to 12 points so that readability is maximized for most users.

The stimulus texts are expository texts that were taken from different sections in the website https://www.procon.org/ which is intended to promote debate on controversial topics. The website describes itself as "Promoting critical thinking, education, and informed citizenship by presenting controversial issues in a straightforward, nonpartisan, and primarily pro-con format".

Both texts were manipulated by this researcher in order to control for similarity in the format, linguistic structure, and balance between

number of argumentations - 4 pro and 4 con the topic under discussion - as arguments recall are the central objective of the post-reading tasks. Therefore, the initial part and the first three paragraphs were taken from the main text provided in the website. The arguments are real opinions given by readers and were taken from two different subsections within the section "Top Pro & Con Quotes" related to the discussion about the topic. In these subsections, specialists from various institutions and the general public are given voices. The manipulation regarding the choice of opinions, the order they appear in the texts were intended to promote an even debate.

For the purpose of the present study, the texts were organized as follows: i) a thematic title; ii) an introduction to the topic; iii) summary of arguments *for* and *against* the proposed issue; iv) a subheading named *Public opinion*; v) a subheading named *Specialized opinion*; and vi) a brief concluding paragraph.

Both texts have similar rhetorical structures, as already mentioned, with arguments pro and con in similar numbers. Text 1, *entitled Should Animals Be Used for Scientific or Commercial Testing?* has four arguments in favor of using animals for testing, and four arguments against it. It is composed of 662 words (including the subheadings, but not the title) and the subheading named *Public Opinion* comes first, followed by the subheading *Specialized Opinion*. The original text can be viewed at https://animal-testing.procon.org/. Text 2, entitled *Are Social Networking Sites Good for Our Society?* has four arguments in favor of social networking and four arguments against it. It is composed of 661 words. The original text on social networking is available at https://socialnetworking.procon.org/.

In order to avoid confounding variables related to differences between texts, the subject matter of both texts were chosen for being of general knowledge and possible interest to the target participants. At first, the topics of the texts were not considered variables as they do not approach specific discussions that require domain knowledge and seem to debate contemporary issues. Even so, a question tackling topic interest was included in the self-evaluation questionnaire and it could be analyzed as being a variable in case results pointed in this direction. Besides, both texts were entered into Coh-Metrix set at the informational genre to determine the number of sentences and the readability. Coh-Matrix is an online program (http://cohmetrix.com/) that analyzes cohesion and coherence metrics for both written and spoken texts and it provides the Flesch-Kincaid grade level (Graesser, McNamara, Louwerse, & Cai, 2004) (Table 2). The difficulty level of

both texts (Flesch Reading Ease) falls within the limits of 30-50, which is considered difficult (Lira & Amaral, 2012).

Table 2
*Cohesion and coherence metrics for the stimulus texts*

| | **Number of sentences** | **Flesch-Kincaid Level** | **Flesch Reading Ease** |
|---|---|---|---|
| Text 1 | 32 | 13.71 | 34.171 |
| Text 2 | 30 | 14.01 | 34.137 |

According to previous research, experimental texts should be difficult enough so as to tax working memory capacity differences and prevent automatic processing, making readers monitor comprehension and strategy use (Just & Carpenter, 1992). The Flesch-Kincaid Level index refers to the number of school years, being 13-16 correspondent to the last year of high-school or the first three semesters of an undergraduate course (Lira & Amaral, 2012), in conformity with the participants' profile.

Regarding the rhetorical structures of the texts, the subsections *Public Opinion* and *Specialized Opinion* in the two texts have both pro and con arguments and readers were instructed to focus their attention on the voices of argumentation (to be further explained in the subsection 3.4.3). Therefore, the order of *Specialized Opinion* and *Public Opinion* are in reverse orders in the two texts, to counterbalance order effect. As the general objective of this research is to verify how readers would position themselves in face of controversial issues with specific purposes, either to criticize or to summarize, it was somehow expected that evaluations of various aspects that underlie arguments in controversial issues could emerge. It was as well expected that readers focused on specialized opinions as the arguments in this subsection are better supported by specialists and institutions. Specifically in the condition *reading to criticize/give opinion* it was expected that the reader would position him/herself in both tasks, online, during the verbal report generating inferences that suggest a critical stance, and offline, in the post-reading task reading to criticize/give opinion by resorting to opinions that are more elaborated to support their own. It was expected that by giving proper attention to certain aspects during reading, encoding would happen so as to guarantee that information goes to LTM and may be retrieved by later measures. The above expectation was drawn based on Daneman and Carpenter's (1980) assumption that information that enters WM may have come from

different sources- perceptually encoded from the text; sufficiently activated to be retrieved from LTM; and may have been the result of a comprehension process - storage and processing compete for WM resources and that explains individual differences in reading comprehension.

As both texts have the same number of arguments (eight in total), differences across conditions regarding characteristics of texts are not expected to interfere due to the similarity of rhetorical structures between them. Therefore, the order of texts was not reversed across conditions, as this procedure could interfere in the number of participants per condition. Text 1 is entitled *Should animals be used for scientific or commercial testing?* And text 2 is entitled *Are social networking sites good for our society?* in all 04 conditions. Providing that in the second text participants could feel more tired, it was decided to leave the text about social networking sites for last as it seems to be more popular among youngsters and more likely to arise interest from them.

Since the stimulus texts are in L2, the definition of three words in each text was provided in pop-up link format in both text modes (linear and nonlinear hypertext). The words were chosen considering that they are important for understanding the main idea of the sentence and, besides, participants in the pilot study helped to define on the relevance or not of providing those definitions.

Regarding the layout of the page in which each text was presented, it was decided not to include any information that could be extraneous to the texts, such as pop-up windows, banners, pictures, as in an authentic Internet environment, in order to avoid uncontrolled variables and ensure that attention is devoted to reading. Even so, a minimum of pop-up notifications did occur during data collection, as the computer should be connected to the open Internet to access the hypertexts, which were hosted on a site, and to be able to use the screen capture software (free version available to be used online only) .

As the study aimed at analyzing the readers' strategy during reading, participants had the options to highlight or underline words during reading, by clicking on buttons N and S respectively, abbreviations from Portuguese *Negritar* and *Sublinhar* to avoid cognitive demands related to processing. As note-taking is also part of metacognitive activities, participants had the option to either take notes in the computer, in which case a note-taking table was provided in a column on the right margin of the text (Figure 1) (Freund, Kopak, & O'Brien, 2016) or use a paper sheet and pen to write down anything

they found relevant. As post-reading tasks intended to measure recall of arguments which is a task that heavily relies on memory, notes could not be used during post-reading tasks and participants were warned about this restriction. The individual web page had a scrollbar to facilitate navigation within the page.

### 3.2.2 Nonlinear hypertext format

The nonlinear hypertexts used in the present study resemble most texts available on websites, in which one can navigate back and forth without having a complete account of the entire text, as in most hypertext models used in research in the area (DeStefano & LeFreve, 2007; Fontanini, 2007; Dee Lucas & Larkin, 1995). The instrument is hosted in the website GitHub ( https://github.com/davi-ao/linear-hypertext-instrument ) and can be tested by clicking on *Clone or Download* option, selecting the *Download Zip*. After downloading the zip file it should be unzipped and the *Index* option should be selected using Google Chrome.

The model of hypertext adopted is closer in design to one of the models used in Klois, Segers, & Verhoeven's (2013) study. It is a text without overview, maps or any other structure. It needs to be connected to the World Wide Web to be accessed, resembling an online Internet text, but which is bound to an electronic system. In this sense, the hypertext version in the present study can be compared to Internet reading to a certain degree due to its limitations regarding availability of texts and amount of hyperlinked information.

The only navigational method used was the contextual embedded linking within document in order to avoid any interference associated with different navigational options, such as menus, maps, and lists. The arrow button (←) at the upper left corner of the screen allowed the participant to go back to the primary text after reading a node. No links to open Internet or to other documents outside the primary texts were present in order to control for access to information outside the stimulus texts and the consequent interference of uncontrolled variables (Antonenko, 2007).

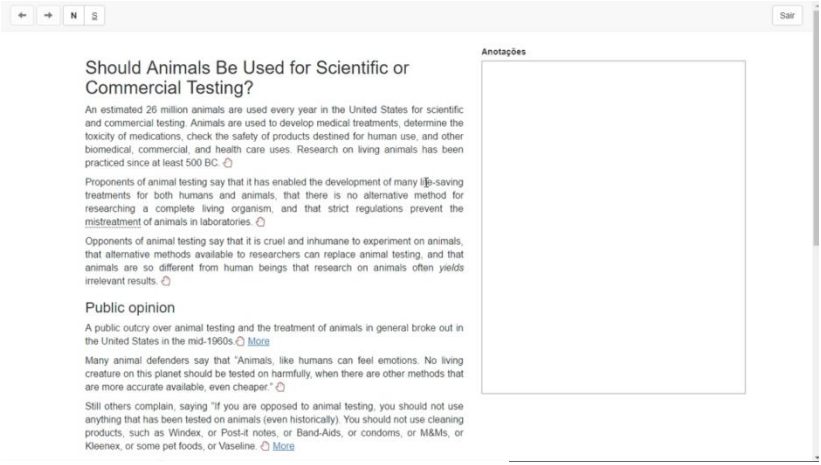


*Figure 1*.Screenshot of the hypertext environment

The hypertext version of both texts has the same number of words as the linear version. Initially, idea units were split so as to have the main arguments in the primary text (four) and in the nodes (four) in both texts, eight in total. However, the pilot study showed that those readers that did not access all the links would not read all arguments. In this sense, it could undermine the analysis of the product in favor of the process of reading, influencing the results of recall in the post-reading tasks. As the present study focuses on both process and product, the hypertext versions were changed to contain the main arguments in the primary text and only supporting details embedded in nodes (7 in total).

The hyperlinked information was accessed by clicking on the expression more, highlighted in blue and underlined. Some minor vocabulary doubts were not expected to disrupt fluent reading. Even so, three word definitions for each text (as detailed in the linear format above) were provided: two in the primary text and one in a node. Word definitions could be read by passing the mouse arrow on the dotted underlined word, in which case a pop-up window would open (e.g.: stalkers).

As regards the number of links in each text, based on the literature, it was predicted that when links are embedded in text, the number is detrimental to a focused reading and sustained attention. Therefore, the more links the reader encounters, the more cognitive resources are required to make decision on whether to follow them or not (Hahnel, Goldhammer, Naumann, & Kröhne, 2016; DeStefano & LeFreve, 2007). Taking this aspect into account, links are limited to seven supporting details in each text.

The link-node hyperlinked text preserves the sequence of the linear text and the transitional signals that relate the ideas, conforming with Charney's (1994) assumptions that adequate connections facilitate reading and diminishes disorientation. Still, in order to minimize disorientation problems (Conklin, 1987) the readers in the present experiment did not have the option to navigate across nodes. They could only choose a link to follow, read the related node, check another link and go back to the primary text. Links embedded in nodes are limited to one supporting detail in each text.(See Figure 2):

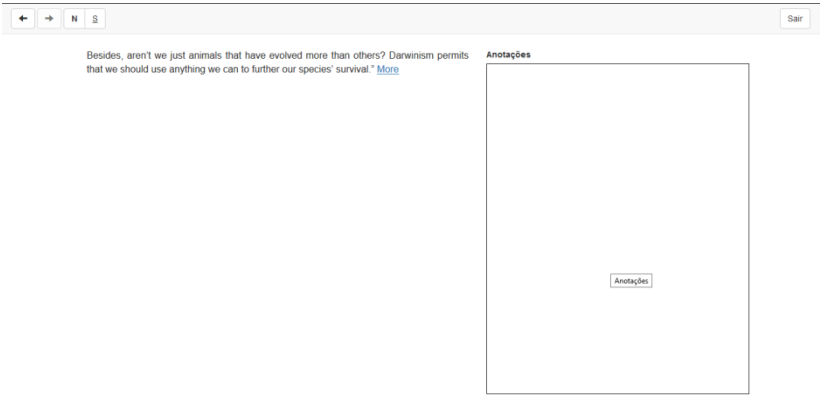


*Figure 2*. Screenshot of the hypertext with and embedded link

Regarding web usability, following Nielsen (2000), a few aspects were considered, such as color of links changed when visited from light blue into dark blue. As the reading environment resembles the link-node model adopted in real web pages, the stimulus texts and the navigation occurred online. Therefore, to ensure ecological validity, an 800-milliseconddelay was provided between a click and the transaction to the node or back to the primary text.

### 3.2.3 Linear format

The linear format of the texts keeps all information in one single electronic page displayed in a straightforward manner without the linking structures. That is, information that is in nodes in the nonlinear hypertext mode becomes part of the single page text.

## 3.3 – INSTRUMENTS AND PROCEDURES FOR COLLECTING DATA

The instruments for collecting data included online measures to assess strategic processing or task performance generated during reading via verbal reports and other types of behavior concerning the reader's actions (note-taking, underlining, rereading, link access). Offline measures refer to the post-reading tasks and self-evaluation

questionnaire, which are executed after the reading *per se* (Hagen et al. , 2014). Other instruments are the RST and the demographic questionnaire (Table 3).

Table 3
*An overview of the steps in the multi-method procedure and the expected data from each instrument*

| **Instruments** | **Description of the collected data** |
|---|---|
| RST | Working memory measures |
| Demographic questionnaire | Profile of participants (digital and print texts reading habits in L1 and L2); reading practice for academic purposes and for entertainment in L1 and L2; reading preferences (digital or print texts); participants perception of reading pace and concentration in digital and print texts; link access and general reading strategies in both digital and print texts |
| Verbal reporting (online) | Revealing of the reader's perception of the text, reactions to its ideas and other reading processes |
| Screen recording (online) | Time spent in reading each text; dynamics involved in the digital environment, clicks on hyperlinks, scroll bar use, rereading, marking, copying and pasting, note taking |
| Post-reading tasks(offline) | Memory of arguments for and against each topic<br>Effect of instruction |
| Self-evaluation questionnaire (offline) | Self-perception of the strategies used and reading behavior<br>Self-reflections on the entire process<br>Awareness of the process<br>Interest in the topics |

Data collection happened in individual sessions. As the purpose of the present study is to focus on process and product of reading in English as an L2 and not on the performance in the target language, all instruments' instructions and tasks are in Portuguese.

Most participants, 16 out of 30, including those from the pilot study, were familiar to this researcher as they took one semester in a subject in the undergraduate course which was 20% administered by myself as a requirement from the post-graduate program. With the other 14 participants, the contact was developed in the following steps (Table 4):

Table 4
*Summary of steps to select volunteer participants (table adapted from Cho (2011)*

| **Group-screening** | **Participant-screening** | **Setting up section** |
|---|---|---|
| - Contacting a pre-selected number of professors to set a date for introducing the study to the target group.<br><br>- Personal contact with the groups upon professor's allowance to briefly present the study and procedures.<br><br>- Collecting e-mail addresses of potential (volunteer) participants. | - Individual contact via e-mail to give enough details about the study.<br><br>- Sending the Consent Form. | - Upon acceptance, participants received a chronogram to be filled in with availability.<br><br>-Setting up experimental session. |

The individual sessions were conducted by this researcher in a room at the Federal University of Santa Catarina, equipped with a laptop computer and a software to capture on-screen activity, and a cell phone with a voice recorder application. Other materials such as instructions, questionnaires and tasks were provided in print format.

### 3.3.1 RST- The Reading Span Test

The first experimental procedure was the RST in Portuguese (devised by Tomitch, 1995/2003) and all participants received training with six sentences, devised by this researcher (Appendix E). Even though participants are proficient in English, the use of the RST in L1 Portuguese is backed up by previous research such as the one by Linck,

Osthus , Koeth, and Bunting (2013). Torres (2003) also indicated that the RST in L1 can be positively correlated to reading comprehension in L1 as well as in L2. Once the span test measures both processing and storage, it is positively correlated with L2 knowledge and may affect storage of information, influencing the final score of the span test. In order to avoid L2 interference, it was decided to use the RST in Portuguese.

The RST (Appendix F) is composed of 60 unrelated sentences ranging from 13 to 17 words, divided in 5 sections, each section containing three trials, as follows: i) first section: three trials of two sentences; ii) second section: three trials of three sentences; iii) third section: three trials of four sentences; iv) fourth section: three trials of five sentences; v) fifth section: three trials of six sentences. All final words are nouns and they do not repeat throughout the entire test.

Sentences were presented in a Power Point format, 36 point black Calibri font, centered, halfway down the computer screen, in white background. Participants were instructed to read each sentence aloud to insure processing, as proposed by Daneman and Carpenter (1980) and to memorize the last word of each sentence. In order to avoid idiosyncratic strategies and to ensure criterion validity, it was experimenter-administered, that is, soon after the participant pronounced the last word of the sentence, the researcher moved to the next sentence (Friedman & Myiake, 2004). At the end of each trial of three sentences, a pencil icon appeared on the screen signaling the recall should begin. Soon after that, the participant wrote down as many words as he/she could remember, in the same order they were presented.

The memory span was calculated based on procedures used by Linderholm and van den Broek (2002), and also in the study by Friedman and Miyake (2005), Friedman and Miyake (2004), and is considered a lenient measure of score. The two studies by Friedman and Miyake (2005; 2004) highlight the total number of words recalled method. Especially in the 2005 study, in which 4 scoring methods were compared, Friedman and Miyake found that the total number of words recalled and the proportion words per set methods presented a more normal distribution, higher reliability and higher correlations with reading comprehension. The words were scored 01 point if recalled in the correct order and maintained the same genre and number (masculine/feminine and plural/singular). If a word appeared in a different order and singular was used instead of the original word plural in the sentence, 0,5 point was scored. The scores ranged from 24,5 to 51.

After the RST, the participant received the demographic questionnaire (detailed below). While completing the questionnaire, it was possible to score each participant's memory test. Since it was necessary to have groups with a balanced memory span for a better comparison between groups, depending on the memory test score the participant was assigned to a different condition: different text mode or reading purpose task.

### 3.3.2 Demographic questionnaire

In order to triangulate results, the demographic questionnaire (Appendix C) was the second instrument to be handed out, in printed format, and it was designed with the intent to collect data on the readers' reading habits, their experience with reading hypertext and printed or linear texts, their age, as these variables may interfere in the results. Depending on the answer to question 10 (*What strategies do you use when you read printed or digital texts?*), each participant was encouraged to choose the most suitable instrument to take notes, paper sheet or the computer, to ensure a minimum of ecological validity.

### 3.3.3 Verbal report – conceptualization

Knowing what goes on in people's mind and the way they think has been of great interest for centuries, since Aristoteles and Plato. As a means for scientific investigations in psychology, philosophy and several other areas, verbal reporting has been aiding researchers to gather data through observations on how individuals may differ or not in the way they solve problems or perform tasks (Gass & Mackey, 2000).

Despite the extensive use of verbal protocols in several areas such as behavioral studies in psychology, thinking processes in problem-solving strategies, second language learning, logical reasoning, or clinically to analyze phobia or anxiety (Luque & O'Hora, 2016) and several others, this methodology was only recently recognized by the cognitive psychology as a mature instrument to infer processing in a given task. The work of Ericsson and Simon (1980, 1993), with the help of standardized procedures and a consistent theoretical framework, have made the protocol analysis a sound method to help researchers since the 90's.

Verbal protocols to assess the cognitive processes of reading have been used as a means to infer both the process and the product of reading (Pressley & Afflerbach, 1995). In reading, it refers to the

process of self-observation and verbalization that a reader performs in relation to the cognitive activity of comprehension (Souza & Rodrigues, 2008, Tomitch, 2007**).** According to Afflerbach (2000), verbal reports generated by expert readers have helped inform classroom practice and can be incorporated to the teaching of strategies, skills and other knowledge that less proficient readers need in order to become better readers. An additional aspect derived from verbal reports and protocol analysis is that they have influenced what to teach, how to teach and may provide readers with the opportunity to become better readers by being acquainted with their own learning process, an important aspect in the teaching of English as an L2.

As a mature methodology for investigating the reading process, verbal protocols provide data to be inferred by the researcher (Tomitch, 2007; Tomitch, 2003; Torres, 2003) and their credibility is the result of a researcher's ability to identify and anticipate strong and weak points and develop research so as to reflect this knowledge (Afflerbach, 2000; Pressley & Afflerbach, 1995). **S**ome of these methodological concerns include: the distinction between *concurrent* and *retrospective* reports and the triangulation of data.

According to Ericsson and Simon (1980, as cited in Tomitch, 2007), 'concurrent verbalization' is performed during the task of reading in which the report occurs almost at the same time as the reading task and can be related to any thought that occurs as reading proceeds (Souza, 2004). According to Tomitch (2007), the concurrent report may be the best way to access the content of the reader's mind during the course of reading, meaning that the process is available to the researcher's interpretation.

In this respect, it is similar to what Cavalcanti (1987, 1989) called 'pause protocol', in which the reader stops at any point during the reading process when there is some type of pause or disruption of the fluent reading. These procedures have been used by other researchers, including Gerber and Tomitch (2008), Tomitch (2003), and Tomitch (1995).

As any instrument for collecting data, verbal protocols should be systematized in order to avoid generalizations and other specific characteristics related to the experimental context. Some of these aspects refer to participant's age, their skills (in the specific study, L2 skills), the context in which the data are collected (lab, classroom, among others) (Samuels & Kamil, 2002). Adding to that, Pressley and Afflerbach (1995) highlight that thinking is not always coherent across individuals. Therefore, one should not expect to gather coherent reports, an aspect

that is peculiar to oral language. It is the researcher's role to infer from the data. The authors add, based on Ericsson and Simon (1984/1993), that explanations and interpretations about the process are not as convincing on the part of the reader as interpretations of the product are, whose role belongs to the researchers. Especially concerning the complex overlapping of differing contexts and situations involving the reading task, Afflerbach (2000) stresses out some variables to be accounted for: "interactions of readers, tasks, texts, and intervening variables" (p. 170).As aforementioned, triangulation of data can complement verbal reports so as to support and validate the results.

Once readers are required to stop and verbalize at any point during reading, specifically in the present study, to criticize, give opinion or comment on the controversial issues being presented, the reading process is not automatized to the extent that it does not require the reader to monitor. According to Presssley and Afflerbach (1995), automatic processes are not reported as they occur very quickly and may not be available to conscious control. Therefore, some kind of challenge should be present in order to slow the processing down. Specifically in the present study, participants were instructed to pay attention to the issuers of opinions in the text, since the topics are controversial.

Retrospective recall is another type of verbal report (Tomitch, 2007, based on Ericsson and Simon, 1980) which refers to the readers' perception of their process of the task that was completed.

In this study, since the reader was also supposed to give a report at the end of a paragraph, it also involves the so called 'retrospective verbalization' similar to Tomitch's (2003) and Cavalcanti's (1987, 1989) studies. According to Ericsson (2006), when concurrent report is not present, the validity of retrospective verbalizations remain very high when the reports occur in a short period of time after the reading task is completed, that is, less than 5 to 10 seconds.

In the present study, both concurrent and retrospective reports were applied. Participants were instructed to verbalize in Portuguese [7]any thought that came to their minds during reading. It could be related to any aspect of the task: vocabulary, ideas in the text, text structure, difficulty related to the task. It was avoided to give too many

[7] Even though participants are fluent speakers of English, they were asked to speak in Portuguese as it was expected that they spontaneously reported their opinions, thoughts at any time without monitoring themselves, since their L1 is Portuguese.

instructions in order not to influence the reader's behavior. Even so, after reading the paragraph, the participant should stop and report the paragraph and any aspect of the process. To remind the reader that he/she had to stop, the following symbol ✋ was present at the end of each paragraph. If the researcher noticed that the participant forgot to report a paragraph, he/she was reminded to do so. Further explanations were given only if during the training the participant required more clarifications. According to what will be further discussed, some participants needed to be reminded to stop in order to report.

#### 3.3.3.1 The reading sessions

As the act of verbalizing thoughts may not be a usual procedure for each reader, each participant received a training session prior to engaging in the experimental task with a shorter, but similar text. The training session was supposed to familiarize participants both with the hypertext condition, its tools, and the concurrent and pause protocols procedures (Appendix G). The training text is composed of 05 paragraphs (380 words) with 05 hyperlinks. As soon as the participant felt at ease with the procedure, he/she would signal that was ready to begin the experiment. Soon after that, the participant received the written instructions about the reading task, its purpose and a description of the text mode (hyperlinked or linear). During the experiment, all instructions were given in printed format to ensure a standardized approach with all participants (Appendices J, L, N, and P). After reading the instructions, if doubts remained, the researcher explained orally what the procedures should be, emphasizing that there would not be any interference on the part of the researcher, and that the reader should pretend he/she was alone in the room. The researcher remained in the room in order to take notes of specific behavioral characteristics that could occur during reading, such as comfort of the participant, tiredness, and to remind the participant to speak in case he/she had forgotten to do so. Participants were instructed to read the title aloud to signal that reading began. The texts should be read silently and comments and thoughts should be verbalized.

There was not a time limit for doing the reading and the subsequent task. Participants were told that they could take as much time as they needed to finish it, and that it should be as close to their own pace during natural reading as possible, especially because the study aims at investigating strategies related to the different text modes. As WMC may be an important variable in the time spent in reading

hypertexts, idiosyncratic characteristics should be more apparent in a context which is as close to a naturalistic environment as it could be.

Soon after finishing reading a text, the participant could have some water or chocolate (provided by this researcher) and proceeded with the reading tasks.

The verbal reports were audio recorded in mp3 format with the help of an application downloaded to a cell phone, resulting in a very high-quality audio. The texts were presented in a portable computer, equipped with a software to provide an adequate hypertextual environment and to collect behavioral data. A software named *oCam* (v294.0) was used to record the screen of the computer which would help in the verification of the procedures participants utilized during reading: underlining, highlighting, copying and pasting, scrolling up/down to check for intra-textual relations, clicking on the links, going back to the primary text, and rereading (as noticed by the use of mouse arrow and scrolling up/down).

### 3.3.4 Post-reading tasks

The following table (5) summarizes the main ideas in each paragraph that were expected to be considered in the post-reading tasks: summarize and criticize/give opinion. The verbal reports were categorized based on the gist of the original text.

In the post-reading summarize condition, it was expected that participants should be able to construct a text in which only the main ideas of the debate and most of or all the 8 arguments from both the Public Opinion and the Specialized Opinion subsections were recalled. In the post-reading criticize/give opinion condition, the total number of arguments recalled were scored.

Table 5

*Summary of main idea per paragraph and arguments in Text 1 and Text 2*

| Text 1: **Should animals be used for scientific or commercial testing?** | |
|---|---|
| **Main text** | **Summary** |
| An estimated 26 million animals are used every year in the United States for scientific and commercial testing. Animals are used to develop medical treatments, determine the toxicity of medications, check the safety of products destined for human use, and other biomedical, commercial, and health care uses. Research on living animals has been practiced since at least 500 BC. | *- Number of animals being used in laboratories;*<br>*- The purpose of using animals in testing;*<br>*- How long is has been practiced.* |
| Proponents of animal testing say that it has enabled the development of many life-saving treatments for both humans and animals, that there is no alternative method for researching a complete living organism, and that strict regulations prevent the mistreatment of animals in laboratories. | *Pro:*<br>*- Animal testing has saved many lives of humans and animals;*<br>*- There are not other methods;*<br>*- Strict regulations prevent animals from suffering.* |
| Opponents of animal testing say that it is cruel and inhumane to experiment on animals, that alternative methods available to researchers can replace animal testing, and that animals are so different from human beings that research on animals often yields irrelevant results. | *Con:*<br>*- It is cruel and there other methods;*<br>*- animals are different from humans so the results are irrelevant.* |

*To be continued...*

*...continued*

| Main text | Summary |
|---|---|
| **Public opinion** | |
| A public outcry over animal testing and the treatment of animals in general broke out in the United States in the mid-1960s. A farmer's pet Dalmation that was kidnapped and sold into experimentation is believed to have been the initial catalyst for the rise in anti-testing sentiment. | *- It is believed that it all started when a farmer kidnapped a Dalmatian and sold for experimentation in the mid-1960s.* |
| Many animal defenders say that "Animals, like humans can feel emotions. No living creature on this planet should be tested on harmfully, when there are other methods that are more accurate available, even cheaper." | *Con:*<br>*- Animals have feelings;*<br>*- There are better and cheaper methods* |
| Still others complain, saying "If you are opposed to animal testing, you should not use anything that has been tested on animals (even historically). You should not use cleaning products, such as Windex, or Post-it notes, or Band-Aids, or condoms, or M&Ms, or Kleenex, or some pet foods, or Vaseline. You cannot complain about the process while enjoying the benefits." | *Pro:*<br>*- Those that oppose to animal testing should not use the products that were tested in animals.* |

*To be continued...*

*...continued*

| **Main text** | ***Summary*** |
|---|---|
| Others say that “Animals were put here for a reason. In my opinion, I think that we should use more species of animals to be tested. They are lower on the food chain for a reason. Besides, aren't we just animals that have evolved more than others? Darwinism permits that we should use anything we can to further our species' survival. We need to cut our morals out of the equation and think about the actual future of the human race." | *Pro:*<br>*- Animals are lower in the food chain so they should serve our purposes.* |
| On the opposite side, Clay defends that animal testing is crueler than eating the animals. The animals that are being butchered aren't suffering everyday. Their pain is short and the death is swift. In Animal Testing, they are tortured everyday and become deformed." | *Con:*<br>*- It is a cruel action: animals are tortured.* |
| **Specialized opinion** | |
| Dario L. Ringach, PhD, MSc, Professor of Neurobiology and Psychology at the UCLA stated that “The contributions of animal research to medical science and human health are undeniable... When the majority of scientists see the work as scientifically justified, and so do the many professional medical and scientific organizations, the expert views cannot be simply dismissed based on wild claims of ulterior motives, self-interest and conspiracy theories.” | *Pro:*<br>*- Animal testing is OK if scientifically justified.* |
| *...continued* | *To be continued….* |

| Main text | *Summary* |
|---|---|
| Neurologist Aysha Akhtar, MD, MPH, says that "Failures of animal experiments have led to human harm. Moreover, misleading animal experiments may have caused the abandonment of effective drugs and cures." One can't help wonder: how many people would have been saved if we used more effective human-based testing methods?" | *Con:*<br>*- Science may have lost the chance to find cure, due to misleading animal testing.*<br>*- Human-based testing methods are more effective.* |
| In Defense of Animals (IDA), an international animal rights and rescue organization, stated that "Cutting-edge technology has forged new frontiers with the use of lasers, fiber optics, microchips, genomics, computer-based drug design, and digital imaging, to name a few... These methods have contributed to a technological revolution in biomedical research and rendered the reliance on animals outdated." | *Con:*<br>*- Technology may help in more updated testing methods.* |
| On the other hand, the Foundation for Biomedical Research (FBR) stated that "From the discovery of antibiotics, analgesics, anti-depressants, and anesthetics, to the successful development of organ transplants, bypass surgery, heart catheterization, and joint replacement, practically every present-day protocol for the prevention, control, and cure of | *Pro:*<br>*- A lot of what has been done to prevent, control and cure diseases was attained because animal testing was conducted.* |

*To be continued...*

| Main text | Summary |
|---|---|
| disease is based on knowledge attained through research with laboratory animals." | |
| While scrutinizing on pros and cons of animal testing, benefits and costs should be considered in either case. | *Both pros and cons should be considered when using animal testing.* |

Text 2: **Are social networking sites good for our society?**

| Main text | Summary |
|---|---|
| 74% of American adults online use social networking sites such as Facebook, Instagram, Twitter, LinkedIn, and Pinterest, as of Jan. 2014, up from 26% in 2008. On social media sites like these, users may develop biographical profiles, communicate with friends and strangers, do research, and share thoughts, photos, music, links, and more. | - *Statistics, types of social networking sites and what they serve.* |
| Proponents of social networking sites say that the online communities promote increased interaction with friends and family; offer teachers, librarians, and students valuable access to educational support and materials; facilitate social and political change; and disseminate useful information rapidly. | *Pro:*<br>- *Social networking sites (SNS) promote interaction and help teachers, students, librarians, facilitate changes and spread information.* |

*To be continued...*

*...continued*

| Main text | Summary |
|---|---|
| Opponents of social networking say that the sites prevent face-to-face communication; waste time on frivolous activity; alter children's brains and behavior making them more prone to ADHD; expose users to predators like pedophiles and burglars; and spread false and potentially dangerous information. | *Con:*<br>*- It is a waste of time, prevent people from meeting and causes changes in children's brain and behavior;*<br>*- Expose people to criminals and spread negative information.* |
| **Specialized opinion** | |
| Companies worldwide struggle to balance employee social network access at work for business purposes. Sophos, a company that develops and sells computer security programs, stated that "Although productivity continues to be the dominant reason for companies to block social networks (a third of companies say this is the reason they block Facebook), there has been a dramatic rise since April 2009 in the number of businesses who believe malware *[malicious software]* is their primary security concern with such sites." | *Con:*<br>*- companies try to balance employee access to the SNS not to affect productivity;*<br>*- Security is reported to be the major concern of companies to block these sites.* |
| The National School Boards Association (NSBA) stated the following: "Almost 60 percent of students who use social networking talk about education topics online and, surprisingly, more than 50 percent talk specifically about schoolwork...With words, music, | *Pro:*<br>*- The SNS have helped students create and express themselves.* |

*To be continued...*

*...continued*

| Main text | Summary |
|---|---|
| Still regarding the youngsters, Brendesha M. Tynes, PhD, Assistant Professor of Educational Psychology at the University of Illinois affirms *that "*Online social networking can facilitate identity exploration, provide social cognitive skills such as perspective taking, and fulfill the need for social support, intimacy, and autonomy. As teens prepare to enter the adult social world, online social environments provide training wheels, allowing young people to practice interaction with others in the safety of their homes." | *Pro:*<br>*- The SNS help teens explore identity and serves as practice in the safety of home.* |
| **Public opinion** | |
| As for regular people who use social networking everyday Raul says "Thanks to Facebook you can talk with your family and your friends who are far. It is very useful because it remembers the birthdays of everybody. On Facebook you can play many games with your friends and you can share information and pictures. You can also meet new people. Facebook is dangerous only for people who aren't careful and who tell their life story." | *Pro:*<br>*- Facebook connects people: friends and family.* |
| Judy reflects on relationships and believes the following: "I believe that social networking sites aren't good for our society because they don't help us communicate socially in person. The sites may | *Con:*<br>*- The SNS prevent people from socializing, they do not help make friends.* |

*To be continued...*

*...continued*

| Main text | Summary |
|---|---|
| give you a wider social circle, but are you truly friends with them or know them at least?" | |
| Security is also under risk, according to Joan: "Criminals use social media to follow people and get there information about their whereabouts also to promote their crimes. Offline crime, like robberies, may result from posting personal information such as vacation plans, or stalkers gaining information." | *Con:*<br>*- Life exposure in the Internet facilitates crime.* |
| To close the heated debate, Daniel concludes that "The internet provides an equal work space for people of all kinds all over the world. With so much to present, there is new competition which will offer more products, consequently more job opportunities, more choices to users." | *Pro:*<br>*-The Internet is a space of equality: more products results in more job opportunities, more options.* |
| Proponents of social media cheer on the benefits and possible advances to society, while dissenters worry the dangers and wasted time far outweigh any benefit. Whether it is good or bad, it is up to everyone to define their personal involvement in networking. | *- With advantages and disadvantages being presented, each individual should define the limits.* |

In short, the post-reading criticize/give opinion task comprised 5 questions:

1. List the 4 arguments in favor of using animals for testing (Text 1)
2. List the 4 arguments in favor of the social networking sites (Text 2)
3. List the 4 arguments contrary to using animals for testing (Text 1)

4. List the 4 arguments contrary to the social networking sites (Text 2)
5. Which arguments do you agree with? Why?
6. What criteria did you use to choose the argument(s) to base your own?
7. Did you consider the issuer of the opinions in which to base your own??

The post-reading summarize task required the participant to write a summary of 200-250 words of the text just read.

### 3.3.5 Behavioral measures

An expert in software, Davi Alves Oliveira, who got his master's degree in Linguistics, developed a tool to serve as a virtual environment for the texts and collected data generated by time spent during reading. Besides, the screen recording device aided in analyzing the readers path through the process. These behavioral data were used to compare processes and products of reading of each participant which will be quantitative and qualitatively discussed in the following chapter.

### 3.3.6 Self-evaluation questionnaire

After all tasks were accomplished, the readers were required to report on their behavior and difficulties regarding the process by answering a questionnaire. Based on previous research, those aspects were sorted in 5 questions that comprised the following themes: performance in either text mode, concentration difficulty, use of links, need to reread, topic interest (Clinton & van den Broek, 2012; Waniek, 2012; Potelle & Rouet, 2003; Macedo-Rouet et al., 2003) (Appendix R). After all data were collected, the 5 items were summarized and organized under the following themes: *i) reading performance awareness; ii) awareness of behavior; iii) concentration difficulty; iv) need to reread*; and *v) topic interest*. The questionnaire was handed out in printed format for most participants. Regarding time constraints, very few of them were asked to fill in the report at home and send them back to this researcher through e-mail (in at least 24 hours after the section, to avoid forgetting about the actual performance and procedures). This approach was only done when the researcher felt that the participant was apparently tired or if the time the participant had allocated for the

experiment was about to reach the limit. Participants generally could take part in the sessions during an interval of 2h between their classes.

### 3.3.7 Design

A between subjects and within subjects design was used. The between subject factor was WMC. Between and within subject factors are: text mode, reading purpose, post-reading recall, use of tools, strategies and time.

The following table (6) summarizes the design of the study and the distribution of participants across conditions (henceforth, participants will be referred to as P1, for Participant 1, P2, for Participant 2, and so forth):

Table 6
*Summary of design and distribution of participants across conditions*

| **Participants** | | | | **Reading and post-reading task: Text 1** | **Reading and post-reading task: Text 2** |
|---|---|---|---|---|---|
| 1 | 5 | 11 | 17 | Hypertext- criticize<br>Task: criticize | Linear- Summarize<br>Task: summarize |
| 20 | 22 | | | | |
| 2 | 6 | 9 | 12 | Linear- criticize<br>Task: criticize | Hypertext-Summarize<br>Task: summarize |
| 15 | 16 | | | | |
| 3 | 7 | 10 | 13 | Hypertext-summarize<br>Task: summarize | Linear- criticize<br>Task: criticize |
| 18 | 24 | | | | |
| 4 | 8 | 15 | 14 | Linear-summarize<br>Task: summarize | Hypertext-criticize<br>Task: criticize |
| 21 | 23 | | | | |

In summary, there were two reading themes, animal testing and social networking sites, two text modes, and two interface conditions: Text 1 in digital linear format to criticize/give opinion, Text 1 in digital linear format to summarize; Text 2 in digital linear format to criticize/give opinion, Text 2 in digital linear format to summarize; Text 1 in digital nonlinear format to criticize/give opinion, Text 1 in digital nonlinear format to summarize; Text 2 in digital nonlinear format to criticize/give opinion, Text 2 in digital nonlinear format to summarize. The 2 x 2 x 2 (two WMC groups reading for two different purposes in two different text modes) design resulted in four experimental groups of six participants per group.

As briefly explained in section 3.*3, Instruments and procedures for collecting data, th*e RST score was calculated before assigning participants to conditions, and distribution across reading purpose and text mode was controlled in order to keep a balanced number of participants per condition.

### 3.3.8 Time

Even though there was not a time limit previously allotted for the whole experiment, on average, participants took 1h and 30min to conclude the experimental session, including the RST, the demographic questionnaire, the reading sessions, the post-reading tasks, and the self-evaluation questionnaire. The same way, even though reading time was not controlled, it was measured by examining the screen shots and the amount of time the participant remained silent, moved or not the mouse arrow to indicate where and when reading or rereading was taking place.

### 3.3.9 The pilot study

Verbal protocols should be systematized so as to avoid the researcher's interference, as they should be as close to a natural process as possible (Samuels & Kamil, 2002). Taking this aspect into account (Souza & Rodrigues, 2008; Tomitch, 2007; Samuels & Kamil, 2002; Kamil, Mosenthal, Pearson & Ban, 2000; Gass & Mackey,2000;Pressley & Afflerbach, 1995; Scaramucci, 1995; Ericsson & Simon (1984/1993, as cited in Pressley & Afflerbach, 1995), and to refine the instrument and avoid wasting material (Bailer, Tomitch & D'Ely, 2011) I

conducted a pilot-study during May and June, 2016, with 6 students from the same group that most participants belonged to (7th semester).

During the pilot study[8], it was decided to try a more ecological approach and avoid the interference of the researcher. In this respect, some participants were left alone in the room while reading the texts. Due to the fact that some participants either forgot to report some paragraphs or ended up speaking too low or even rereading the whole text, it was decided that the researcher should remain in the room in order to monitor the experiment and still maintain a minimum of interference.

Another important observation that arose from the pilot-study analysis is the position of the links in the hypertext format. As some arguments were previously hidden in links, those participants that did not access some links would not recall information from them. As both post reading tasks measure the number of arguments recalled, it was hypothesized that the process would hinder the product and the results could not be directly correlated to WMC.

Instruction to the post-reading task in the criticize/give opinion condition was as well adapted to directly instruct participants to focus in the issuer of each argument, with the inclusion of the following statement: "*Pay attention to the issuers of opinions in the text*." Once instructions to consider the issuer of arguments were absent in the pilot-study version, other demands of the task were interpreted to have contributed for the lack of attention to such an aspect and may have impaired the encoding of information in the course of reading.

Analysis of the self-evaluation questionnaire also demonstrated the need to include a confirming question to question number four: 4.*What criteria did you use to choose the arguments to base your own?; 5. Did you consider the issuer to base your own opinion?* This change has helped in collecting data to support qualitative analysis of the effect of instructions in the reading tasks.

A final contribution from the pilot-study emerged from the participants' suggestions to include some more options in the demographic questionnaire. They include the frequency of reading practice (casual reading for entertainment and for academic purposes). The pilot-study also helped determine the usefulness of the glossary to be included in pop-up links.

[8]The Project was not sent to the Ethics Committee after the pilot study as changes were mainly made to the structure of the hypertext and the structure of questions and did not involve changes to the main objective of the study.

## 3.4 PROCEDURES AND CRITERIA FOR ORGANIZING AND ANALYZING DATA

### 3.4.1 Verbal protocols- data transcription

Verbal utterances of all participants in both conditions were detailedly transcribed by inserting the *oCam* video clips into a transcription software named InqScribe (https://www.inqscribe.com/) (see Figure 3), and complemented by audio mp3 files captured by the application on the cell phone, when necessary.

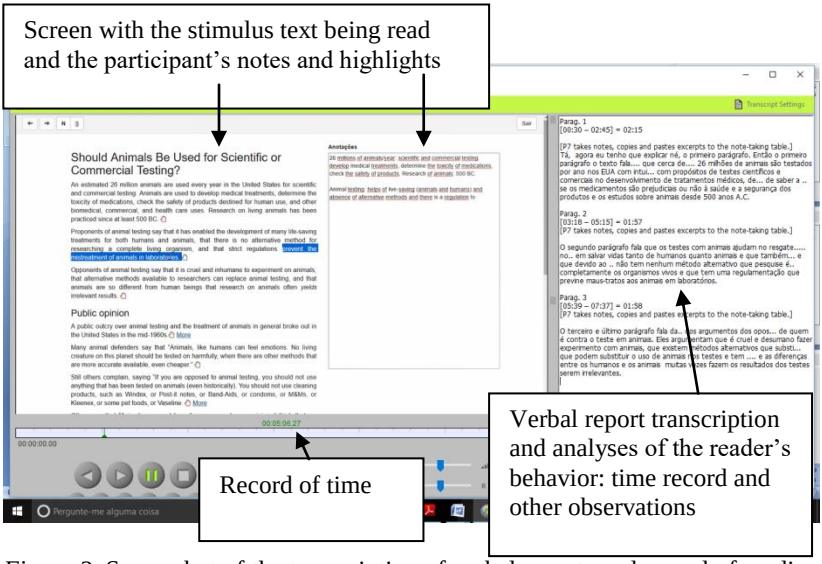


*Figure 3*. Screenshot of the transcription of verbal reports and record of reading behavior

During transcriptions of verbal reports, I considered every pause in the speech and the short pauses (up to 2s) are represented by two dots and longer pauses (3s or more) are represented by three or more dots. If longer pauses were identified so as to characterize rereading, annotations in brackets are provided (e.g.: *P1 seems to be rereading excerpt*). Single periods are considered end of idea units or sentences. When rereading was noticed, it was added to the total reading time. When rereading happened after they started reporting at the end of the

paragraph, even though it was signaled, time of rereading was not added to the total reading time.

While transcribing verbal reports, time spent in each paragraph was recorded taking into account the reader's navigation in the screen, the mouse movement, the silence, and the scroll bar movement, when it applied. Every strategy used on the screen such as note-taking, copying/pasting, underlining, clicking on hyperlinks, going back to primary text, was registered in observation notes in brackets. When participants used annotations in paper sheet, observations were added to their reports.

Transcriptions were, then, transferred to a doc file in order to be analyzed and categorized. Annotations on participant's behavior where organized into a summary table.

### 3.4.2 Inference categories ratings

Two independent raters who were blind to the conditions (rater 1, a teacher of English who got his master's in reading and was a graduate student at the Programa de Pós-Graduação em Inglês (PPGI) at the time, a post-graduate program at UFSC; and rater 3, an English teacher at PUC-PR who got her master's in reading assessment at UFPR, plus this researcher (rater 2) categorized the verbal reports according to the inference category framework by Linderholm and van den Broek (2002). Raters were invited by email and got written instructions(Appendix U). Training was conducted on the reports from the pilot-study and discrepancies were resolved through discussion. 58% of the reports were categorized by at least two raters as demonstrated in Table 7. Then all reports were categorized by this researcher. Inter-rater reliability is 89% between rater 1 and rater 2, and 90% between rater 2 and rater 3.

Table 7
*Demonstration of sampling for rating categories*

| Participants | Rater 1 | Rater 2 | Rater 3 |
|---|---|---|---|
| P1 | X | X | |
| P2 | X | X | |
| P3 | X | X | |
| P4 | X | X | |
| P5 | X | X | |
| P6 | X | X | |
| P7 | | X | X |
| P8 | | X | X |
| P9 | | X | X |
| P10 | | X | X |
| P11 | | X | |
| P12 | | X | |
| P13 | X | X | X |
| P14 | X | X | |
| P15 | X | X | |
| P16 | | X | |
| P17 | | X | |
| P18 | | X | |
| P19 | | X | |
| P20 | | X | |
| P21 | | X | |
| P22 | | X | |
| P23 | | X | |
| P24 | | X | X |

For clarification, examples from the actual study will follow each category definition (Tables 8, 9, and 10):

Table 8

*Definitions and examples of inferences and cognitive processes as identified in the present study*

| Inference category | Examples |
|---|---|
| ***Associations:*** are concepts invoked by the text that are not necessary for comprehension: | P6: *Eu não sei. Isso me vem à cabeça os japoneses... que tem lá os seus problemas sociais e que tem a doença lá que eles simplesmente não saem de casa. Isso já virou.... tem um nome pra isso, eles não saem de casa pra socializar com ninguém.*<br><br>P17*: E meu deus, agora eu comecei a lembrar de um vídeo que eu vi sobre produção de leite..... De leite ..... de vaca. E é a coisa mais cruel que eu já vi na minha vida.(...).* |
| ***Evaluative comments:*** reader's opinions about the text. | P1: *Ok. ....a opinião pública... é bem mais irracional.*<br>P20: *Acho que os dois, tanto os oponentes, os que se opõem como os que são a favor eles têm razão.* |
| ***Connecting inferences:*** *c*onnection of content of the current sentence with meaning form immediately preceding sentence. | This category was not identified in the data. |
| ***Elaborative inferences****:* content of the current sentence is explained taking into account the reader's background knowledge. | P8: *Quantas pessoas... não morreram porque o teste no animal não foi bem sucedido, foi.... sei lá, desviado?*<br>P18*: A Internet pros estudantes ela proporciona um meio em que tu tem vontade de... de interagir de mostrar o que você tá produzindo num lugar.* |
| ***Predictive inferences***: anticipation of what will come next in the text. | P1*: Eu espero que eles falem quais são.*<br><br>P13:*Então .... vou ver o que ... os que são contra vão ... vão dizer.* |

| | |
|---|---|
| **R*einstatement inferences*:** explanation for the current sentence is based on prior text information that is not in the immediately preceding sentence. | P12: *O segundo parágrafo é mais complementar e.. complementar ao primeiro...*<br><br>P15*: E como nós tivemos um parágrafo que diz as coisas boas (no outro nós temos um que diz coisas ruins....)* |
| ***Metacognitive comments*:** reflections of the reader's understanding or lack of understanding of the text. | P9: *Ãh, ah... é que eu tive um pouco de dificuldade no começo pra entender. Eu li rapidão assim e não vi quem tinha falado isso. Daí encontrei "opponents of animal testing".*<br>P4: *Huuummm eu acho que eu precisaria de uma explicação um pouco mais específica sobre esse negócio de ... ãh...* |
| ***Paraphrases*:** the reader changes the current sentences into his/her own words giving a gist meaning of the sentence. | P3: *... pesquisas na área científica, comerciais, lidando com animais, ou seja, levanta-se alguns tópicos a respeito do uso de animais pra desenvolver tratamentos na área de medicina, onde eles têm o papel de serem os objetos de testes pra checar se é seguro um medicamento específico, se é tóxico ou não, basicamente pra serem as cobaias dos medicamentos que são criados.*<br>P11*: ...o envolvimento nas redes sociais fica a critério de cada pessoa e ..... as pessoas podem usar e elas podem usar também conscientemente as redes sociais sem abusos ou ... algum tipo de ..... não de exagero mas ...que elas saibam balancear os dois pontos: entre vida pessoal e vida nas redes sociais.* |
| ***Text repetitions*:** exact wordings of the current sentence. As the stimulus texts were in L2 English and the verbal report was done in L1 Portuguese, literal translations of the | P2: *O Daniel .....acha que a internet pode providenciar o.... um espaço igualitário de trabalho pras pessoas de todos os tipos por todo o mundo que... e que agora com tanta coisa pra apresentar pode ter uma nova competição e pode oferecer mais produtos, mais oportunidades de trabalho.* |

| | |
|---|---|
| paragraph or excerpts were considered text repetitions. | P7*: No segundo parágrafo o... um dos principais argumentos dos defensores .. dos defensores de animais é que os animais tem sentimentos como os humanos. E que nenhum animal deveria estar sujeito a estes testes tão dolorosos, principalmente que há métodos que são mais eficazes, precisos e até baratos.* |

Two other categories were identified and added to the framework: *summarizations* (main idea of the paragraph) and *misunderstandings*. One aspect differed summarizations from *paraphrases*: number of words compared to the original paragraph. Paraphrases could be longer with changes in words, keeping the gist of the original sentence or paragraph. Summarizations were much shorter in length, preserving the main idea of the sentence or paragraph. Differing from Linderholm and van den Broek's study, this distinction was deemed important for the present study once verbal reports were required to be uttered at any time during reading, but also after paragraphs. A characteristic that may enhance the generation of summaries after a paragraph is read.

Table 9

*Definition and examples of new inferences and cognitive processes as identified in the present study*

| **Inference category** | **Examples** |
|---|---|
| ***Summarization:*** | P8*: É sobre esse último aqui, tipo se tu é contra os testes em animais e.... só que não vai poder usar o que já foi testado em animais.* (parag. 06)<br><br>P15*: No parágrafo seguinte, ele ... ele diz que ..... esse tipo .. tipo de rede social costuma criar uma grande relação com... entre amigos e .. família que ... enfim... ele fala algumas das... das qualidades e do que realmente é útil nesse tipo de rede social.* (parag. 08) |

The other category that was created is *misunderstandings* (miscomprehension of main idea). Besides the fact that reading in L2 may be more demanding for some readers, verbal reports were done in the participant's L1 Portuguese. The translation process may lead to some misunderstanding.

Table 10
*Definition and examples of new inferences and cognitive processes as identified in the present study*

| **Inference category** | **Examples** |
|---|---|
| ***Misunderstanding:*** | P21*: Ah, então já no começo fala que em 1960 teve um sequestro de cachorros e... começou, por causa do sequestro de cachorros, então, pôxa, ... tá, é um sequestro, mas que já deve ter acontecido bem antes dos Dálmatas, com tantos outros animais assim.... Ãh... outras coisas talvez tenham sido bem piores do que o sequestro de um.... um cachorro assim e provavelmente muitos outros eram vendidos, então .. bom... se foi a público .... talvez isso* .(parag. 04)<br><br>P24*: Aqui... de janeiro de 2014 pulou pra 26% em 2008. 2008? De 2014 pra 2008? . Oh… OK*.(parag. 01) |

Misunderstandings where classified by Linderholm and van den Broek together with metacognitive comments when readers reported to be aware of such an occurrence. However, in the present study misunderstandings regarding mistranslations were not identified by participants. When awareness was identified, such comments were classified as *metacognitive comments*.

Linderholm and van den Broek (2002) call inferences categories such as connecting inferences, elaborative inferences, predictive inferences and reinstatement inferences. All other processes, such as evaluative comments, associations, paraphrases, text repetitions, and metacognitive comments are referred to as reading strategies or processes. In the present study, all terms will be referred to as inferences, including those that emerged during the experiment

(summarizations and misunderstandings), following Gerber and Tomitch (2008).

### 3.4.3 Post-reading tasks

As the main objective of the present study is to analyze process and product of reading and not language fluency, instructions and tasks in both post-reading tasks conditions were performed in the participants L1 Portuguese.

*Reading to criticize/give opinion – criteria.* According to Carlson (2011), assessing the product of reading via offline measures is a successful way to examine whether a reader recalls important parts of a text.

The post-reading task in the specific condition *reading to criticize/give opinion* aimed at verifying the ability of readers to both recall and evaluate the arguments used by different voices in the texts(Appendices K and N).The evaluation section, as it will be further explained, complemented the reading task since the purpose was reading to give opinion.

The controversial issues discussed in the texts were organized so as to counterbalance pros and cons, as well as opinions from the common sense and perspectives from authorities and institutions. Even though there are more than four arguments in each side, four of them are more elaborated and further discussed. Although the credibility of the sources could not be verified by the reader, some criteria on the selection of arguments were expected, since the purpose for reading the texts was to be critical and participants were directly instructed to pay attention to the issuers. Arguments from the subsection Public Opinion are based on common sense and are not deep enough to be taken seriously: e.g.:

"*In my opinion, I think that we should use more species of animals to be tested. They are lower on the food chain for a reason*".

""*Thanks to Facebook you can talk with your family and your friends who are far*".

Hence, the five questions on the post-reading task *Reading to criticize/give opinion* condition aimed at verifying the following:

*Questions # 1 and # 2*: *List four arguments for and against the main topic*: *Using animals for scientific or commercial testing* (Text 1) and *The influence of social networking sites in society* (text 2):

The expected answers for these two questions were that the participant listed at least the 4 main arguments (for and against)

presented in the texts within the subsections *Specialized Opinion* and *Public Opinion.* General topics roughly developed in the first three introductory paragraphs are not being considered for the purpose of critical reading. The memory for arguments is being measured in the two questions. One point twenty-five (1.25) was given to each argument (total= 10.0 points) in this case. The total score (10.00 points) accounts for the memory of arguments in this specific condition, reading to criticize/give opinion. The same score was split in two categories: 5.0 points for Specialized Opinion (SO) and 5.0 points for Public Opinion (PO). Although it was expected to, it was not specified in the instructions that the readers should support their arguments on the specialized opinion subsection in order not to influence or direct the reader to specific aspects in order to criticize. Instead, the instruction was: *Base your opinion/critic in the best arguments; pay attention to the issuers of opinions.* Based on a previous study, it was hypothesized that direct instructions, beyond the approach adopted in this study, could emphasize low-level inferences, such as "locate-and-memorize" and could lead to a deliberate focus on excerpts that would interest the expected results. Instead, a more high-level approach based on "review-an-integrate" strategy could suggest that the reader should reflect on any issue to criticize (Rouet, Vidal-Abarca, Bert-Erboul & Millogo, 2001, as cited in Rouet and Britt, 2011). For that purpose, if more arguments from the Specialized Opinion subsection were recalled, the interpretation was that a critical evaluation of arguments took place during reading so as to facilitate the encoding to happen, contributing to storage of information in LTM (Daneman & Carpenter, 1980).Qualitative analyses of the results based on the instructions will be discussed in section 4.6.

*Question # 3: Which arguments do you agree with? Why?*

This question was intended to fit the reading to criticize/give opinion scenario and is not part of quantitative analysis as it was not possible to evaluate whether the reader was critical or not, once the topic 'being critical' is a complex construct. It was hypothesized that giving the reader a real purpose to read should be complemented by a post-reading task that is not a fake one. Once participants were exposed to two different reading conditions, if the first post-reading task did not require what the instructions claimed, results could be different in the second text and post-reading task, with the participant losing interest in maintaining the purpose. The effects of instruction on the outcome will be qualitatively discussed.

*Question # 4:Which criteria did you use in the selection of arguments to base your own opinion?* and # 5: *Did you consider the issuer of the opinion to base your own?*

The two remaining questions of the post-reading task in the criticize/give opinion condition refer to the self-analysis of the participant and help verify to what extent the explicit instruction was taken into account and /or remembered and if instruction was purposefully followed, since the instruction was that the participant objectively paid attention to that aspect**.** The questions refer to i) criteria used to choose the argument in which to base the reader's own opinion, and ii) if the issuer was considered. As participants were instructed to focus on the issuer when reading the texts, the answers were expected to consider the opinions on the subsection *Specialized Opinion.* Question # 5 confirms the answer to Question # 4. (Table 11).

Table 11
*Criteria for post-readings criticize scores*

| **Questions** | **Main aspect** | **Score** |
|---|---|---|
| 1 & 2 | - Number of arguments recalled from *Specialized Opinion* and *Public Opinion*<br>- Effect of reading purpose and instruction | 10.00 |
| 3 | - Critical stance towards ideas presented in the text: argument(s) from *Specialized Opinion* | Qualitative analysis |
| 4 & 5 | - Effect of reading purpose and instruction | Qualitative analysis |

Qualitative analysis of the effects of reading purpose on post-reading tasks as well as the influence of instructions on the outcome/product of reading will be discussed taking into consideration the answers to questions 3, 4, and 5.

*Reading to summarize- criteria:* The specific condition *reading to summarize* intended to assess the readers' ability to recall the arguments in a summary of 200 to 250 words. In fact, the ability to summarize was of secondary importance to the objectives of the study. The task was intended to bring some meaning to the reading purpose, as discussed above in the reading to criticize condition. Again, it was hypothesized that giving the reader a real purpose to read should be complemented by a post-reading task that was not a fake one to ensure a minimum of ecological validity and trustworthiness to the process. For the purpose of measuring the products of reading in this condition, the recall of the eight or most of the main arguments discussed in the texts were expected to happen as a voluntary retrieval, once participants were not instructed to focus on any specific information. The results of recall were scored from one to ten (1.0-10.0) points, considering that each argument recalled is worth 1.25 points (8 x 1.25 = 10.00), the same criteria used in the post-reading *Criticize/give opinion condition.*

The results from both post-reading sections (criticize/give opinion and summarize) were scored by this researcher and it was assumed that no other rater's evaluation was necessary once the scores are objectively the total number of arguments recalled and did not demand subjective interpretations. Results in both conditions were compared to the inference categories (Linderholm & van den Borek, 2002) generated during verbal reports.

## 3.5 DATA ANALYSIS - VARIABLES AND MEASURES

This research of deductive and exploratory nature was conducted with the help of a mixed-method approach via de employment of different measures that could account for the processes and products of reading. This study employed the triangulation of quantitative and qualitative data analysis, an approach that has been extensively applied in the area of reading (Winfield, 2014; Caldart, 2012; Tomitch, 2003, to mention a few).

According to Eisner (1998), in the qualitative approach the interpretative characteristic of the researcher is key for making sense of

situations based on some frame as reference. The author highlights that "since what we know about the world is a product of the transaction of our subjective life and a postulated objective world, these worlds cannot be separated" (p. 52).

As regards the study of inference generation, Graesser and Kreuz (1993) point out that a proper methodology to measure inferences that are truly online includes, in fact, a set of methodologies. Whether more global inferences are generated online or offline and how they are related to recall and learning, it requires a combination of methodologies including verbal protocols, which in a complementary manner with other measures, may provide insights into inference categorization, comprehension and memory for texts.

The following tables(12 and 13) summarize the variables and measures considered in the study:

Table 12

*Variables and measures used in the quantitative analysis*

| **Type of variable** | **Variable** | **Measure** |
|---|---|---|
| Independent | WMC | Reading Span Test |
| Independent | Text presentation | Digital linear texts and nonlinear hypertexts |
| Independent | Reading purpose | Reading to criticize/express opinion Reading to summarize |
| Dependent | Amount of inferences | Total amount per category |
| Dependent | Memory (recall) | Post-reading tasks: criticize and summarize |
| Dependent | Reading time | Time spent in actual reading |

Table 13
*Other variables used in the qualitative analysis in this study*

| Variable | Measure |
|---|---|
| Readers' reading practice | Demographic questionnaire |
| Reading behavior | Time<br>Use of tools (marking, highlighting, underlining, taking notes, cutting and pasting, scroll bar use)<br>Rereading<br>Accessing links<br>Focus and orientation |
| Process and product of reading | Verbal report/ Inference categorization<br>Post-reading tasks: criticize/summarize<br>Self-evaluation questionnaire |

The software environment for statistical analysis R (R Core Team, 2017) was used in the statistical data analysis alongside the graphical user interface RStudio (RStudio Team, 2016). One 2 x 2 x 2 Mixed ANOVA was run for each type of inference identified in research question # 1. Means, standard deviations and p-values of possible main effects of each factor or interaction among variables will be summarized. For research questions # 2 and # 3, Spearman's correlation was run. Research questions # 4 and # 5 will be qualitatively analyzed in face of the results provided in the quantitative analysis and triangulated with other important patterns that emerged from the data.

# 4 RESULTS AND DISCUSSION

## Preliminaries

According to what has been considered so far in light of inference generation theory, readers produce inferences in response to a reading purpose (Roscioli & Tomitch, 2014; Gerber & Tomitch, 2008; Linderholm & van den Broek, 2002; van den Broek et al., 2001;1995). Several other variables influence this process, though, among these lie WMC and text mode (Fontanini, 2007), WMC and fluency in L2 (Rai et al. 2011; Alptekin & Erçetin, 2009; van den Noort et al., 2006), to mention a few.

Based on the above, the main objective of the present research is to examine reading of linear digital and nonlinear hypertexts by low- and high-WMC readers of English as an L2 by means of online and offline measures considering two different reading purposes: to criticize/give opinion and to summarize.

This chapter reports the results of statistical tests run for the first three research questions to verify interactions between the variables WMC and types of inferences generated during reading, the relation between those variables and scores from post reading-tasks, and reading time. Effects of task instruction and strategies employed in the entire process of reading will be qualitatively discussed. The results and discussion are organized in the following manner: First, data from the statistical tests run for RQ#1 are first reported for each inference category. After all findings are reported, a discussion will follow. RQ#2 and RQ#3 will similarly be first reported on the data from the statistical tests and followed by discussion. The first three research questions will be qualitatively discussed in a complementary manner. As for RQ#4 qualitative results will be first reported and then followed by discussion, triangulating results from those of the previous research questions. Finally, RQ#5 will be discussed triangulating results with the demographic and the self-evaluation questionnaires as well as results from previous questions and observation of behavioral data.

## 4.1 WORKING MEMORY CAPACITY SCORES

The scores from the Reading Span Test ranged from 24,5 to 51,0. Initially, participants scores were split into three groups: low-spans

(24,5 – 30,5), medium-spans (31,0 – 34,5), and high-spans (35,0 – 51). The reason for splitting groups in three was intended in order to better distribute low, medium, and high scores in each condition. If only criteria of low and high were considered, some groups could have extreme scores, what would make comparison difficult to make. Therefore, based on Linderholm and van den Broek's (2002) criteria that considered 30,5 to be the highest score for the low-span group and 35,0 to be lowest for the high-span group, it was interpreted to be a safe ground to have those limits and the in-betweens as medium-spans just for the sake of distribution. Participants were assigned to each condition according to their RST so as to have a balanced number of participants across conditions (see subsections 3.*3 Instruments and procedures for collecting data*). After having all scores, a medium split criteria was adopted and the scores were dichotomized into: low-spans -from 24,5 to 34,5; high-spans – from 35,0 to 51,0 as demonstrated in Table 14

Table 14
*Results from the Working Memory Span Test*

| **Participant** | **Score** | **Participant** | **Score** |
|---|---|---|---|
| P1 | 35,5 | P13 | 37,5 |
| P2 | *24,5* | P14 | 45,0 |
| P3 | 51,0 | P15 | *32,5* |
| P4 | 40,5 | P16 | *32,5* |
| P5 | 38,5 | P17 | 38,0 |
| P6 | 44,5 | P18 | 37,0 |
| P7 | *29,5* | P19 | 46,0 |
| P8 | *29,0* | P20 | *33,5* |
| P9 | *30,5* | P21 | *32,5* |
| P10 | *32,5* | P22 | *25,0* |
| P11 | *25,5* | P23 | 36,5 |
| P12 | 37,5 | P24 | *30,5* |

*Note*: Low-span scores in italics

## 4.2 INFERENCES

Two different texts were used as stimulus: one discussed the use of animals in research and the other the influence of social networking in society. These two texts appeared in two different modes (linear and nonlinear hypertext) in two different conditions: reading to summarize and reading to criticize/give opinion.

During the experiment, participants read each text at a time and reported their thoughts, reactions, opinions and interpretations. These utterances were rated into eight categories, based on previous study by Linderholm and van den Broek (2002), namely, elaborative inferences, evaluative comments, text repetitions, paraphrases, associations, metacognitive comments, reinstatement inferences, and predictive inferences. Two other categories were added according to comments that emerged during the experiment: summarizations and misunderstandings. The categories were calculated per participant and organized into a table (see Appendix Z for the complete summary of inferences per participant).

For the sake of clarity, the two reading purposes in the present research were selected based on what undergraduate students mostly do in their academic reading practices. In my view, and based on previous studies, such as the ones by van den Broek, Lorch, Linderholm, and Gustafson (2001) and Linderholm and van den Broek (2002), by analogy with the two reading purposes in their studies (reading for study and reading for entertainment), reading to summarize and to criticize are two distinct reading purposes that require different strategies and, thus, stimulate the generation of differing inferences.

Tables 15 and 16 demonstrate the total number of inferences by isolating the variables so as to show the performance of participants in each reading situation separately: texts and participants, conditions and participants, text mode and participants, and WMC of participants.

Table 15
*Total inferences in each condition*

| | **Text 1** | **Text 2** | **Criticize** | **Summarize** | **Hypert.** | **Linear** |
|---|---|---|---|---|---|---|
| Total inferences | 545 | 554 | 555 | 544 | 550 | 549 |

Table 16
*Total inferences per WM group*

| | **Low-WMC** | **High-WMC** |
|---|---|---|
| Total inferences | 550 | 549 |

In general, 1,099 inferences were generated during reading both texts. Despite the fact that reading a hypertext stimulated the generation of more inferences, even though some links were not accessed by some

participants (see qualitative analysis for link access), the difference may not be noteworthy.
Types of inferences are summarized in figures 4 and 5 below:

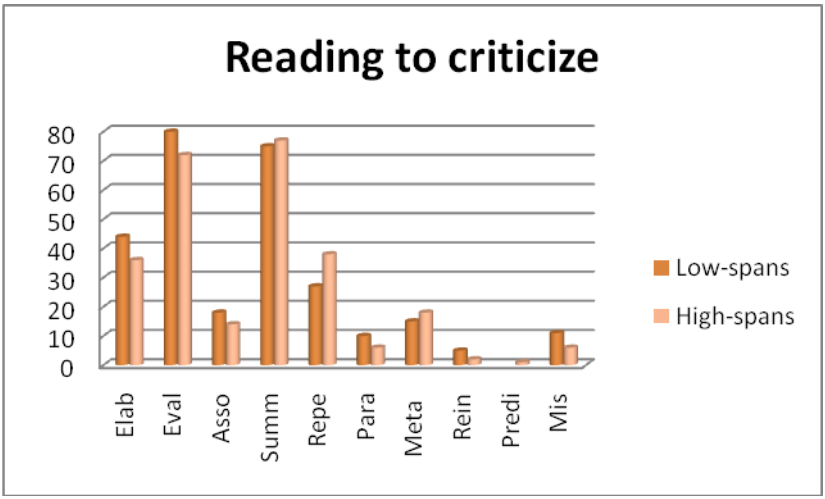


*Figure 4*.Total inferences per condition and WMC group

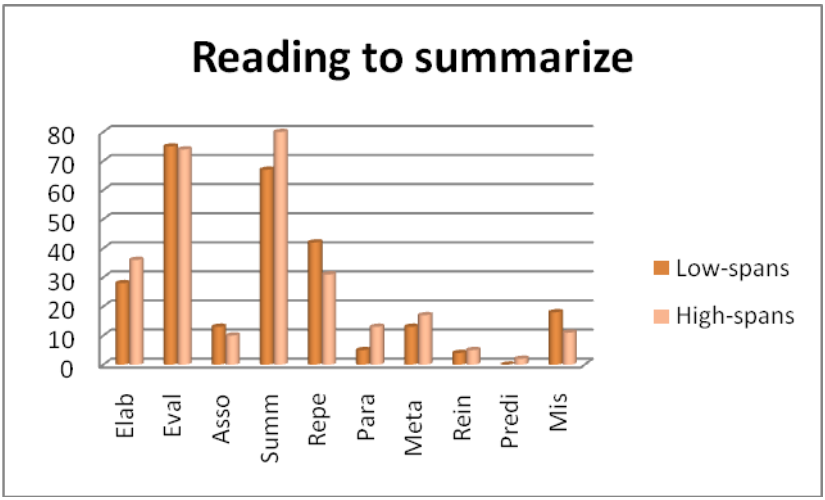


*Figure 5*.Total inferences per condition and WMC group

Table 17
*Total inferences per memory span group in each text mode*

| | **Low-WMC** | **High-WMC** |
|---|---|---|
| Hypertext | 280 | 270 |
| Linear | 270 | 279 |

Overall, differences between groups in each text mode are not noteworthy. Statistical analyses will be conducted to verify interactions between variables.

## 4.3 RESEARCH QUESTION 1

### 4.3.1 Statistical data analysis – results

In order to pursue the main objective of the study**,** the first research question is analyzed:

*RQ1:What types of inferences, as proposed by Linderholm and van den Broek (2002), are generated in verbal reports by low- and high-WMC readers in each condition-summarizing and criticizing/giving opinion in each text mode: linear digital and nonlinear hypertext reading?*

The software environment for statistical analysis R (R Core Team, 2017) was used in the statistical data analysis alongside the graphical user interface RStudio (RStudio Team, 2016). One 2 x 2 x 2 Mixed ANOVA[9] was run for each type of inference, namely Elaborative inferences (Elab), Evaluative comments (Eval), Summarizations (Summ), Text repetitions (Repe), Paraphrases (Para), Associations (Asso), Metacognitive comments (Meta), Reinstatement inferences (Rein), Predictive inferences (Pred) and Misunderstandings (Misu). The analyses were based on one within-subject factor, namely Working Memory Capacity group (high and low), and two between-subject factors, namely condition (criticizing/giving opinion and summarizing)

[9]Since some of the parameters for the ANOVA were not met ( Appendix V), linear mixed-effects models were also fit and the results were compared with the ANOVA. They yielded the same conclusions, thus only the ANOVA results are reported for the sake of simplicity. This approach was based on recommendations by Erceg-Hurn and Mirosevich (2008).

and text mode (hypertext and linear) with two levels each, with alpha set at .05. Tables18, 19, and 20 summarize the results, showing the means, standard deviations and p-values of possible main effects of each factor. Sequentially, each ANOVA is summarized in their respective interaction plot, followed by the statistical results. In summary, no statistically significant main effect nor interaction was observed. The lack of statistically significant results may be due to the reduced sample size (n=24) which is split in 4 groups when conditions are looked at separately. However, some effects that approached significance at the alpha level of $\alpha$= .1 were considered trends and are discussed in view of similar results in previous research. The decision to consider significance approach at the level of $\alpha$= .1 intended to ensure sufficient power to the test and took into account previous studies that corroborate the assumption that there are differences in reading performance between low- and high-WM groups in similar circumstances to those addressed in the present study (Linderholm & van den Broek, 2002) and similar reading purposes that facilitate the generation of specific inferences (van den Broek et al., 2001). In this respect, and based on discussion provided by Larson-Hall (2010) and Kline (2004) it was decided that a Type II error (in the case of increasing the alpha level) could contribute to the field in the sense that it points to an effect in the sample which is backed up by previous research (see Naumann, Richter, Flender, Christmann, & Groeben, 2007, for similar alpha level use in reading research).

Post-hoc analysis with two paired samples t-tests was run to further investigate the effect of grouping the categories into text-base inferences (paraphrase, text repetition, and summarization) and situation model inferences (elaborative inferences, evaluative comments, and associations).

There is no main effect of WMC on inference generation at the 5% level of significance. However, at the alpha level of .1, high- and low WMC would differ in the amount and quality of inference generation ( Table 18).

Table 18

*Effects of working memory capacity on inference generation*

| | Working Memory Capacity | | | | |
|---|---|---|---|---|---|
| | Low Span Group | | High Span Group | | |
| Inference Category | *M* | *SD* | *M* | *SD* | *p* |
| Elaborative Inferences | 2.91 | 2.91 | 3.08 | 2.45 | .861 |
| Evaluative Comments | 6.41 | 4.54 | 6.15 | 4.37 | .880 |
| Summarizations | 5.73 | 3.28 | 6.65 | 2.65 | .463 |
| Text Repetitions | 3.14 | 4.05 | 2.65 | 3.15 | .747 |
| Paraphrases | 0.68 | 1.99 | 0.73 | 1.66 | .935 |
| Associations | 1.36 | 1.79 | 0.96 | 1.51 | .469 |
| Metacognitive comments | 1.27 | 1.70 | 1.35 | 2.30 | .918 |
| Reinstatement inferences | 0.41 | 0.85 | 0.27 | 0.53 | .445 |
| Predictive inferences | 0 | 0 | 0.12 | 0.43 | .237 |
| Misunderstandings | 1.32 | 1.49 | 0.65 | 1.09 | .085[a] |

*Note.* Means and Standard Deviations of the generation of inferences per participant in each WMC group. [a] Significant at the $\alpha$= .1 level

No main effect of reading purpose was evidenced in the generation of inferences in either condition: reading to criticize or to summarize. That is, overall reading to criticize or to summarize did not influence the generation of inferences in the specific study ( Table 19).

Table 19

*Effects of condition on inference generation*

| | Condition | | | | |
|---|---|---|---|---|---|
| | Criticizing | | Summarizing | | |
| Inference Category | *M* | *SD* | *M* | *SD* | *p* |
| Elaborative Inferences | 3.33 | 2.96 | 2.67 | 2.30 | .156 |
| Evaluative Comments | 6.33 | 4.61 | 6.21 | 4.28 | .860 |
| Summarizations | 6.33 | 3.32 | 6.13 | 3.29 | .747 |
| Text Repetitions | 2.71 | 3.20 | 3.04 | 3.95 | .473 |
| Paraphrases | 0.67 | 1.88 | 0.75 | 1.75 | .854 |
| Associations | 1.33 | 1.90 | 0.96 | 1.33 | .366 |
| Metacognitive comments | 1.38 | 2.36 | 1.25 | 1.67 | .781 |
| Reinstatement inferences | 0.29 | 0.62 | 0.38 | 0.77 | .705 |
| Predictive inferences | 0.04 | 0.20 | 0.08 | 0.41 | .663 |
| Misunderstandings | 0.71 | 1.12 | 1.21 | 1.47 | .209 |

*Note.* Means and Standard Deviations of the generation of inferences per participant in each reading condition

There is no main effect of text mode on inference generation at the 5% level of significance. The main effect may be considered statistically significant at the $\alpha$= .1level in both cases (p = .080 <.1; mean=3.42; SD=2.60 for elaborative inferences and p= .096 < .1; mean=1.50; SD=1.96 for associations). As it can be observed, in general, readers elaborated more when reading linear texts. Hypertext reading favored associations, though ( Table 20).

Table 20

*Effects of text mode on inference generation*

| | Text Mode | | | | |
|---|---|---|---|---|---|
| | Hypertext | | Linear | | |
| Inference Category | *M* | *SD* | *M* | *SD* | *p* |
| Elaborative Inferences | 2.58 | 2.67 | 3.42 | 2.60 | .080[a] |
| Evaluative Comments | 6.63 | 4.27 | 5.92 | 4.60 | .323 |
| Summarizations | 6.21 | 3.27 | 6.52 | 3.13 | .948 |
| Text Repetitions | 2.63 | 3.37 | 3.13 | 3.79 | .286 |
| Paraphrases | 0.75 | 1.75 | 0.67 | 1.88 | .854 |
| Associations | 1.50 | 1.96 | 0.79 | 1.18 | .096[a] |
| Metacognitive comments | 1.50 | 1.87 | 1.13 | 2.19 | .409 |
| Reinstatement inferences | 0.21 | 0.51 | 0.46 | 0.83 | .262 |
| Predictive inferences | 0.13 | 0.45 | 0.00 | 0.00 | .200 |
| Misunderstandings | 0.79 | 1.14 | 1.13 | 1.48 | .397 |

*Note.* Means and Standard Deviations of the generation of inferences per participant with each Text Mode.[a] Significant at the $\alpha$= .1 level

Other interactions will be further discussed for all categories as each ANOVA is summarized in their respective interaction plot.

*Elaborative inferences*. No statistically significant main effect was observed. However, Text Mode would be significant at the alpha level of .1. It may be considered a trend. No statistically significant interaction was observed.

There is no interaction of variables on the generation of elaborative inferences at the 5% level of significance. It can be considered significant at the$\alpha$= .1 level., showing a trend, $F(1,20) = 3.39$, $p = .080 < .1$, as displayed in Table 21 (mean=3.42; SD=2.60). Both groups elaborated more when reading the linear version of texts. Even though the low-WMC group produced more elaborations than their counterparts when reading hypertexts, high-spans elaborated more in the linear version of text. Elaborations could have been the predicted outcome taking the level of controversy of the topics in both stimulus texts into account.

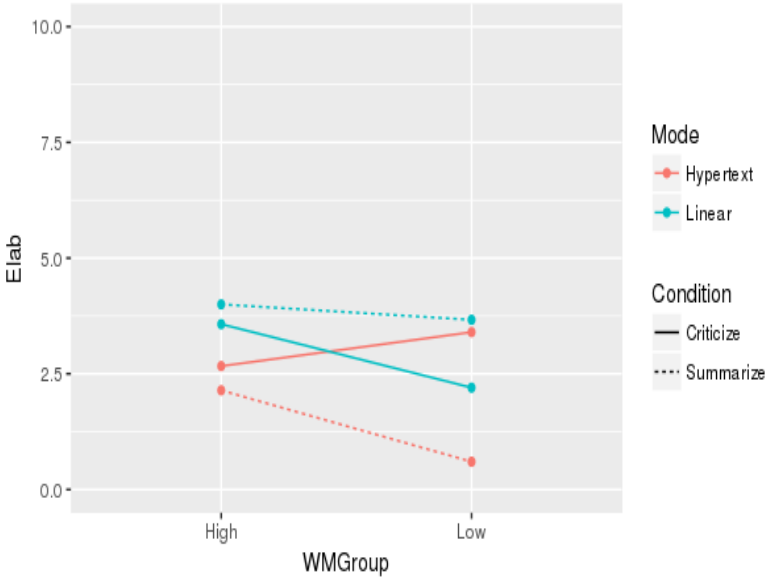


*Figure 6*. Effects of WMC group (high and low), text mode (hypertext and linear) and condition (criticize and summarize) on the generation of Elaborative inferences

Table 21
*ANOVA results with Elaborative inferences as dependent variable*

| Factor | $F(1, 20)$ | $p$ |
|---|---|---|
| WM[a] Group | 0.03 | .861 |
| Text Mode | 3.39 | .080[b] |
| Condition | 2.171 | .156 |
| Interactions | | |
| WM Group and Text Mode | 1.45 | .242 |
| WM Group and Condition | 1.89 | .185 |
| Text Mode and Condition | 2.60 | .123 |
| WM Group, Text Mode and Condition | 1.45 | .242 |

*Notes.* $N$=24. [a] Working Memory. [b] Statistically significant at the $\alpha$= .1 level

*Evaluative comments.* No statistically significant main effect was observed. No statistically significant interaction was observed.

The observed difference between low- and high-WMC readers in the condition reading to criticize in the hypertext mode is not considered statistically significant F(1,20 = 0.02, p =.880, Table 22). However, Figure 7 shows a trend which is consistent with results from the post-reading task in reading to criticize/give opinion condition. Low-span readers evaluated more when reading to criticize in the hypertext mode. Linear reading did not display differences between groups.

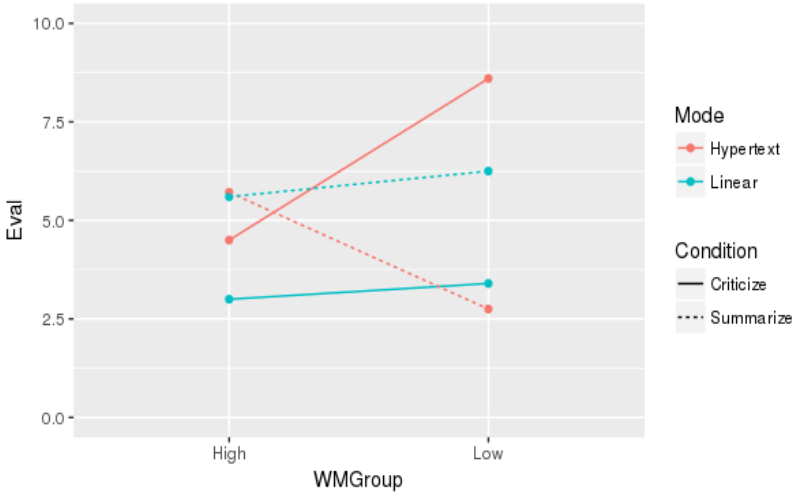


*Figure 7*: Effects of WMC group (high and low), text mode (hypertext and linear) and condition (criticize and summarize) on the generation of Evaluative comments

Table 22
*ANOVA results with Evaluative comments as dependent variable*

| Factor | *F*(1, 20) | *p* |
|---|---|---|
| WM[a] Group | 0.02 | .880 |
| Text Mode | 1.03 | .323 |
| Condition | 0.03 | .860 |
| Interactions | | |
| WM Group and Text Mode | 0.37 | .548 |
| WM Group and Condition | 0.01 | .920 |
| Text Mode and Condition | 2.81 | .109 |
| WM Group, Text Mode and Condition | 1.00 | .329 |

Note. N=*24*. [a]*Working Memory*

*Summarizations.* No statistically significant main effect was observed. No statistically significant interaction was observed.

Even though observation may point to differences between the amount of summarizations generated by high- and low-WMC groups,

the difference is not statistically significant F(1,20 = 0.56, p = .463, see Table 23). Text mode and condition did not yield significant results.

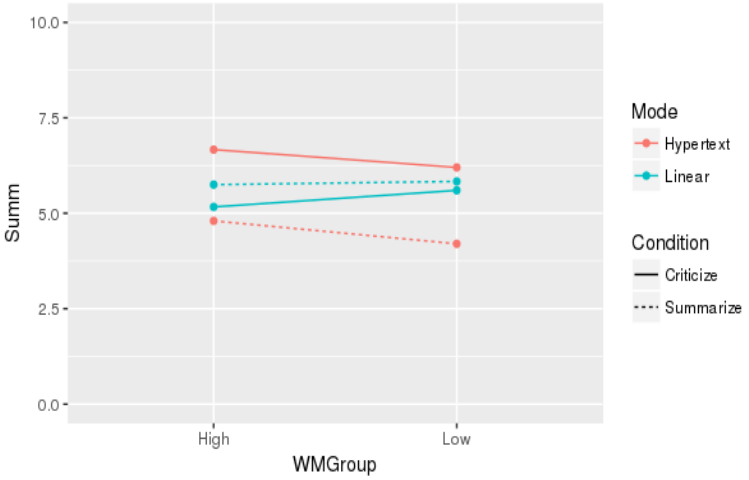


*Figure 8*Effects of WMC group (high and low), text mode (hypertext and linear) and condition (criticize and summarize) on the generation of Summarizations

Table 23
*ANOVA results with Summarizations as dependent variable*

| Factor | *F*(1, 20) | *p* |
|---|---|---|
| WM[a] Group | 0.56 | .463 |
| Text Mode | > 0.01 | .948 |
| Condition | 0.11 | .747 |
| Interactions | | |
| WM Group and Text Mode | > 0.01 | .974 |
| WM Group and Condition | 2.40 | .137 |
| Text Mode and Condition | 0.83 | .374 |
| WM Group, Text Mode and Condition | 0.08 | .776 |

*Notes. N*=24. [a]Working Memory

*Text Repetitions*. No statistically significant main effect was observed. No statistically significant interaction was observed.

However, the interaction between WM Group and Condition would be significant at the alpha level of .1 ( F(1,20) = 4.07, p= 0.057 < .1, see Table 24 (criticize: mean=2.71; SD=3.20; summarize: mean=3.04; SD= 3.95). It may be considered a trend. The low-WMC readers repeated the text independently of reading condition. In closer inspection, high-WMC readers repeated the text more in the criticize than in the summarize condition.

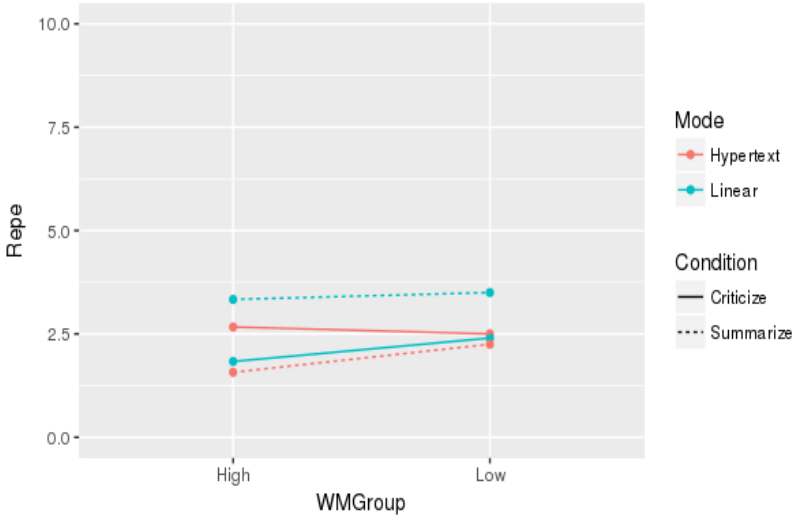


*Figure 9.* Effects of WMC group (high and low), text mode (hypertext and linear) and condition (criticize and summarize) on the generation of Text Repetitions

Table 24
*ANOVA results with Text Repetitions as dependent variable*

| Factor | *F*(1, 20) | *p* |
|---|---|---|
| WM[a] Group | 0.11 | .747 |
| Text Mode | 1.20 | .286 |
| Condition | 0.53 | .473 |
| Interactions | | |
| WM Group and Text Mode | 2.64 | .120 |
| WM Group and Condition | 4.07 | .057[b] |
| Text Mode and Condition | 0.02 | .888 |
| WM Group, Text Mode and Condition | 0.10 | .753 |

Notes. N=*24.* [a] *Working Memory.* [b] *Statistically significant at the* α= *.1 level*

*Paraphrases*. No statistically significant main effect was observed. No statistically significant interaction was observed.

Even though differences in the total number of paraphrases can be observed favoring the low-WMC group in the linear criticize condition, and the high-WMC group in the summarize condition (hypertext), results are not considered statistically significant, F(1,20) = 0.01, p =935, (Table 25).

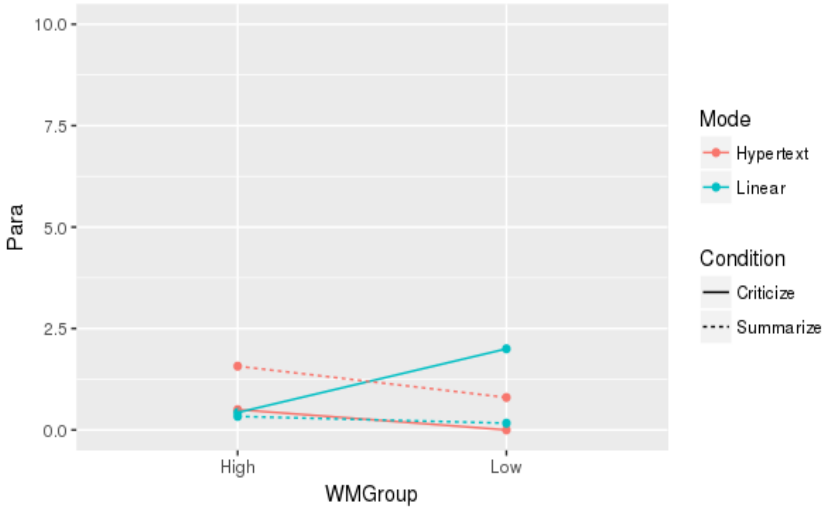


*Figure 10*.Effects of WMC group (high and low), text mode (hypertext and linear) and condition (criticize and summarize) on the generation of Paraphrases

Table 25
*ANOVA results with Paraphrases as dependent variable*

| Factor | $F(1, 20)$ | $p$ |
|---|---|---|
| WM[a] Group | 0.01 | .935 |
| Text Mode | 0.04 | .854 |
| Condition | 0.04 | .854 |
| Interactions | | |
| WM Group and Text Mode | 2.18 | .156 |
| WM Group and Condition | 1.25 | .276 |
| Text Mode and Condition | 2.39 | .138 |
| WM Group, Text Mode and Condition | 0.38 | .546 |

*Notes.* $N$=24. [a] Working Memory

*Associations*. No statistically significant main effect was observed. However, Text Mode would be significant at the alpha level of .1. It may be considered a trend. No statistically significant interaction was observed.

Both groups associated more when reading hypertexts. The low-WMC group outperformed the high one when reading hypertexts to criticize, reaching significance at .1 level, F(1,20 = 3.06, p=0.096 < .1, see Table 26) (mean=1.50; SD=1.96).

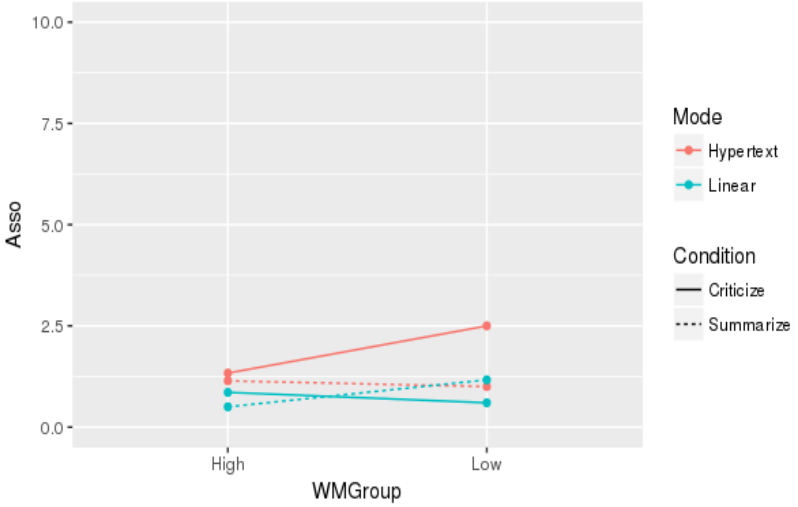


*Figure 11*.Effects of WMC group (high and low), text mode (hypertext and linear) and condition (criticize and summarize) on the generation of Associations

Table 26

*ANOVA results with Associations as dependent variable*

| Factor | *F*(1, 20) | *p* |
|---|---|---|
| WM[a] Group | 0.55 | .469 |
| Text Mode | 3.06 | .096[b] |
| Condition | 0.86 | .366 |
| Interactions | | |
| WM Group and Text Mode | 0.14 | .708 |
| WM Group and Condition | 0.06 | .816 |
| Text Mode and Condition | 0.62 | .441 |
| WM Group, Text Mode and Condition | 1.04 | .319 |

Notes. N=*24.* [a] *Working Memory.* [b] *Statistically significant at the* α= *.1 level*

*Metacognitive comments*. No statistically significant main effect was observed. No statistically significant interaction was observed. However, the interaction between Text Mode and Condition would be significant at the alpha level of .1 F(1,20) = 3.39, p= 0.081 < .1 (see Table 27 ),(criticize: mean=1.38; SD=2.36; summarize: mean=1.25; SD=1.67). These interactions may be considered a trend.

Both groups made more metacognitive comments when reading hypertexts to summarize than when reading hypertexts to criticize. The high-span group outperformed the low-span one in both conditions. The low-WMC group generated the same average amount of metacognitive comments when reading to criticize in both text modes. Both groups generated more metacognitive comments when reading linear texts to criticize than when reading linear texts to summarize, but the high-spans outperformed the low ones.

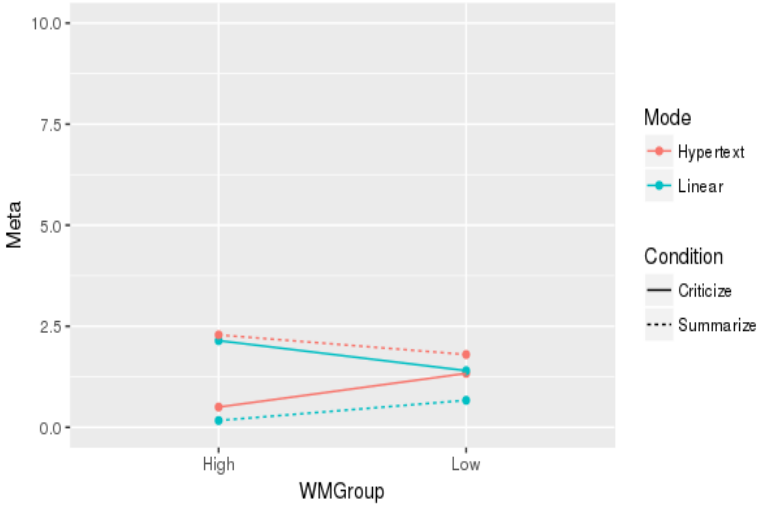


*Figure 12*. Effects of WMC group (high and low), text mode (hypertext and linear) and condition (criticize and summarize) on the generation of Metacognitive comments

Table 27
*ANOVA results with Metacognitive comments as dependent variable*

| Factor | $F(1, 20)$ | $p$ |
|---|---|---|
| WM[a] Group | 0.01 | .918 |
| Text Mode | 0.71 | .409 |
| Condition | 0.08 | .781 |
| Interactions | | |
| WM Group and Text Mode | 0.11 | .744 |
| WM Group and Condition | > 0.01 | .966 |
| Text Mode and Condition | 3.39 | .081[b] |
| WM Group, Text Mode and Condition | 0.82 | .375 |

Notes. N=*24.* [a] *Working Memory.* [b] *Statistically significant at the* α= *.1 level*

*Reinstatement inferences*. No statistically significant main effect was observed. No statistically significant interaction was observed F(1,20 = 0.61, p =.445, Table 28). That is, no effects of WMC on the generation of reinstatement inferences were observed in either text mode nor condition. The negative results will be further discussed in view of specificity of instruments utilized in the present study.

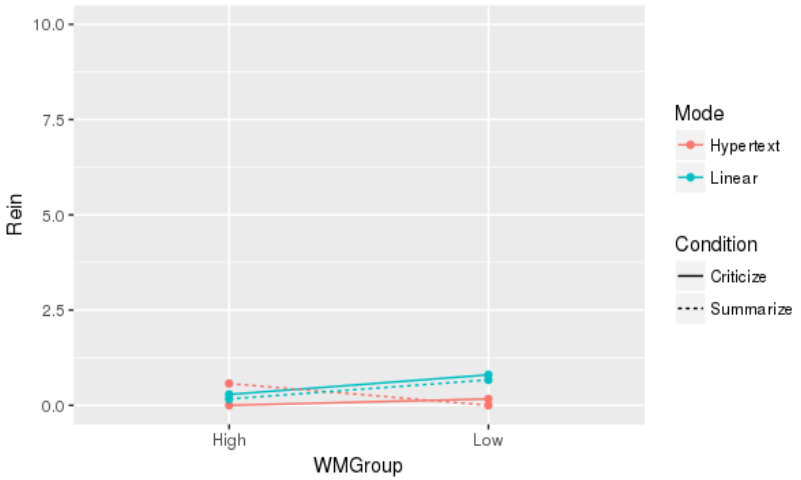


*Figure 13*. Effects of WMC group (high and low), text mode (hypertext and linear) and condition (criticize and summarize) on the generation of Reinstatement inferences

Table 28
*ANOVA results with Reinstatement inferences as dependent variable*

| Factor | *F*(1, 20) | *p* |
|---|---|---|
| WM[a] Group | 0.61 | .445 |
| Text Mode | 1.33 | .262 |
| Condition | 0.15 | .705 |
| Interactions | | |
| WM Group and Text Mode | 2.60 | .122 |
| WM Group and Condition | 0.74 | .399 |
| Text Mode and Condition | 1.00 | .329 |
| WM Group, Text Mode and Condition | 1.01 | .327 |

Notes. N=*24*. [a] *Working Memory*

*Predictive inferences*. No statistically significant main effect was observed. No statistically significant interaction was observed F(1,20 = 1.49, p =.237, Table 29). That is, no effects of WMC on the generation of predictive inferences were observed in neither text mode nor

condition. The negative results will be further discussed in view of the specificity of the instrument utilized in the present study.

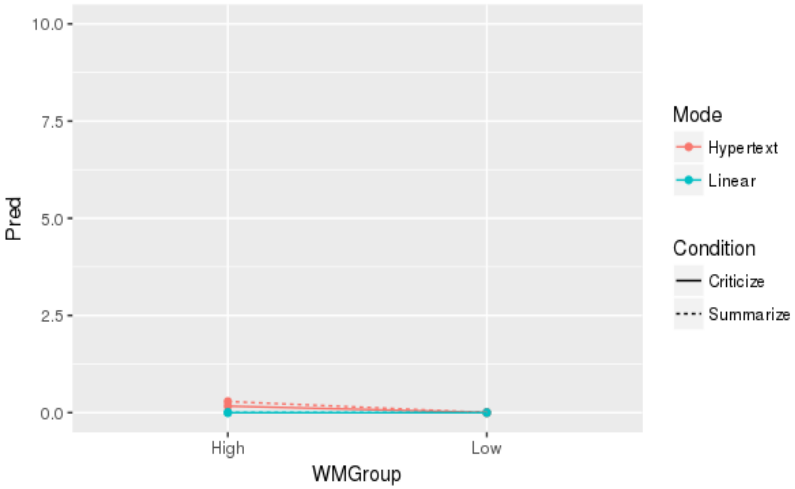


*Figure 14.* Effects of WMC group (high and low), text mode (hypertext and linear) and condition (criticize and summarize) on the generation of Predictive inferences

Table 29
*ANOVA results with Predictive inferences as dependent variable*

| Factor | *F*(1, 20) | *p* |
|---|---|---|
| WM[a] Group | 1.49 | .237 |
| Text Mode | 1.76 | .200 |
| Condition | 0.20 | .663 |
| Interactions | | |
| WM Group and Text Mode | 1.41 | .249 |
| WM Group and Condition | 0.10 | .757 |
| Text Mode and Condition | 0.12 | .736 |
| WM Group, Text Mode and Condition | 0.10 | .757 |

Notes. N=*24.* [a] *Working Memory*

*Misunderstandings.* No statistically significant main effect nor interaction was observed at the 5% level of significance. However, the WM Group would be significant at the alpha level of .1. Low-WMC readers revealed more misunderstandings than the high-WMC ones. If the alpha level of .1 is considered, $F(1,20) = 3.29$, $p = .085 < .1$, Table 30) (Mean=1.32; SD=1.49) in comparison to the high-WM group (Mean=0.65; SD=1.09). It may show a trend. Those readers showed more misunderstandings than the high-WMC group when reading to criticize and to summarize in the linear mode.

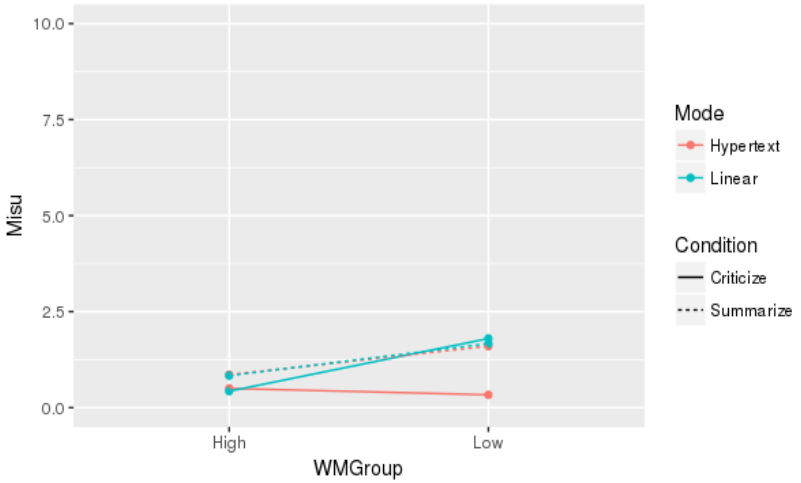


*Figure 15.*Effects of WMC group (high and low), text mode (hypertext and linear) and condition (criticize/give opinion and summarize) on the generation of Misunderstandings

Table 30
*ANOVA results with Misunderstandings as dependent variable*

| Factor | $F(1, 20)$ | $p$ |
|---|---|---|
| WM[a] Group | 3.29 | .085[b] |
| Text Mode | 0.75 | .397 |
| Condition | 1.69 | .209 |
| Interactions | | |
| WM Group and Text Mode | 1.11 | .305 |
| WM Group and Condition | 0.06 | .813 |
| Text Mode and Condition | 0.70 | .411 |
| WM Group, Text Mode and Condition | 0.97 | .337 |

Notes. N=*24.* [a] *Working Memory.* [b] *Statistically significant at the* α= *.1 level*

### 4.3.2 Discussion

The RQ1 under analysis strives to identify the types of inferences generated during reading and revealed through verbal reports of participants and how those inferences interact with other variables such as WMC, text mode and reading purpose.

Discussion will be first conducted taking into account those categories which presented a statistically significant interaction at the alpha level of .1, namely, elaborative inferences, text repetitions, associations, metacognitive comments, and misunderstandings. The other categories that did not display a statistically significant result will be addressed afterwards (evaluative comments, paraphrases, summarizations, reinstatement inferences, and predictive inferences).

*Elaborative inferences*. In closer examination, both groups elaborated more when reading the linear version of texts. However, high-WMC readers generated more elaborative inferences than the low-WMC ones in this text mode in both conditions. The low-WMC group elaborated more than the high-WMC one when reading to criticize in the

hypertext mode, even though text mode did not show statistically significant result.

Linear text reading may be less demanding in terms of cognitive load as compared to nonlinear hypertext, as suggested in studies by Lee and Tedder (2003, 2004), for example. However, the influence of hypertext also depends on its structure and the type of reading that is performed.

Considering that during linear text reading elaborative inferences were generated by both WM groups, one can conjecture that being the stimulus texts provocative, highly enhancing the reader to take a side, they elicited more opinions from both groups who felt at ease to draw on background knowledge. So much so that by looking at reading conditions isolatedly, reading purpose did not significantly influence the generation of elaborations. Processes such as elaborations, associations and evaluations involve integrating background knowledge and opinions to the text's ideas and are less demanding cognitively speaking (van den Broek et al., 2001).

According to Gagné et al. (1993) elaborations increase the probability of information to be remembered and used later on, as they connect new information to previous, acquired information, guaranteeing transfer of knowledge and allowing readers to go beyond the written text and also helping remembering the content of the text later. According to van Dijk and Kintsch (1983) when the reader employs his/her topic knowledge to complement details that are not mentioned in the text, inferences that contribute to the integration between information in the text and the reader's prior knowledge are positive and help comprehension and retention. On the other hand, elaborative inferences can also point to an overreliance on prior knowledge in detriment of text information ending up in deficiency in recalling certain details of the text and may hinder text comprehension (Tomitch, 2003). Both groups engaged in a type of processing in which prior knowledge was easily called upon. Especially the low-spans did so in the hypertext mode.

*Text repetitions*. Reading to summarize did not yield significant results in both memory span groups as regards text repetitions. Low-WMC readers generated the same average amount of text repetitions independently of reading condition. On the other hand, high-WMC readers generated more text repetitions in the criticize than in the summarize condition.

Reading to summarize may be seen as a more demanding reading task as compared to reading to criticize as it requires more commitment

to the internal structure of the text. Therefore, it was expected that readers produced more text repetitions in the summarize condition than in the criticize/give opinion condition. A possible explanation for the use of text repetitions by both groups independently of conditions could be the constraints derived from the verbal protocol in itself in the way it was performed in the specific study. Having to read in English and report in Portuguese may have influenced the repetition of text by both WM groups as two important activities were taking place simultaneously: comprehension and translation in order to report. Repeating the text may have seemed faster and more at hand than trying to get the gist of ideas. Especially referring to low-spans, Oliveira (2016) found out that mental translation may have increased the demands of WM resources of low-WM spans as they read a text in English and recalled in L1 Portuguese, suggesting that translation can be detrimental to comprehension for those readers. It remains to be answered why the high-spans also engaged in such processing.

*Associations.* Even though no statistically significant results were shown at $\alpha = .05$, both groups associated more when reading hypertexts. The low-WMC group outperformed the high one when reading hypertexts to criticize. The generation of associations by low-WMC readers in hypertext reading confirms the trend when compared to the generation of elaborative inferences. Low-WMC readers also elaborated more when reading hypertexts to criticize. In the framework by Linderholm and van den Broek (2002) elaborative inferences are seen as necessary to comprehend the text, while associations are generally interpreted as non-relevant to the text's ideas. As discussed above, other researchers classify elaborations as necessary or non-necessary for comprehension, depending on the excessive use of prior knowledge so as to dismiss text information.

As previously addressed, Vonk and Noordman's (1990) proposed that some characteristics of the reader need to be considered if online measures are used: the reader's knowledge and reading purpose control inferences in a balance between costs and benefits.

The standards of coherence model proposed by van den Broek , Risden, and Husebye-Hartmann (1995) (based on van de Velde, 1989) suggests that readers adjust their cognitive effort to the goal they want to achieve when reading (Vonk & Noordman, 1990). When reading to study, readers may engage in a more text-based representation, generating more paraphrases and connecting inferences, employing effort to generate more benefits from the task: a better memory of the reading. Conversely, when reading for entertainment, the representation

of the text will be more global, associating information from the text to one's own experiences, and making more evaluative comments and associations (Gerber & Tomitch, 2008; Linderholm & van den Broek, 2002; van den Broek et al., 2001; van den Broek et al., 1995). In the present study, knowing that they would have to criticize something and being the texts highly controversial in arguments and thought provoking, readers may have felt freer to elaborate and associate more in the condition reading to criticize/give opinion.

*Metacognitive comments*. Reading to summarize in the hypertext mode generated more metacognitive comments by both memory span groups. However, the high-span group outperformed the low one. Both groups generated more metacognitive comments when reading linear texts to criticize than when reading linear texts to summarize, but the high-spans generated more metacognitive comments in this condition. The low-WMC group generated the same average amount of metacognitive comments when reading to criticize in both text modes.

Metacognitive comments are viewed as demanding once they require verbalizations of thoughts and this process would compete for attention and split resources in the effort to comprehend and reflect on comprehension at the same time (Linderholm & van den Broek, 2002). Both reading to summarize and hypertext reading may fall in this spectrum. Qualitative analysis on the kind of reading performed by both groups deserves discussion when looking at link access and the use of other strategies.

Reading to criticize may have been less demanding and low-WMC readers could engage in verbalizations of thoughts. These results seem to partially follow a trend identified in Linderholm and van den Broek's (2002) study. In their research, both WMC groups made more metacognitive comments in the study than in the entertainment condition. However, low-WMC readers made more metacognitive comments in the entertainment condition. In an attempt to learn or memorize text information to be able to accomplish the reading task, readers may resort to strategies that consume less resources.

Another explanation may be that skilled readers (who could also be high-spans) use cognitive strategies in a more successful way than less skilled readers (the low-spans). It is consistent with the discussions provided by Cho and Afflerbach (2017). The authors claim that skilled readers do manage to balance disorientation and comprehension in hypertext as they draw upon strategies to accomplish their goal. Caution is needed not to conclude that low-spans are not strategic. The difference between both groups under discussion may lie on the fact that

strategies may vary according to more and less demanding processes to achieve learning goals.

*Misunderstandings*. Low-WMC readers showed more misunderstandings than the high-WMC group when reading to criticize and to summarize in the linear mode.

Besides being consistent with the trends hereby discussed so far and with previous research (Linderholm & van den Broek, 2002), these results can be discussed in view of what has been found so far in the literature regarding reading in L2. It is still an arena of discussion how WMC can affect reading comprehension in L2. Even though participants in the present study were regarded as proficient readers judged by their intense practice of reading and writing in English as two important academic skills in a language course, some kind of interference of the variable language proficiency may have occurred. Based on Zwaan and Brown (1999) we can contend that a certain level of L2 and general skill on reading are necessary for higher level inferential comprehension and situation-model construction. Again, based on Oliveira (2016), mentally translating the verbal utterances to L1 Portuguese may have caused the low-WMC readers to overtax the cognitive system which in turn impairs comprehension.

The remaining categories that did not display statistically significant results, namely, evaluative comments, summarizations, and paraphrases are going to be discussed in view of similarities to the five inference categories discussed above.

The other two categories that did not show statistically significant results at any alpha level, namely predictive inferences and reinstatement inferences, deserve a qualitative analysis as the total amount generated (03 and 16 respectively) does not seem noteworthy in comparison to the total 1,099 inferences. Due to the specific approach adopted in the present study regarding verbal report in which participants could speak at any time during reading a paragraph and also at the end of the paragraph, this procedure may have influenced the low number of those two categories and the total absence of the category *connecting inferences*. The verbal report approach followed by Linderholm & van den Broek (2002) and other studies in the area based on a similar framework (van den Broek et al., 2001) required the participant to speak at the end of every sentence. In this manner, as a complete idea may not be encapsulated in a single sentence, the generation of predictions (anticipation of what will come next in the text ) and reinstatement of ideas (explanation for the current sentence is based on prior text information that is not in the immediately preceding

sentence) seems to be more likely to be generated. Once a paragraph is supposed to contain a complete idea, in the present study participants spoke during and after the paragraph was read and utterances predicting content, reinstating previous information or connecting idea to previous sentence may not have been necessary at the paragraph level. Both reinstatement inferences and predictive inferences, when did occur, either referred to a more global retrieval of previous information or showed expectations that demonstrated more clearly the awareness of the rhetorical pattern of the text, as the following examples suggest:

Predictive inferences:

P1: *"...fala que existem outras alternativas. Eu espero que eles falem quais são"*

P13: *"Então .... vou ver o que ... os que são contra vão ... vão dizer"*

P13: *"Então no .... no segundo parágrafo da opinião pública .... aparecem uns dados meio desconexos ali. Eu... espero que tenham explicações mais específicas ..... depois"*

Reintatement inferences:

P3: *"Em contraste, a Fundação de Pesquisa biomédica fala que ..... endossa a opinião do professor de neurobiologia e psicologia Dario"* (referring to previous paragraph)

P15: "*E como nós tivemos um parágrafo que diz as coisas boas no outro nós temos um que diz coisas ruins...."*

*P24: "Ele tá falando dos benefícios mais especificamente do Facebook que ele já tinha falado antes ...de aproximar as pessoas"* (referring to the first paragraph)

Based on such analysis, it is reasonable to conclude that the retrospective verbal protocol procedure hereby adopted may have contributed to the low amount of predictions and reinstatements and their negative statistical power so as to point to a lack of interaction between variables.

Following the analysis with the remaining categories with no statistical significance at any alpha level (neither at .05 nor showing a trend at.1), evaluative comments, summarizations, and paraphrases, qualitative discussion will consider the trend by combining those inferences with others of similar nature. That is, elaborative inferences, associations, and evaluative comments are considered situation model inferences because they refer to cognitive processes or strategies that draw upon the readers' background knowledge brought to the text to form the situation model. On the other hand, text repetitions, summarizations, and paraphrases refer to inferences or processes that

rely on the internal structure of the text and are referred to as text-based inferences.

As discussed above, low-spans repeated the text the same average amount across conditions. By comparison, they also summarized the same average amount in both reading purposes, and both WM groups' processes were similar across text modes. High-spans summarized more than the low ones when reading to criticize, similar to what happened to this group with text repetitions.

The generation of paraphrases although not statistically significant seems to be more consistent with what is found in the literature regarding reading strategies that employ more text-based inferences. High-spans paraphrased more in the summarize condition in both text modes. This process is expected to happen in reading purposes that require more involvement with the internal structure of the text because they result in more learning goals.

### 4.3.3 Exploratory data analysis

To further analyze whether by grouping text-base and situation model inferences would account for differences in the processes generated and verbalized in verbal reports hereby analyzed, two paired samples t-tests were run with the sum of the *elaborative inferences, evaluative comments* and *associations*, considered here as situation model inferences (as the first test's dependent variable), since they draw on previous knowledge, and the sum of *summarizations, text repetitions* and *paraphrases*, referred to here as text-based inferences, as the dependent variable of the second test. The two broad categories of inferences were identified as patterns in the studies of Linderholm and van den Broek (2002), Lehman and Schraw (2002), and van den Broek , Lorch, Linderholm , and Gustafson (2001). The independent variable in both t-tests was Condition, with the levels Criticize and Summarize, as used in previous analyses. As evidenced in the boxplots below (Figure 16), no statistically significant differences were observed in either case (Situation Model Inferences: $t(23)=1.11$, $p=.278$; Text-Base Inferences: $t(23)=-0.32$, $p=.750$).

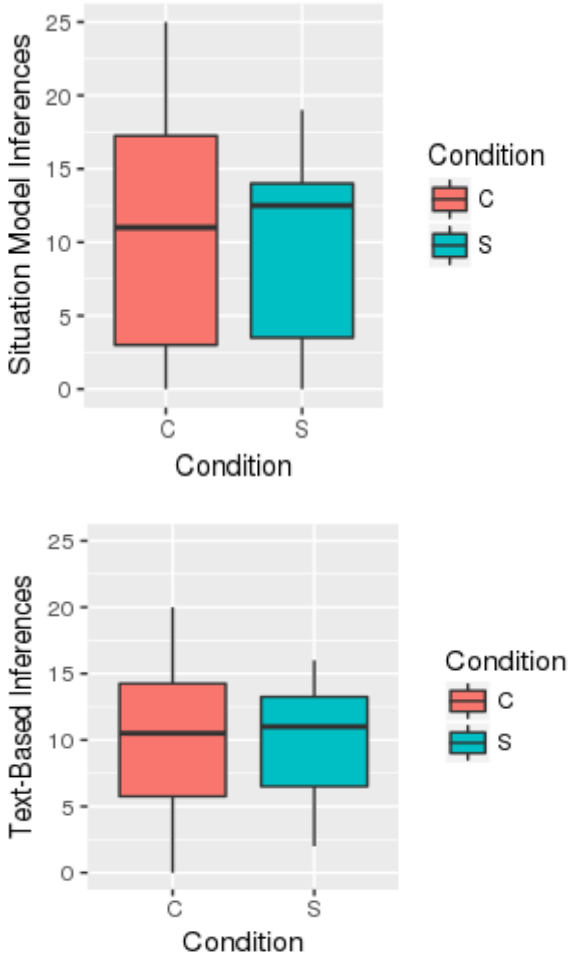


*Figure 16*. Boxplots of groups of situation model and text-based inferences in each condition

Even though not statistically significant, the boxplots in the criticize condition seem to display a more normal distribution than in the summarize condition. If this assumption is possible, then the scores in the post-reading criticize best reflect the reading process in this condition, an issue to be qualitatively discussed.

In a close look at raw numbers, the total amount of text-based and situation model inferences generated by each group as demonstrated in table 31may help qualitative analysis:

*Table 31*
*Total amount of text-based and situation model inferences in each condition.*

| **Types of Inferences** | **Reading to summarize** | | **Reading to criticize** | |
|---|---|---|---|---|
| | Low-spans | High-spans | Low-spans | High-spans |
| **Text-based** | 114 | 124 | 112 | 121 |
| **Situation model** | 116 | 120 | 142 | 122 |

Overall, when reading to summarize, high-spans resorted to more text-based inferences and engaged in text repetitions, summarizations and paraphrases in order to reach learning goals. Conversely, low-spans generated more situation model inferences when reading to criticize, in line with the assumption that somehow low-spans are acquainted with the limited resources and try to find a balance between processes that require more or less from the system with the purpose to achieve learning goals. Whether and how these strategies affected recall is another issue to be tackled in the discussion of the remaining research questions.

When situation model inferences are considered, the low-spans in the present study generated more elaborative comments and associations than the high-span group, especially when reading to criticize in the hypertext mode. Similarly, but with no statistical significance, low-spans evaluated more in the criticize condition when the text mode was hypertext (low-spans: 55; high-spans: 42). In sum, low-WMC readers elaborated, associated and evaluated more in the hypertext criticize condition, strategies that are employed by readers with fewer WM resources because these processes are less demanding cognitively speaking and easier to execute to reach learning goals (van den Broek et al., 2001). The difference between the use of those strategies by low- and high-spans may lie in the fact that high-spans are more likely to check prior knowledge against the text and revise it. Therefore, verbalizing elaborations, evaluations and associations may have been interpreted as non-relevant and were delayed or more suppressed by high-spans, in line with Heitz, Unsworth, and Engle's (2005) view of attentional control. Those readers voluntarily employ attention independently of the difficulty of the task, but rather on the need or not

to control attention and the need to report processes that may not be relevant to the task.

Being hypertexts more demanding in terms of cognitive processing, based on the literature, the observed difference between the total amount of elaborations, associations, and evaluations point to the interpretation that reading in this mode may have been more demanding for low-WMC readers, which could bring about the employment of some remediating actions. On one hand, readers could resort to strategies that require less from the system (Lee & Tedder, 2003), such as generating elaborative inferences and associations that draw on prior knowledge. Criticizing information that pops up seemed to be a non-demanding task. On the other hand, readers could employ strategies that function as fixing-up measures to achieve a goal, in the specific case, avoiding clicking on links, rereading, and conducting a more linear type of reading.

Not accessing all links may be a sign of disorientation or part of a decision-making process, suggesting that low- and high-spans in the present study are strategic readers by employing fixing-up measures to achieve a goal. In support of this claim, qualitative analyses of link access via screen shots examination allow for some speculation on the behavior of readers in the hypertext environment (six low- and six high-WMC readers in the condition reading hypertext to criticize) (see figures 17 and 18).

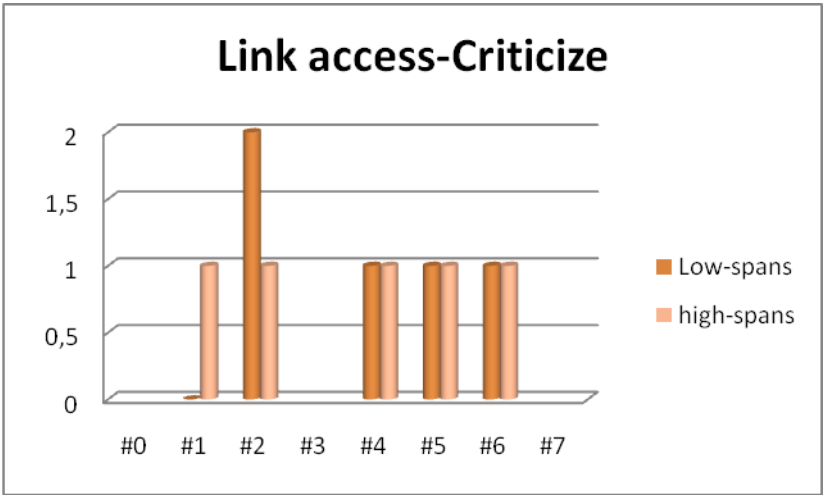


*Figure 17.*Amount of links accessed in the criticize condition, hypertext mode

None of the participants accessed all links in the condition reading to criticize/give opinion in the hypertext mode. Five participants out of 12 accessed most links (5-6) in this condition. Four low-spans reported to have decided not to access some or all links (two in the criticize) and two low-spans did not notice how many links they had read in this condition.

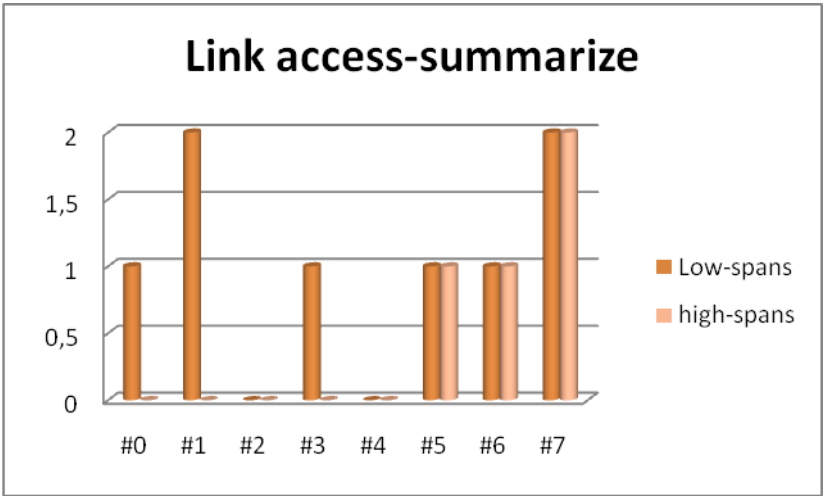


*Figure 18.*Amount of links accessed in the summarize condition, hypertext mode

Conversely, eight participants out of 12 accessed most links (5-7) in the hypertext/summarize condition. Readers in the condition reading to summarize seemed to be more committed to exploring the entire text.

One might conjecture that not accessing links may either have been a choice not to overtax the cognitive system (Lee & Tedder, 2003), or a result of the reader's disorientation (Macedo-Rouet, Rouet, Epstein, & Fayard, 2003). Drawing on background knowledge to facilitate the achievement of the reading purpose could also be a compensatory strategy. Other analysis regarding link access will be further developed in RQ5.

Reading to criticize stimulated the generation of knowledge-based inference and situation model construction in both WM-span groups due to the high-level of controversy of the stimulus texts. Some readers found remediating strategies to cope with the dynamicity of hypertexts. Reading purpose is more difficult to maintain when the task is demanding. Both WM groups seemed to have used different strategies to cope with non-beneficial processes. The low-spans, not being able to

suppress the provocative invitation of the topics in the stimulus texts, elaborated, associated and evaluated ideas that popped up, but found remediating strategies to cope with the dynamicity of the nonlinear text.

Proceeding with the analysis, Research Question # 2 strives to investigate the results of post-reading tasks and their relation to the participants WMC in each condition and text mode.

## 4.4 RESEARCH QUESTION 2

### 4.4.1 Statistical data analysis

*RQ2: How is the reader's WMC related to the ability to recall arguments in each text mode, linear digital and hypertext, as measured by the post- reading tasks in both conditions reading to criticize/give and reading to summarize?*

Correlations between the scores from the Reading Span Test and the recall scores in a post-reading task were analyzed for the two text modes, namely Hypertext and Linear text in both conditions, namely reading to criticize/give opinions and reading to summarize. As previously reported, significant outliers were observed in the data (see APPENDIX W). Since the classical and most well-known correlation coefficient, Pearson's *r*, is not robust to outliers, Spearman's ranks were analyzed instead. Figures 19 and 20 show the plots of the analyses. The correlations were not statistically significant as shown in Table 32. The lack of a well-defined pattern in the plots' lines corroborates the lack of relationship between the variables. Again, the small sample size may have contributed to the negative statistical results.

Table 32
*Correlations between working memory capacity and post-reading task scores*

| **Condition** | $r_s$[a] | | | |
|---|---|---|---|---|
| | *Hypertext* | *p* | *Linear* | *p* |
| Criticize | .21 | .510 | -.25 | .430 |
| Summarize | -.23 | .473 | .38 | .226 |

*Notes. N*=24. [a] Spearman's rank correlation

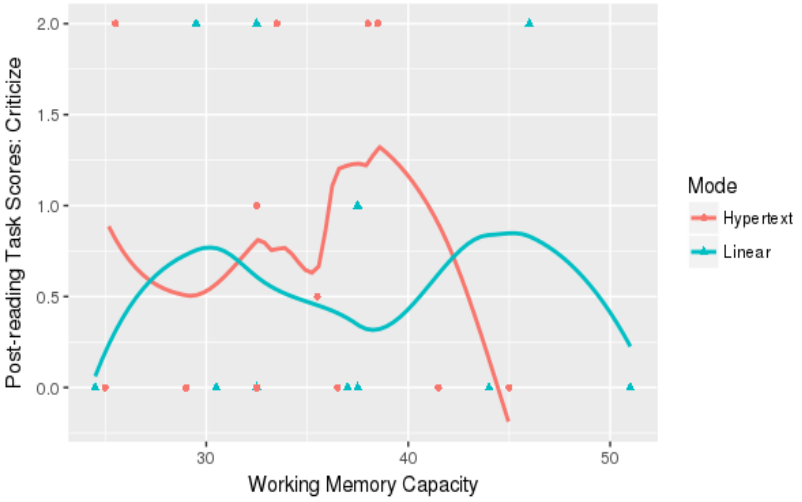


*Figure 19.* Correlations between WMC and recall scores in the hypertext and linear text modes, in the criticize condition.

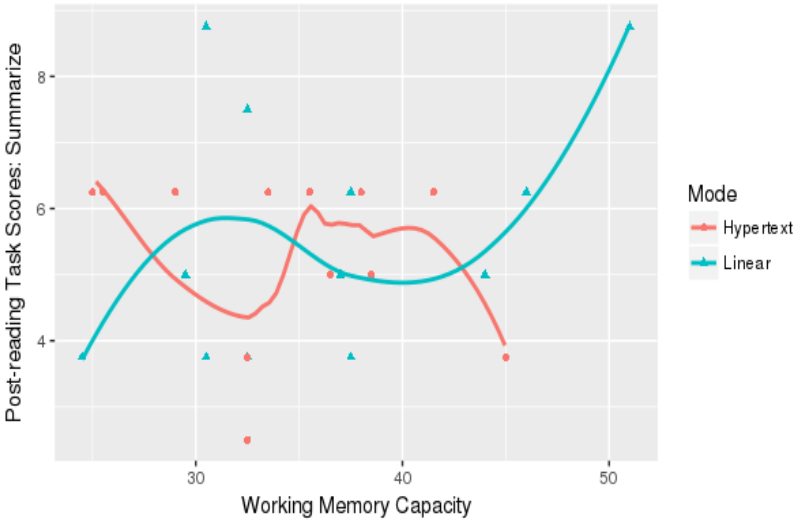


*Figure 20***.** Correlations between WMC and recall scores in the hypertext and linear text modes, in the summarize condition

### 4.4.2 Discussion

The post-reading tasks were scored taking into account the total number of arguments recalled in each condition. The quality of the recalls were not analyzed in the specific statistical test. Instead, the scores considered the amount of arguments even if only key words were listed to the recall.

Even though significant correlations between WMC and scores were not identified in each condition, in the summarize condition scores in general were lower than in the criticize, approaching a floor effect. Only three participants scored 7,0 or higher in this condition in contrast to the results in the criticize condition. From the 10 top scores (7,0 or higher), six were obtained by low-spans in the criticize condition. By triangulating results from RQ1 and scores from the post-reading tasks, and qualitative analysis of post-reading results, it is possible to say that as low-spans produced more elaborative inferences, associations and evaluative comments in the criticize condition, it may have resulted in better recall in the post-reading task in this condition.

Linderholm and van den Broek (2002) demonstrated that low-WMC readers are able to maintain reading purpose in detriment of other processes during reading:

> Another more likely explanation for the current results is that low-WMC readers have some awareness of the fact that they have limited resources and attempt to strike a balance between more and less demanding processes in an attempt to meet learning goals (p.782).

However, in their study, maintaining reading purpose did not result in better recall.

Similar results in which low-spans got better scores than the high ones were identified in Lee and Tedder's (2003) study with two different text modes, linear traditional text and hypertext. Low-WMC readers showed better results than high-WMC readers in the traditional text condition, remembering more from linear traditional text than from hypertext. Again, by analyzing the performance of the low-spans in the present study (six top scores out of ten in the criticize condition), four low-spans scored higher in the linear version of text, and two in the hypertext.

It is important to highlight that texts' characteristics may have played an important role in the results. Reading highly controversial topics to criticize may have enhanced the reader's search for specific information to look at in order to be able to express opinion and elaborating, associating and evaluating may have been choices to

achieve the goal. Texts' characteristics may have benefited the generation of knowledge-based inferences by both groups.

According to Conway and Engle (1994), WMC plays an important role in the retrieval which relies on controlled search rather than on search which is automatic activation. It may explain both groups' poor results in the condition reading to summarize in the sense that readers benefit from clear instructions on what to consider while reading for a better recall. It may be even more important for low-spans. Therefore, being instructed to look at arguments before reading and being instructed to recall a specific number of arguments may have contributed to better scores in the criticize when compared to the summarize condition for the low-WMC group.

Criteria suggesting to look at specific arguments were not followed by 50% of the participants, as the discussion of the RQ4 has concluded. However, allocation of attention to arguments in general as important elements may have allowed the eight or the majority of arguments to be best recalled in the criticize/give opinion condition. Perhaps the general notion that just being for or against in a discussion was taken for granted and other aspects were not considered as the participants did not have search tools to check for credibility of informants and other features that deserved questioning (authority of informants, authorship, among others).

Another relevant aspect to account for when discussing the lower scores on the summarize condition by both WMC groups when recall is considered is that the results may have been affected by the instructions in the pre-reading, by limiting the task to summarization. The post-reading instruction in this condition did not specify the number of arguments to be included in the summary. Independently of WMC, clear instructions influence the outcomes in the products of reading, as proposed by McCrudden and Schraw (2007):

> Text segments can be made more relevant by providing pre- or inserted-questions, instructions to focus on particular text segments, or providing the reader with specific goals for reading. The reader or someone directing the reader, such as a teacher, induces the relevance effect (p.115).

Having asked participants to just summarize the text may not have contributed to a complete account of the relations between this specific reading purpose and the post reading and for the perceived difference between low- and high-WMC readers demonstrated in previous research. Based on a previous study (Gil, Braten, Vidal-

Abarca, & Stromso, 2010a), it is reasonable to conclude that evaluating the quality of summaries and arguments may better demonstrate the difference between groups. In their study, Gil et al. concluded that students reading to summarize performed better on comprehension tasks and wrote more integrated and transformed essays than those reading to write an argument. It remains a question to future studies whether more guided post-reading summarizing tasks with clear criteria may highlight the difference between low- and high-spans and between reading purposes.

Moreover, reading to summarize without a more guided procedure, such as directing the participants to what focus attention to may have contributed to the general employment of misleading cognitive processes as summary quality was not measured. While summarizing, readers may have controlled the number of words (200-250 words) and the number of arguments might have been neglected or condensed in favor of a well-structured summary. For instance, 2 arguments in each text were similar, and could have been recalled as one. When summarizing, participants could have more closely focused on " macrorules" as those proposed by Brown and Day (1983), as summarized by Tomitch (2012, pp. 79-80): deletion of trivial information; deletion of redundant information; superordination of lists; superordination of actions; selection of a topic sentence; invention of a topic sentence.

Having this possibility in mind, summaries were re-evaluated considering the use of the criteria described in Table 33.

Table 33
*Criteria considering quality of summaries in the summarize condition*

| **Criteria** | **Score** |
|---|---|
| - selection of a topic sentence; invention of a topic sentence;<br>- recall of at least 4 main arguments out of 8;<br>- deletion of trivial or redundant information;<br>- it contains 200-250 words. | 7.0 to 10.0 |
| - selection of a topic sentence; invention of a topic sentence;<br>- recall of 2 to 3main arguments out of 8;<br>- use or redundant information, repetition of arguments;<br>- it contains less than 200 words;<br>- it contains opinions and/or information that are not in the text. | 6.0 to6.5 |

The summaries were considered to be average (7.0) or well-structured (8.0-10.0) if they contained a topic sentence that presented a general idea and recalled most or all arguments within the limits of 200-250 words and deleted the redundant information.

Still maintaining the pattern, most of those who recalled more arguments, also did better in the second criteria when the whole summary text is considered. However, grades in the second evaluation are higher (see Figures 21, 22, 23 and 24):

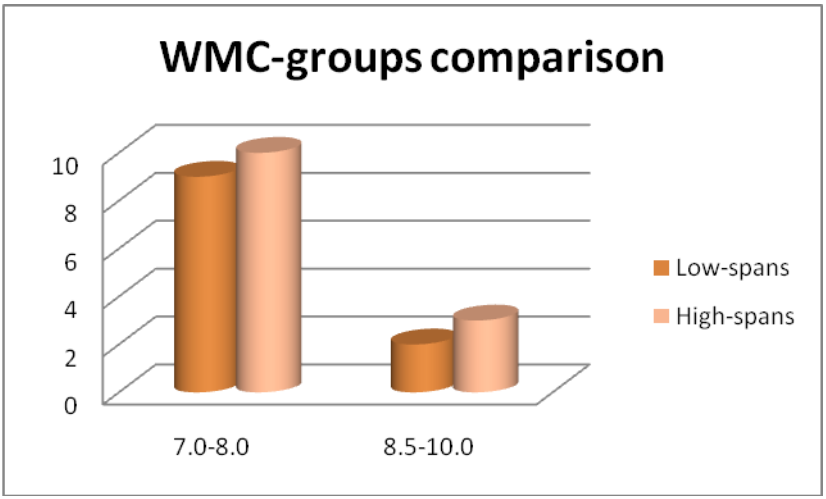


*Figure 21.*Comparison of scores between low- and high-spans in the second criteria

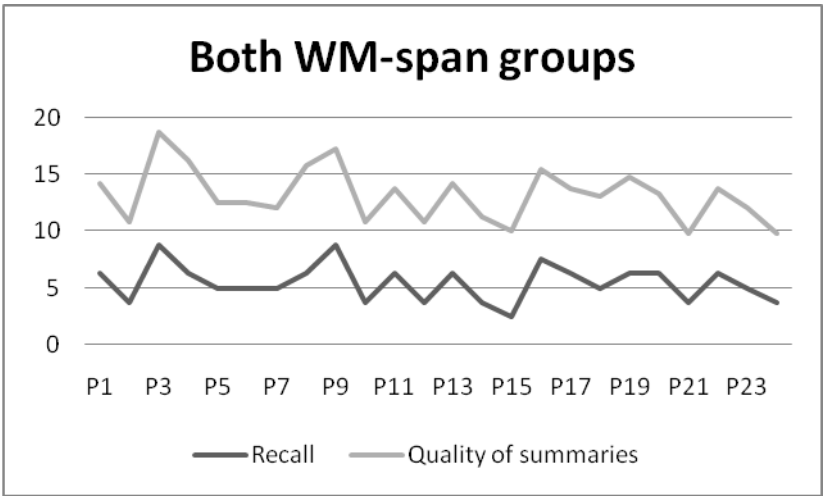


*Figure 22.*Reading to summarize- post-reading task criteria ( both WM-span groups)

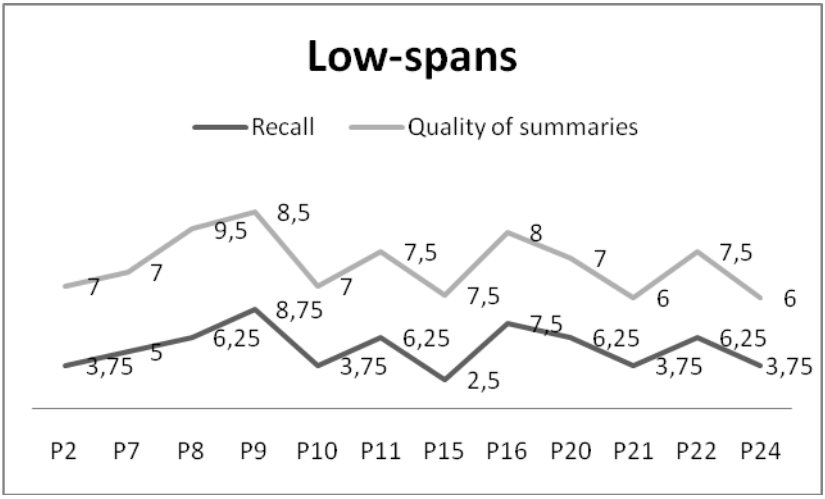


*Figure 23.*Reading to summarize - post-reading task criteria (low-span group)

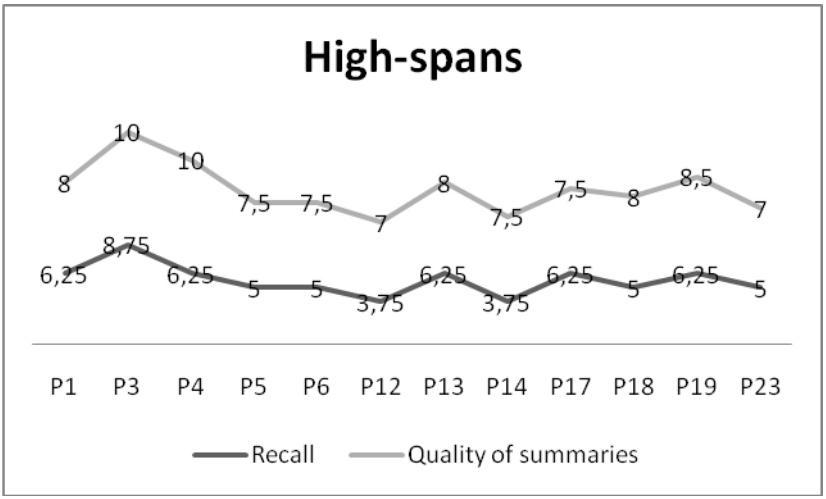


*Figure 24.*Reading to summarize- post-reading task criteria (high-span group)

As it can be inferred from the comparison between different criteria, both WMC groups maintained the trend. However, scores in the second criteria seem to be more consistent with the total amount of text-base inferences generated in reading to summarize. That is, by changing criteria, the amount of text-based inferences (text repetition, summarizations, and paraphrases) generated by both WMC groups (low-spans:114; high-spans: 124) in the condition reading to summarize did contribute to a concise summary. High-spans performed better in this condition than the low-spans as they produced more text-based inferences resulting in more learning goals. These results are more consistent with those in previous research (Linderholm & van den Broek, 2002; van den Broek et al. 2001), although the recall measure used in their study was number of idea units.

These results are also consistent with those presented by Garnham (1981) (as revised by Kusiak-Pisowacka (2016). Inspired by mental model theories, Garnham found that the pattern chosen by readers on a memory test following expository reading was dependent on instruction. That is, when readers knew a memory test would follow the reading task, they seemed to have processed the texts as mental models showing difficulty in recalling the text at the prepositional level.

Validity of the second criteria applied in the present study especifically in RQ#2 was not statistically tested and may be questioned as summaries were not submitted to raters who were blind to conditions.

In any case, offline measures should be adapted so as to provide a safe ground of discussion and for a better account of cognitive processes occurred during online processes.

## 4.5 RESEARCH QUESTION 3

### 4.5.1 Statistical data analysis

*RQ3: How is WMC related to reading time in each condition, reading to criticize/express opinion and reading to summarize?*

Correlations between the scores from the RST and Reading Time were analyzed in both conditions, namely reading to criticize/give opinions and reading to summarize. As participants were encouraged to behave naturally during the reading process, it was predicted that links could not be accessed conforming with each individual's reading habit or need in the nonlinear hypertext. Therefore, the research question under analysis did not include text mode as an independent variable. In addition, observation of screen shots identified several participants who did not access all or some links. In total, participants spent 167 min and 22 sec to read the hypertext and 193 min and 52 sec to read the linear text and this difference may in part be due to some participants not accessing some or all links.

Reading time was recorded in minutes and seconds (e.g: P1, reading Text 1, took 04 min and 31 sec) and reflect the actual time spent on reading or rereading.

As previously reported, significant outliers were observed in the data (see Appendix V). Since the classical and most well-known correlation coefficient, Pearson's r, is not robust to outliers, Spearman's ranks were analyzed instead. Figure 25 shows the plot of the analysis. While the correlation in the criticize condition approached significance at the .05 level (p=05), the correlation in the summarize condition was just significant (p=04 < 05) as shown in Table 34. The lines, especially in the summarize condition, show a curve-like pattern suggesting that the high-WMC participants read faster than the low-WMC ones.

Table 34
*Correlations between Working Memory Capacity and Reading Time*

| **Condition** | $r_s$ [a] | *p* |
|---|---|---|
| Criticize | -40 | .055 |
| Summarize | -41 | .046* |

*Notes*. *N*=24. [a] Spearman's rank correlation * < .05

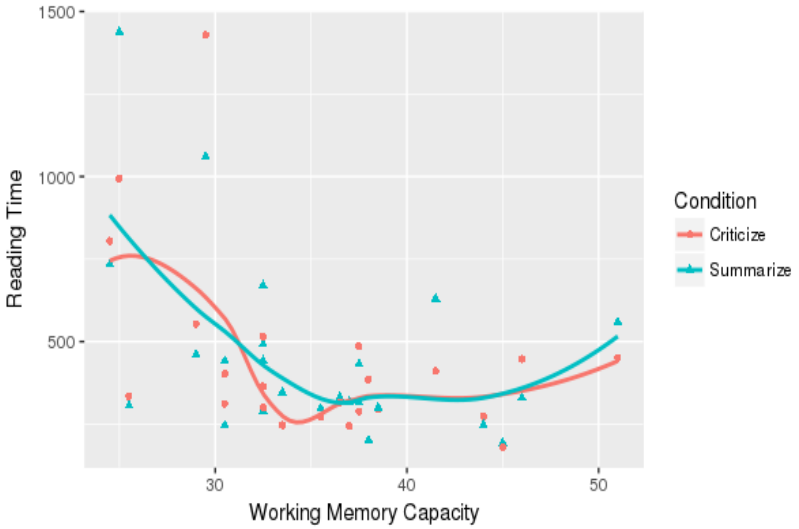


*Figure 25.* Correlations between WMC and reading time in the criticize and summarize conditions

Both groups took longer to read the texts in the summarize than in the criticize/give opinion condition. The low-WMC readers read slower than the high-WMC readers when reading to summarize (p=04 < 05).

### 4.5.2 Discussion

Previous studies corroborate the assumption that low- and high-WMC readers emphasize different reading strategies when reading for different purposes. The study by Linderhom and van den Broek (2002) is one of such example. Based on that and on the results of reading time herein presented, low-WMC readers employ rereading strategies and

high-WMC emphasize comprehension monitoring. As I am opposing reading to *criticize/give opinion* and reading to *summarize* to the typical purposes reading for *entertainment* and reading *for study*, respectively, traditional previous studies have corroborated the assumption that low-WMC readers take longer to read when reading to summarize, as compared to reading to criticize (Linderholm, Cong, & Zhao, 2008; Linderholm & van den Broek, 2002). Reading time was 40% longer for the low-WMC group in the summarize condition.

When recall of arguments scores are considered in this condition, reading time did not contribute to learning for low-spans. However, if summaries are evaluated on basis of main idea construction and specific criteria for accuracy and conciseness as qualitative analysis of RQ# 2 has demonstrated, both WMC groups did engage in a more in-depth reading when the purpose was to summarize. With a slight difference, it is reasonable to assume that high-WMC readers did better than the low-spans in the post-reading summarize condition when quality of summaries is considered(see Figure 21). Moreover, both WMC groups adjusted processing to reach learning goals, but the pattern of processing adopted by low-spans in the summarize condition affected the post-reading results in a negative way (Linderholm & van den Broek, 2002).

## 4.6 RESEARCH QUESTION 4

### 4.6.1 Qualitative data analysis

*RQ4: What is the effect of the specific instruction to consider the issuers in the post-reading criticize/give opinion task?*

The qualitative analysis hereby presented will not take into account the text modes used in the experiment, namely, linear digital and nonlinear hypertext, as no pattern was identified so as to support claims related to text mode. Being the participants of the present study proficient readers of a language course, it is sensible to suggest that they may read quite equally in either text mode.

As previously detailed in the Method section, readers were instructed to allocate attention selectively to a particular aspect of the text, that is, to the issuers of opinions in order to base their own on the post-reading criticize condition. It was expected the participants noticed that the opinions under the Specialized Opinion subsections in both texts were better supported and that the opinions under the Public Opinion subsection were opinions from the general public, with a high level of moral and passion involved. Arguments pro and con in each subsection

were even. To check whether the instruction was followed, question 3 of the post-reading task asked participants to give their opinion on the topic and say why they were for or against a certain argument.

In general, results show that the instructions were not fully followed by all participants. Fifty eight percent of the experimental group (14 participants) listed arguments that they themselves referred to as most closely related to what they believe. Those readers who did not use the suggested criteria to select issuer considered the relevance of being for or against the topic based on personal opinion and common sense rather than filtering out who was issuing the opinion.

Taking into account that participants may not have considered the issuer of opinions when positioning themselves given the highly controversial aspect of the topics, and, moreover, in order to confirm if instruction was taken into account when selecting the best arguments, questions # 4 and # 5 of the post-reading further investigated the criteria selected by each participant when supporting their arguments with opinions from the text. Answers to those questions were classified into three groups: based on *previous knowledge*, based on *personal opinion/beliefs*, and those that considered *the issuer* (Tables 35 and 36).

Table 35

*Answers to question # 4: Criteria used to base your own opinion*

| **Previous knowledge** | **Personal opinion/belief** | **The issuer** |
|---|---|---|
| P1–P3–P5 – P6 – P7**<br>P8 – P10 – P11**- P12<br>P13–P15–P18–P19<br>P20 – P21– P22 – P24 | P2– P4 – P14 | P7 – P9 – P11 |

*Notes.* * Other participants did not make clear the criteria followed
** reported to have used both, previous knowledge and issuer

Table 36

*Answers to question #* 5: *Did you consider the issuer?*

| **Previous knowledge** | **Personal opinion/belief** | **The issuer** |
|---|---|---|
| P2 – P4** – P8 – P10 –P21 – P23 – P24 | P11** - P5** - P15 | P4 – P5 - P7– P8–P11-P12–P16–P17– P19 – P20 |

*Notes.* * Other participants did not make clear the criteria followed
** reported to have used previous knowledge/personal opinion and issuer

Due to the inconsistencies between answers given to questions 4 and 5, with participants giving one answer and then the opposite, I

further investigated which participants did use some arguments based on Specialized Opinion when answering question 3 (*What arguments do you agree with? Why?)*. Although the difference between those who used it and those who did not is not high, most participants based their arguments on previous knowledge and selected arguments that were more closely related to their personal view on the topic. A group of 10 participants, 41.66%, (P5, P7, P11, P16, P17, P19, P20) selected arguments based on the Specialized Opinion subsection, following the instruction that suggested the issuer should be considered at the beginning of the reading task and, according to Table 36, which summarizes the awareness of selecting the issuer. These participants show a consistency between the answers given to question # 3 and their awareness of the instruction. Only one participant, P12, partially followed the instructions and selected Specialized Opinion only minimally, explaining that the choice was based on the issuer only if the argument coincided with his/her own. Even though P4 and P8 reported to have considered the issuer, they admitted to have relied on previous knowledge on question # 4, and question # 3 confirmed that. P1 and P15, even though they partially based their opinion on the specialized opinion, they were not aware of that, as evidenced by the answers to questions 4 and 5. The other 12 participants either revealed that they did not take any ideas presented in the text into consideration or did not focus on the issuer, only on the pro/con aspect, picking those opinions they agreed with.

### 4.6.2 Discussion

The direct instruction to pay attention to the issuer in the criticize/give opinion condition may have been neglected in favor of other processes according to the relevance the readers assigned to the task. Based on Daneman and Carpenter (1980), if during reading information is not given enough attention so as to facilitate encoding to happen, storage of that information in long-term memory may not occur. If by following the instruction the reader had focused on specific aspects, it would be a way to facilitate retrieval on later recall. Effects of reading purpose in the reading to criticize/give opinion may have spread to other aspects of the texts, for instance, the controversial topics addressed by the stimulus texts, the pro/con characteristic of arguments. Moreover, several other aspects of the stimulus texts deserve a critical evaluation such as the lack of an author (mentioned by two participants),the lack of a representative of an institution (e.g.: *The*

*National School Boards Association (NSBA) stated the following…,* to mention a few).

Previous research aids interpretations hereby presented regarding evaluation of ideas during reading. Sparks and Rapp (2011) investigated the influence of credibility of sources while reading narratives in 4 experiments and found that only when given explicit encouragement before and during reading to evaluate source credibility the judgement took place as a spillover effect, that is, in subsequent sentence for which the evaluation should take place. This effect corroborates the assumption that the reader can only evaluate content when reading is complete. According to the authors, readers may not judge the consistency of information until they have both "a) comprehended that information and b) evaluated its consistency with the active contents of memory" (p. 243).

Another possible explanation comes from a review comparing several studies on relevance, both general relevance and specific relevance instructions, and goals for reading by McCurdden and Schraw (2007). Important patterns emerged from the review and may help understand the results of the present study pertaining to the effect of instruction. The first one is that if a reader assigns relevance to certain text segments, other segments that do not fit the reader's task perception may be considered less or non-relevant and learning does not take place. It might be the case in the present study of those participants who reported to have used previous knowledge or personal opinion to select the arguments to support their own. The ideas pro and con popped up and called more attention than the issuer, after all what is made relevant or not also depends on individual interests(McCrudden & Schraw, 2007). McCrudden, Magliano, and Schraw (2010) posit that personal intentions do influence strategies enacted to meet reading goals, which affect processing of more or less relevant information to that goal, influencing memory.

As readers do not always apply their knowledge about argumentation while reading, scaffolding may be a better guide to develop readers' focus on subtleties and better integrate text-based and knowledge-based inferences and construct a deeper comprehension of the text. (Lin et al., 2014).

As the reading purpose required the participants to criticize, it may have been understood by most readers as choosing one side, possibly the one it is agreed upon. McCrudden, Magliano, and Schraw (2010) claim that it is still unclear to what extent personal intentions interact with given intentions and the way readers utilize relevance

instructions to establish goals and enact strategies to reach those goals.

Previous studies have enhanced the difference between readers who hold a more naïve belief about certainty of knowledge and those readers who adopt a more evolving rather than an absolute view of knowledge (Braten et al, 2011; Gil et al, 2010a) and engage in a more critical stance towards what is being presented. After all, reading should have the ultimate goal of adding to one's previous knowledge.

## 4.7 RESEARCH QUESTION 5

### 4.7.1 Qualitative data analysis and discussion

*RQ5: What reading strategies are deployed in each condition: digital linear and digital nonlinear hypertext; for summarizing and criticizing/giving opinion?*

In order to answer Research Question # 5, analyses of reading behavior such as link access, underlining, note-taking, rereading and focus on reading will be disclosed by means of data collected during reading both texts and information given by the participants via the self-evaluation questionnaire, in which participants were required to report on their observed behavior during reading, and the demographic questionnaire.

The 05 items of the self-evaluation questionnaire, namely: *i) reading performance awareness; ii) awareness of behavior; iii) concentration difficulty; iv) need to reread*; and *v) topic interest*, helped this researcher to check and compare behavior and the participants own perception of the process, once I am interested in verifying the level of attention employed in reading hypertexts and how it may have contributed for the sense of disorientation, as it has been advocated by previous research (Waniek, 2012; Madrid et al., 2009) or deliberated action to achieve the task.

As previously described in the Method section (subsection 3.2.2), the hypertext version of the texts contained seven hyperlinks, with complementary ideas embedded in links so as not to compromise the recalling of main arguments in case a participant did not access some or all links. As recalling of arguments was the objective of the post-reading tasks, it was deemed important to add only details to the nodes. The hyperlinked information was accessed by clicking on the expression more, highlighted in blue and underlined. The access of links was

observed by analyzing the screen shots collected during the experimental sessions. Figure 26 below summarizes link access by participants:

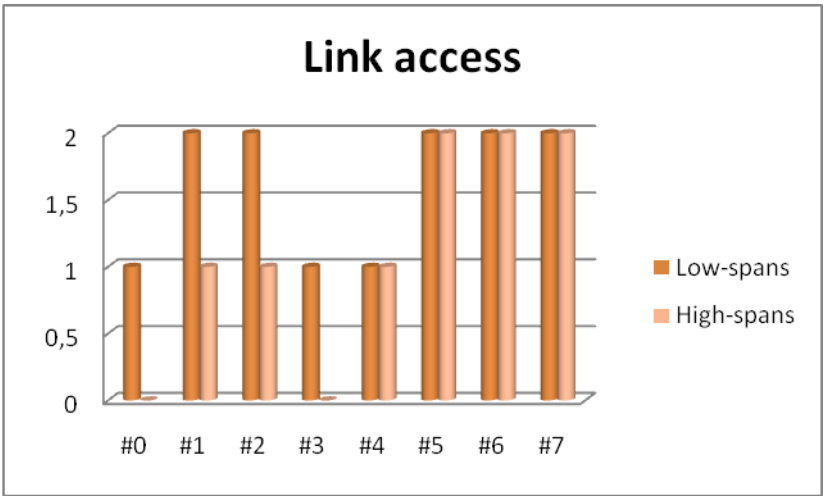


*Figure 26*. Number of links out of 7 accessed by the WMC groups

As the self-evaluation questionnaire was handed in immediately after the post-reading task to most participants, it was expected that it revealed participants' perception about their own process. The results are summarized in four main items that resulted from the answers provided in the questionnaire (see Figure 27).

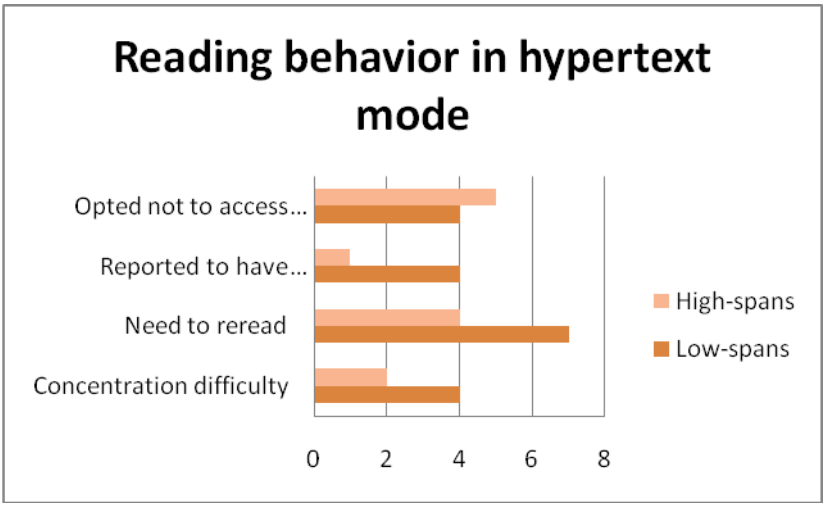


*Figure 27.*Self-perception of reading behavior in hypertext mode
*Note.* Items *i) reading performance awareness* and *v) Topic interest* are not represented in the figure and are discussed separately.

The analyses of two items from the questionnaire, *i) reading performance awareness* and *ii) awareness of behavior*, allow for some speculations about decision making when encountering a link. As aforementioned, the reader as the agent of the process of reading is augmented with the features of hypertexts (Lee & Tedder, 2003)and the two questions of the self-evaluation questionnaire intended to verify to what extent not accessing links were choices readers made or just a result of disorientation.

From those who accessed some or all links, when asked if their reading performance was different in the two text modes, with and without links, (item *i, reading performance awareness*), five of them stated that their reading performance was the same, that is, no disruption was noticed because of links. Fifteen participants revealed that the links gave more information and helped in comprehension, clarified, explained, complemented and extended ideas, and that the extra information had helped on general idea and reflection, stimulating critical attitudes and curiosity, and made the text stronger and more interesting. Some of those participants who believe links can help in extending ideas of the primary text also blamed the links either in item *iii)concentration difficulty* or in item iv) *need to reread* (P10, P18, P20, P22, P24).

Considering that four of those are low-WMC readers, even though it may seem contradictory, it may be the case that those readers do see hyperlinked texts as augmenting the possibilities of exploiting other information outside the text being read on one hand, but are aware that links become an extra load to the cognitive system.

Previous research supports the claim that as well as helping the reader on adding to the text, links may disrupt fluent reading as decisions have to be made, interrupting the linear flow of the task (Kamil & Chou, 2009). Even if the number of links are minimal, their presence triggers the decision-making process that can either help the reading experience or augment the complexity of comprehension, or both (DeStefano & Le Freve, 2007).

Having or not accessed all or some links may be a matter of choice (Lee & Tedder, 2003) or, as it has been previously discussed, a result of the reader's disorientation (Macedo-Rouet, Rouet, Epstein, & Fayard, 2003). It may well be the case of those readers who did not access all links (only 5 or 6) and reported to have accessed all of them (P3 – P10 – P15 – P22 – P24). Still, two participants (P12 – P13) did not notice the presence of some (P13) or all links (the case of P12). Seven participants reported to have opted not to access some links (P1 – P4 – P8 – P9 – P16 – P17 – P19) and two decided not to access all links (P5 - P20). This decision is quite similar between WMC groups as we can interpret from Figure 27 with disorientation being more present among low-WMC readers with a slight difference.

When asked in the demographic questionnaire about their reading practice when reading hyperlinked texts on the Internet, 13 of the participants reported to explore all links and 11 participants said they read the whole text first and decide on accessing or not the links at the end. Most of those who deliberately did not access all links in the present study reported to do the same when reading on the Internet (P4 – P8 – P9 – P16 – P19), four of those being low-spans, allowing for the interpretation of awareness and self-regulation to achieve a purpose.

The item *iii) Concentration difficulty* asked participants in which of the two modes (with or without links) it was noticed concentration problem, three participants related the concentration difficulty to topic, but did not mention in which text. Seven reported having problems with linear texts, but did not say what the problem was, seven did not have problems. One participant stated that links help in the post-reading and the other who decided to click on links only when the primary text was read. Six participants (four low-spans) blamed the links saying they affect recall, the blue word "more" disturbed meaning, break the flow

and are slow, felt less concentrated, clicking on links and going back to contextualize, too many elements on the screen (P14 -P16- P18- P20 – P22 – P24). Participants within this group who related links access to some concentration difficulty are evenly distributed across conditions (3 in summarize and 3 in criticize).

In item *iv) need to reread*, 11 participants reported to have noticed a need to reread the nonlinear hypertexts. Some reasons listed are: links are distracting (2x), more attention is needed to relate information, knowing links exist disturbs concentration, links bring more information. Only one participant pointed the topic of the text as a reason to reread and six did not mention the reason.

The reasons listed by those participants conform with Kamil and Chou's (2009) assumptions that reading hypertexts differ from traditional forms of texts and beyond following links, one needs to integrate the ability to return to the original text and integrate information within the text and across links. The sense of not having account of the whole or that the whole is scattered may contribute to this feeling.

Results summarized in Figure 27 in which more- low-WMC readers reported a need to reread the hyperlinked text triangulated with cognitive strategies quantitatively analyzed in RQ1 are backed up by the literature and together corroborate the assumptions that disorientation provided by the environment seems to impede those readers from having the complete account of the entire text and of all tasks to be performed, in view of the fact that most of those readers did not remember how many links and if they had accessed all links. It is important to highlight that the actual question that provided results for item *iv) need to reread* did not tackle if the participants did reread the text as a whole. Instead, the question was*: In which text mode did you feel like rereading: linear or nonlinear hypertext?* Rereading did occur at the sentence or paragraph level, as it will be further discussed together with other strategy use collected via screen shot analyses.

Even though the version of hypertexts used in the present study do not present many links embedded in other links and the information in nodes were short, the expectation of the reader in relation to the dynamics involved in reading hypertexts may have influenced the participants in deciding not to access links. Both texts have almost the same number of words, including the information in nodes (Text 1 with 660 and text 2 with 661 words). The decision not to access some or even all links most reported by high-WM spans and closely followed by low-spans suggests that besides deciding what works or not to achieve

comprehension is a characteristic of good readers. This trend of high-spans also corroborates the assumptions that high-WMC readers are more aware of their behavior as they can focus on pre-determined objectives and block intrusion from what they judge as interfering in the process (Heitz, Unsworth, & Engle, 2005). However, caution should be taken when discussing procedural knowledge employed by low-spans, especially due to the fact that participants of the present study are highly functional university students and may read as well in different reading situations. Moreover, features of both digital texts (linear and nonlinear hypertext) used in the present study may not have triggered consistent observable differences between groups, as discussion of the demographic questionnaire will suggest next.

Based on the demographic questionnaire, organized in the following Figures (28 and 29), one can infer that the reading habits of the participants include digital texts. However, this practice is more enhanced when reading for entertainment.

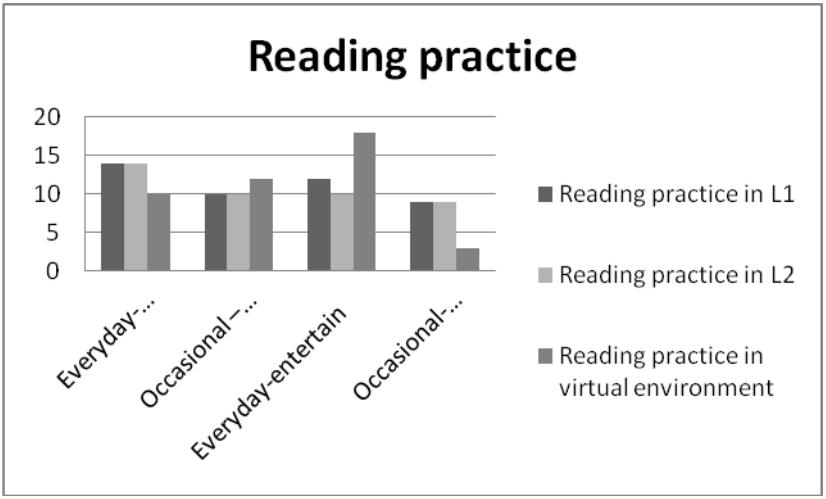


*Figure 28*. Reading practice reported in the demographic questionnaire

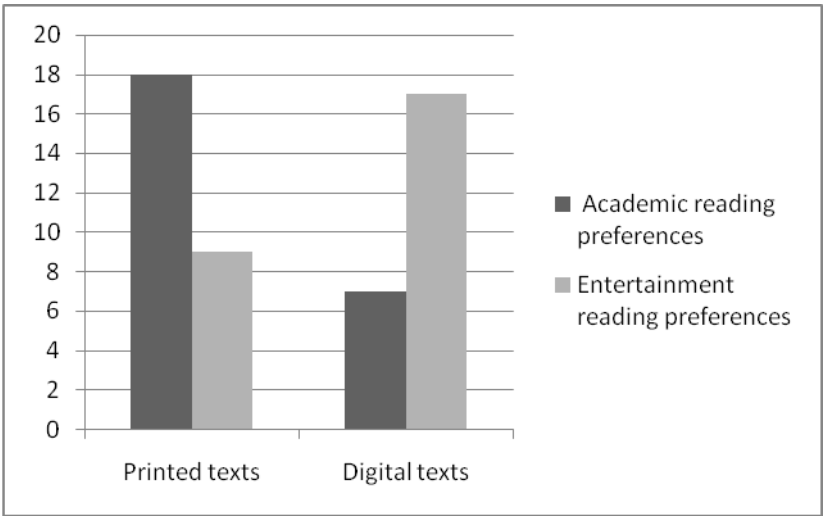


*Figure 29.*Reading preferences

When reading requires more focused and in-depth learning, the preference is for printing texts. The analysis corroborates previous studies on strategies and inferences generated in similar reading situations provided in studies such as van den Broek et al.'s (2001) and Linderholm and van den Broek's (2002). Reading for entertainment does not seem to require a more text-based learning and readers tend to engage in a more surface reading. This result is also consistent with tendencies that arose in RQ1 and the significant moderate correlation between reading purpose and reading time in RQ3.

Topic interest is another aspect which affects reading comprehension. Clinton and van den Broek (2012) found a positive relationship between topic interest and recall or accurate answers to comprehension questions. Even though readers may be aware of their level of interest, self-reports depend on how much they are willing to reveal their level of interest (Schiefele, (1992) as summarized in Clinton and van den Broek (2012).

Despite being interest a subjective construct and difficult to measure, I directly asked participants to report on their interest on the topics discussed in the stimulus texts my means of self-evaluation questionnaire, item *v) topic interest.* Eighteen out of 24 participants revealed interest in both topics discussed in the stimulus texts and five preferred one of them (one participant did not find any of the two texts interesting). Triangulated with item 9) *Level of concentration on*

*Internet reading* from the demographic questionnaire (handed in prior to reading) and which approaches the participants' reading practice, it is possible to infer that the level of interest in the topics discussed in the stimulus texts did not negatively influence the pace or any other result in the present study. Item 9 revealed that the participants' perception of their own level of concentration is related to topic interest (for 19 participants – 79.16%) and only seven readers interpreted their level of concentration to require some effort because it is always impaired on Internet reading.

As previously detailed, screen shots of participants behavior during reading allowed for inference of some patterns regarding the repetition of procedures within and across participants. Three main strategies were identified: rereading, highlighting, and note-taking.

Some other procedures appear in less frequency such as reading aloud or subvocalizing. These strategies also seen as improving comprehension were employed by four participants (P5, P6, P19, P23), all high-WMC readers. Two of them read aloud or subvocalized while reading both texts. Individual differences are expected to play a role in such strategy use as this pattern is not a strong feature among participants and were recursive across text modes and conditions.

*Rereading.* Data collected from screen shots considered the use of scroll bar and mouse arrow, as well as time and other features that could indicate rereading of excerpts or paragraphs was taking place (e.g.: participant started speaking and stopped to reread). Results are summarized in Figure 30:

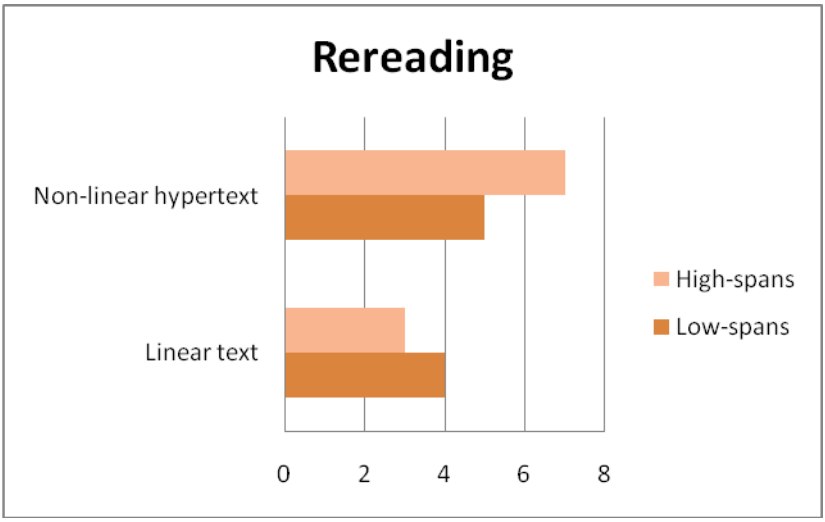


*Figure 30.*Reading behavior

During reading hypertexts, 12 participants (P2, P3, P4, P5, P6, P7, P10, P11, P13, P16, P17, P19) resorted to the strategy *rereading* as compared to seven participants in the linear version of texts (P2, P4, P6, P16, P19, P22, P24). Reinstating the procedural knowledge proposed by Gagné et al.'s (1993) framework, comprehension monitoring is seen as a high-level process (Tomitch, 2011) and refers to the reader's awareness of his/her cognitive processes to reach a goal. Thus, selecting a strategy to achieve comprehension and deploy remediating actions in case the goal is not being achieved is part of the reader's metacognition. However, not all participants who reported the need to reread the whole text in the self-evaluation questionnaire item *iv) need to reread* seemed to have used this strategy in each paragraph or even in excerpts. From 11 participants who revealed they needed to read the text again, only P17 used this strategy along the paragraphs. Perhaps those ten participants could only notice the need when they felt global coherence was not achieved and they could not integrate ideas in the whole text into a situation model (Lehman & Schraw, 2002).

Rereading may also be a result of some kind of disorientation. For five participants rereading was done after clicking on links. After reading the node, those participants returned to the primary text and seemed to be reading the paragraph again. From those participants, two were low-WMC readers, who also reread two nodes. Besides the need of rereading, forgetting to perform a task may be a sign of disorientation as

a result of resources being drained away as attention must be allocated to several tasks. Seven participants forgot to report (P9, P11, P13, P19, P20, P22, P23, 04 low-spans) in at least one paragraph during the experiment (five in the hypertext mode), and they had to be reminded by the researcher to continue speaking.

According to a study by Freund, Kopak, and O'Brien, (2016) some readers may spend more time reading in an attempt to be better prepared for a post-reading test. It is a characteristic of less skilled readers, while better readers may resort to highlighting and reviewing. Torres (2003) also found that readers who face some constraints during the process (e.g.: processing bottlenecks), may resort to some local strategies, such as rereading or translating.

*Highlights and note-taking.* As previously discussed, highlighting important information in the text is a study strategy that readers employ when they are monitoring their progress and are trying to achieve comprehension (Li, Tseng, & Chen, 2016). Such a strategy may aid the reader in directing attention for reviewing and encoding. Participants of the present study where encouraged to use whatever procedures they were used to during normal reading that they believed could help them remember information later as they were warned that the texts or any notes would not be available during the post-reading tasks.

When asked in the demographic questionnaire about their most used strategy while reading digital texts, ten participants reported to use underlining/highlighting and 11 to use note-taking and summarizing. In closer inspection, participants maintained the same procedure in both text modes (see Figure 31):

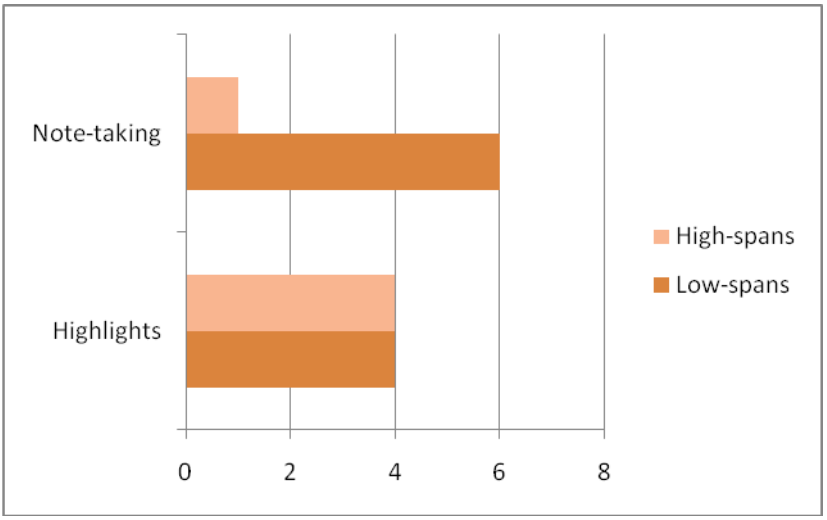


*Figure 31*. Analysis of screenshots on reading strategies

The analysis of the screen shots identified 8 participants who highlighted excerpts during reading both text modes and conditions (P2, P4, P8, P12, P15, P17, P19, P22) and one who used the procedure in the linear version to summarize only (P5) and two who highlighted during hypertext reading to summarize only (P13, P18) . The strategy can be said to be part of the readers' characteristic in both groups, low-WMC (four participants) and high-WMC readers (seven participants) and text mode does not seem to play a role as the use of this strategy is almost equally distributed between linear and nonlinear texts.

As regards the note-taking procedures, seven participants took notes either on paper sheet or in the table provided on the right side of the stimulus texts (P4, P7, P9, P11, P15, P21, P22), six of them are low-WMC readers. Three of them took notes either after reading every paragraph or after reading most paragraphs by using keywords, by copying and pasting excerpts from the text. Only two participants did not take any other procedure besides reading and scrolling down when necessary and reading links.

Still regarding strategy use while reading, the demographic questionnaire aided in the disclosure of reading behavior in other forms of reading such as the reading of printed texts. Even though printed texts were not used in the experiment, the questions in the demographic questionnaire considered the possibility of gathering data to compare and contrast with the digital texts in case text mode *per se* did not

provide evidence for differences across participants. The demographic questionnaire revealed that the most common strategy used by participants when reading printed texts are: underline/highlight (21 participants); take notes/summarize (20 participants).

Underlining/highlighting, taking notes, and summarizing are combined procedures adopted when texts are printed. However, there is a slight change when they read digital texts or hypertexts, in which case their favorite procedure is still to underline/highlight, but they also summarize in paper, copy excerpts to a file (three participants), take notes in paper sheet (four participants). This comparison provided some evidence that strategies change according to the text mode when printed texts are compared to digital ones. While reading printed texts, readers resort to the underlining/highlighting and note-taking pattern, and do it more often. When reading digital texts, other possibilities are at hand and using the paper sheet or saving the text for later reference seem to provide more confidence to the reader that information will be available for checking later. The combined procedure underlining/highlighting and taking notes seemed to be more consistent among participants in printed texts, while digital texts require some additional strategies as taking notes on paper seems to be more physically disconnected from the digital source, the text.

As both texts in the present experiment where digital, differences across text modes were not identified as far as underlining/highlighting and note-taking are considered. Procedures were recursive across conditions and text modes within the same participant, being the choices more possibly related to other variables than to the text mode, such as individual differences in strategy use to compensate for WM limitations, topic knowledge, density of topic, need to report or the participants revealed preference for printed texts, ending up in similar procedures across text modes. Variations in the amount and type of procedure may as well be due to characteristics of the texts.

# 5 FINAL REMARKS, LIMITATIONS OF THE STUDY, SUGGESTIONS FOR FUTURE RESEARCH, AND PEDAGOGICAL IMPLICATIONS

In this chapter, first, results provided by the research questions will be summarized. Second, limitations of the present study regarding sampling and method will be suggested. Following that, suggestions for future research are presented. Finally, implications for teaching reading are discussed.

## 5.1 FINAL REMARKS

It was the purpose of this study to analyze reading comprehension from the perspective of a cognitive process regarding working memory and its relation to inference generation and other cognitive processes in reading to criticize/give opinion and reading to summarize in two text modes: linear digital and nonlinear hypertext. Departing form the discussion of contemporary trends in text comprehension, it was presumed to be important to consider new forms of reading, such as digital linear and nonlinear hypertext, as new forms of literacy emerged with the Internet and have imposed new challenges to practice, teaching and research.

According to van Dijk and Kintsch (1983), readers employ strategies based not only on text characteristics, but also on his/her world knowledge and goals. Research on inference generation has shown that readers' goals, text characteristics, context, and language proficiency influence the mental representation of text (Gerber & Tomitch, 2008; van den Broek, Rapp, and Kendeou, 2005; van den Broek et al, 2001; 1995; Linderholm & van den Broek, 2002; Zwaan & Brown, 1999; Graesser & Kreuz ,1993; Vonk & Noordman's, 1990, to mention a few).

Within van Dijk and Kintsch's model (1983), when discussing reading comprehension, it is essential to consider that understanding happens at three levels: the surface code, the text base representation and the situation model. These levels are broadly represented in Gagné et al.'s (1993) framework, combining declarative and procedural knowledge.

Specifically, the present study examined the reading process via online measures and reading products via post-reading tasks in order to answer the following research questions:

*RQ1:* What types of inferences, as proposed by Linderholm and van den Broek (2002), are generated in verbal reports by low- and high-WMC readers in each condition- summarizing and criticizing/giving opinion in each text mode: linear digital and nonlinear hypertext reading?

RQ2: How is the reader's WMC related to the ability to recall arguments in each text mode, linear digital and hypertext, as measured by the post- reading tasks in both conditions reading to criticize/give and reading to summarize?

RQ3: How is WMC related to reading time in each condition, reading to criticize/express opinion and reading to summarize?

RQ4: What is the effect of the specific instruction to consider the issuers in the post-reading criticize/give opinion task?

*RQ5:* What reading strategies are deployed in each condition: digital linear and digital nonlinear hypertext; for summarizing and criticizing/giving opinion?

Overall, analysis of Research Question # 1 showed a trend that is backed up by previous research and provided converging evidence to the assumption that low- and high-WMC readers do differ in the type of inferences generated and cognitive processes and strategies deployed during reading for different purposes. The results suggest that low-spans do find ways to cope with the difficulties of the task by resorting to strategies that require less from the cognitive system. On one hand, those readers elaborate, evaluate, and associate more when reading to criticize in the hypertext mode, suggesting that they select strategies to achieve a goal and/or use strategies according to the demands of the task. Elaborative inferences refer to the use of background knowledge to make sense of information and are necessary to comprehend a text and remember information later, while associations are mostly referred to as elaborations that are not necessary to comprehend a text. The difference between low- and high-span readers lies on the fact that high-spans may suppress cognitive processes that may not be relevant to learning and, therefore, generate more inferences that show commitment to the internal structure of the text, namely, summarizations, text repetitions and paraphrases (Linderholm & van den Broek, 2002; van den Broek et al. 2001). Overall, both WM groups generated the same average amount of text repetitions across conditions suggesting that somehow repeating the text provided a safe ground for both groups. This procedure may be explained in part by the type of verbal report used in the study. Although the participants of the present study were considered proficient speakers and readers of English at this stage of

their course, they were instructed to speak in their L1 Portuguese while reading in L2 English. Therefore, translation may have influenced the repetition of text due to an overload of the memory system engaged in getting the gist of the paragraph and having to translate it in order to report.

Metacognitive comments in the present study refer to the readers' utterances on the difficulties of the process and may be related to vocabulary, text structure, and constraints pertaining to the integration of ideas and the sense of achievement or lack of comprehension achievement by the reader. It is known as a resource consuming process and the verbalization of those comments may split attention of readers between making meaning and reporting. Results from the present study suggest that both WM spans generated more metacognitive comments when reading to summarize in the hypertext mode but the high-spans outperformed the low ones. It suggests that the constraints of a reading purpose which seemed more demanding may have been augmented by the text mode, ending up in the decrease of such comments by low-spans.

Low-WMC readers generated more misunderstandings in both reading purposes, to summarize and to criticize in the linear mode. On one hand, this process may have been enhanced by the procedure of mentally translating the text into L1 Portuguese during verbal report, which could have impacted low-spans in a negative way by overtaxing the cognitive system and constraining comprehension. On the other hand, even though participants are proficient users of English, a certain level of L2 and general skill on reading are seen as impacting higher level inferential comprehension and situation-model construction.

Taken as a whole, reading to summarize can be viewed as a more challenging reading situation leading readers to monitor comprehension and employ the necessary effort to accomplish a goal. In different ways, both WMC groups seemed to possess the necessary procedural knowledge, as proposed by Gagné et al. (1993), to approach the text and select the appropriate strategy to achieve a specific goal, check and take fix-up measures. During hypertext reading, qualitative analysis shows that both groups took decisions that could benefit the process: link access shows more commitment to explore the entire text in this condition.

Reading to criticize stimulated the generation of associations by the low-spans. As discussed above, low-spans engaged in a strategic processing that would demand less from the cognitive system by drawing on background knowledge to learn from the texts. Even though

being highly stimulated by the topics, high-spans seemed to suppress comments and thoughts that would not contribute much to the understanding, while low-spans seemed to feel freer to associate more in this condition.

The low amount of reinstatement inferences and predictive inferences may have been affected by methodological procedures in the verbal report hereby adopted. As participants were instructed to speak during reading and after the paragraph, the generation of reinstatement and predictive inferences seemed to be less likely to be uttered once paragraphs may represent complete thoughts. Another explanation may stem from the low number of participants.

From what is stated above, and drawing on results from Research Question # 2 that intended to establish relations between WMC and the post-reading recall scores, reading to summarize can be seen as a more demanding reading purpose, as compared to reading to criticize. In such a challenging reading situation, it is reasonable to conclude that pre- and post-reading instructions may enhance or hinder the type of information to be recalled. Especially pre-reading clear instructions on the type of task that will follow the reading activity may diminish the effect that an artificial reading purpose, peculiar to experimental sessions, could exert on the results. Qualitative analysis of instructions given in both reading purposes under discussion suggests that once the purpose is given and not selected by participants, they should be clear enough so that information in the text is given enough attention so as to guarantee encoding in long-term memory and the consequent retrieval. These interpretations are in line with Heitz, Unsworth and Engle (2005), Conway and Engle's (1994), and Daneman and Carpenter's (1980) views of WM.

In this sense, based on qualitative analysis of post-reading tasks, reading to summarize is best measured by evaluation of summaries rather than the number of arguments recalled, as it was first hypothesized. Number of arguments as a measure of memory retrieval seems to best suit the criticize condition, as the boxplots show a more normal distribution in this condition. It remains unclear, though, why low-spans performed better when reading to criticize than the high-spans as measured by recall if qualitative analysis is considered. Reading to criticize a text in which controversial topics pop up may not be challenging enough so as to tackle differences. One possible way to better perceive differences in performance between memory groups should involve reading different texts in which abilities to integrate,

summarize and elaborate would increase the demands and, thus, make clear the differences between groups.

Significant results of moderate correlation between WMC and reading time in each reading purpose addressed in Research Question # 3 add support to the discussion pertaining to reading in demanding reading situations such as reading to summarize. Low-spans took longer to read in this condition, probably by trying to find ways to cope with the difficulties of the task, such as rereading before reporting. Qualitative analysis showed that readers in this condition accessed most links when compared to reading to criticize when reading in the hypertext mode. Strategic readers do find a balance between costs and benefits in order to achieve a goal. Analysis of the quality of summaries points to the interpretation that both groups engaged in a more in-depth reading, taking longer to read in this condition. Low-span readers spent more time than the high-span ones. Both groups adjusted processing to achieve learning goals. While low-spans found strategies to cope with the constraints of the task, high-spans relied on text-based inferences, producing more summarizations, text repetitions, and paraphrases, ending up producing more concise and comprehensive summaries.

Research Question # 4 intended to verify the effect of the direct instruction to participants to pay attention to the issuer of arguments in order to base their own opinion. Qualitative analysis shows that 58% of the group did not take the specific instruction into account and chose the arguments that best reflected their own opinion and previous knowledge was reported to have influenced their responses. It is reasonable to claim that instruction was not followed by most participants due to some characteristics of the stimulus texts: i) the texts did not have an author; ii) the several unknown voices presented in the subsection Specialized Opinion per se may not have called the readers' attention so as to legitimate the authority, which could not be checked or doubted; iii) critical evaluation may have spread to the several other aspects of the discussion, such as the pro/con characteristic; iv) assigning relevance to a specific instruction may depend on the reader's task perception and personal relevance may not interact with given relevance; and v) evaluation may have occurred only after readers comprehended information and judged its consistency with the active contents of memory.

The last question, Research Question # 5, qualitatively explored the process of reading and the reader's perception of their performance and behavior. As undergraduate students of a language course of English as an L2 , proficient and regular readers, the participants of the

present study were expected to cope with processing constraints as it is peculiar with strategic readers. Within the procedural knowledge proposed by Gagné et al. (1993), some component processes happen in order for comprehension to occur: once a reading goal is set, readers select strategies, check goal achievement and apply fixing-up measures to accomplish the goal. While reading nonlinear hypertext, deciding not to access some or all links was a strategy reported by both WM groups (4 low-spans, 5 high-spans).

As advocated by previous research, links may disrupt fluent reading due to the decision making process, which breaks the linear flow of the task ( Kamil & Cho, 2009). Besides being a choice, not accessing links may be a sign of disorientation (Macedo-Rouet, Rouet, Epstein, & Fayard, 2003). Disorientation while reading hypertext was reported in the self-evaluation questionnaire and some evidence of its occurrence was also identified. As for reports, comments blaming links saying they affect recall, disturb concentration, break the flow and are slow, that the blue word "more" disturbs meaning, and that there are too many elements on the screen suggest the uneasiness of some participants while reading in this text mode. Awareness of the difficulties (5 high-spans, 4 low-spans) in this text mode led some readers to decide on not to access some or all links, on one hand. This decision most reported by high-WM spans and closely followed by low-spans suggests that besides deciding what works or not to achieve comprehension is a characteristic of good readers. Disorientation may have been minimized by a more linear reading adopted by some readers. On the other hand, disorientation may have affected other readers as the access or not was not noticed by this group. Various signs of disorientation in this text mode as attention is drained away could be also identified as a result of reading a link. Some of such instances are: i) returning to the primary text, rereading the paragraph or even the node; ii) forgetting to report. The demographic questionnaire aided in the interpretation that the awareness of such a difficulty with nonlinear hypertext does occur on an everyday basis as participants reported to avoid clicking on links and self-regulate their link access in online environment.

The overload of the memory system seemed to have affected some readers as they reported the need to reread the text in order to do the post-reading task (45,83% of participants in the hypertext mode, as compared to 33,33% in the linear mode). During reading hypertexts half of the experimental group resorted to the strategy of rereading

suggesting that the participants of the present study are highly strategic readers when they are aware of the cause of the constraint.

As both texts in the present experiment where digital, differences across text modes were not identified as far as underlining/highlighting and note-taking are considered. Overall, while highlighting seemed to be employed by both memory span groups, note-taking was mostly employed by low-spans. These procedures happened independently of text mode or condition, being the choices more possibly related to individual differences in strategy use to compensate for WM limitations, topic knowledge, density of topic, need to report or the participants' revealed preference for printed texts, ending up in similar procedures across text modes.

In sum, participants of the present study display several characteristics of strategic readers. Low and high-spans seem to be aware of constraints provided by challenging reading situations and find fixing up measures to make up for the demands of the task. On one hand, both digital text structures used in the present study, namely, digital linear and nonlinear hypertext, may have been equally challenging to both WM groups as the demographic questionnaire revealed their preference for printed texts when engaged in academic reading. Having said that, differences pertaining to the text modes hereby utilized may have contributed in part to its weak statistical power.

## 5.2 LIMITATIONS OF THE PRESENT STUDY AND SUGGESTIONS FOR FUTURE RESEARCH

As any systematic procedure to conduct a research, informed choices have been made to best contribute to the research in the area, but are not problem-free. Context differences have to be considered and highlighted in order to provide a safe ground for debate. In this regard, general claims pertaining to relations between cause and effect should not be made from the findings.

Several limitations to this study deserve discussion:

*Number of participants*. The lack of statistical power in the first two research questions may, in part, be attributed to the small number of participants. The Brazilian social context regarding proficiency in English and the legislation that does not allow for financial compensation limit the possibility of having large groups of participants.

*Profile of participants*. Even though the Reading Span Test may have pointed to some differences in the memory capacity between groups, differences may not be apparent in reading tasks. Being highly functional undergraduate readers of an English as an L2 language course, who manage to do research and pass exams, those participants might have ways to compensate for memory constraints with strategies. Reading to criticize and to summarize are routinely performed in the academic context and are generally performed in conjunction when these students do academic research.

*Criteria for splitting groups*. The criterion adopted in the present study was the medium split, ending up in two groups. By having a larger sample, the upper- and lower-third criterion should be adapted so as to have a clear difference between groups.

*Hypertext (structure and environment)*. Even though previous research has provided evidence that the linking structure of hypertexts, even being minimal, can introduce the decision-making process and increase the complexity of reading, the hypertext linking structure adopted in the present study may not have been challenging enough so as to show clear differences in performance between memory groups on digital linear and nonlinear hypertext. Moreover, the text modes being both in digital format may have been equally challenging as the participants revealed to prefer printing texts for academic purposes. As a suggestion, reading to criticize could include information in order to check for critical thinking, such as, more information on issuers, links to other texts, and so forth, which could also function as a dual task or additional overload to the task. In an attempt to control variables, a more naturalistic online environment was neglected and may have weakened the ecological validity. For practical reasons and to control for variables, the reading sessions could not include the use of an open web space and therefore might not have tackled the complexity of real web-based reading and navigation. For this reason, research on the complexity of hypertext reading should continue. Studies on different hypertext structures make comparison among them rather simplistic. Therefore, caution should be taken not to make assertive assumptions based on isolated findings.

*Post-reading task criteria*. Offline measures of reading should be well planned so as to provide a safe ground of discussion pertaining to cognitive processes occurred during online processes. The criteria adopted in the post-reading summarize may have contributed to the floor effect. Different reading purposes should end up in being

corresponded by post-reading tasks in the sense that the reader is not being misled.

*Instructions*. As criticizing is a difficult construct and defining what to criticize depends on each individual, when more specific tasks are decided a priori, future studies should insert reminders during reading. Another possible procedure could include the reader's underlining issues that he/she would like to criticize during reading or on later tasks, procedure that could point to some critical evaluation happening online.

*Instruments.* Reading time and rereading were inferred based on some pre-established criteria that combined lack of reporting and navigational actions. To enrich the analysis, eye-tracking could help understand reading strategies as well as navigation strategies in hypertext reading.

## 5.3 PEDAGOGICAL IMPLICATIONS

The discussion provided in the present research may help the reading practice in educational contexts in the sense that the teaching of reading should consider the students' social practice, be it in the academic context or in schools. While it is taken for granted that the Gen Z or the iGeneration is defined by their ability to cope with the contingencies of the information era and the virtual environment, social contexts have to be considered. Reading highly interactive texts for entertaiment may not be a constraint for such a generation. Therefore, educational practice should consider the inclusion of digital reading in web-based reading space to ensure that students can slowly be literate in different text modes. Moreover, instruction could develop and support the use of strategies for comprehension and navigation skills given the changing nature of reading with the advent of computarized reading and the Internet availability of texts.

When critical reading and summarization teaching are discussed, Lin et al.'s (2014) study propose argument scaffolding to guide readers on becoming more strategic on integrating information from various sources, summarizing and constructing more elaborated summaries and becoming more critical, specifically, but not limited to, academic contexts.

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**APPENDIX A – Consent form – Participant** [back]
**Termo de Consentimento Livre e Esclarecido – Participantes**

Este é um estudo acerca das relações da memória e compreensão leitora em língua inglesa. Como você possui conhecimento nessa língua, está sendo convidado(a) a participar dessa investigação. Esta pesquisa está sendo conduzida por Leonilda Procailo, doutoranda do Programa de Pós-Graduação em Inglês: Estudos Linguísticos e Literários da Universidade Federal de Santa Catarina. Este trabalho está sendo orientado pela profa. Dra. Lêda Maria Braga Tomitch.

**Objetivo da pesquisa**: O objetivo deste estudo é verificar relações entre memória de trabalho e construção de sentido na leitura de texto em língua inglesa. Pesquisas têm demonstrado que nossa memória de trabalho, com sua capacidade limitada, está relacionada com diferenças na maneira como lembramos do que lemos e também na produção de sentido do texto. Assim, esta pesquisa busca contribuir com os estudos na área de leitura e sua participação será muito importante tanto para o trabalho com leitura no ambiente educativo quanto para o desenvolvimento de ferramentas que auxiliem na leitura de textos virtuais.

**Procedimentos:** Você será solicitado a desempenhar as seguintes tarefas: 1) Responder a um questionário demográfico, para obtenção de informações gerais tais como suas práticas de leitura; 2) Realizar teste de memória; 3) Ler dois textos e verbalizar reações, fazer comentários, quando couber (este procedimento será gravado em áudio, sendo que somente as pesquisadoras terão acesso ao mesmo); 4) Realizar tarefas de compreensão de texto e fazer resumo; 5) Responder a um questionário auto-avaliativo, onde você responderá perguntas sobre sua percepção das tarefas realizadas.

Todos os procedimentos serão realizados em horários previamente acordados entre a pesquisadora e você.

**Riscos:** Todo e qualquer processo de avaliação pode impactar negativamente nos participantes, uma vez que os resultados podem não ser satisfatórios, não correspondendo as suas expectativas. No entanto, ao receber retorno sobre os resultados da pesquisa, você poderá ter uma melhor noção da capacidade de sua memória, ajudando-o a ser mais estratégico ao abordar um texto. Além disso, você poderá solicitar esclarecimentos sobre quaisquer aspectos dos procedimentos e dos resultados quando desejar. Você pode também escolher não responder a alguma questão ou mesmo desistir de participar do estudo a qualquer

momento, sem qualquer prejuízo para a sua pessoa e sem afetar seus laços com o Curso ou com a Universidade.

**Confidencialidade:** Os resultados do estudo serão divulgados em trabalhos científicos, no entanto, o nome dos(as) participantes ou qualquer informação que possa identificá-los(as) não serão divulgados. Somente a pesquisadora e a orientadora terão acesso aos dados coletados.

**Custos da participação, ressarcimento e indenização por eventuais danos**: A participação no estudo não acarretará custos para os participantes, e não haverá qualquer compensação financeira pela participação. Em havendo necessidade de deslocamento do participante especificamente para realização da pesquisa, a pesquisadora pagará a passagem de ônibus ou fará o ressarcimento do gasto. Eventuais prejuízos ao participante, decorrentes diretamente do experimento, serão devidamente indenizados pela pesquisadora.

Você poderá desistir de participar desse estudo a qualquer momento, sem necessidade de se justificar. Ao tomar essa decisão, por favor, informe a pesquisadora pelo e-mail lprocailo@gmail.com e/ou pelos telefones: 3365-9092 ou 9662-7565.

Os procedimentos na condução desta pesquisa estão de acordo com as normas estabelecidas na RESOLUÇÃO Nº 466, de 12 de DEZEMBRO de 2012 e o projeto foi aprovado pelo CEPSH-UFSC-CAAE sob registro: 54319416.0.0000.0121, Parecer: 1.487.656.

No caso de quaisquer dúvidas, você poderá entrar em contato com a pesquisadora pelos telefones ou e-mail citados acima ou ainda pelo seguinte endereço: Secretaria do PPGI: Trindade - Campus Universitário – CCE “B” - Sala 313 – 88.040-900, Florianópolis, SC.

Você poderá também esclarecer dúvidas com o CEPSH-UFSC: Prédio Reitoria II, 4º andar, sala 401. Rua Des. Vitor Lima, No. 222, Trindade, Florianópolis. Telefone: (48) 3721-6094.

Esse termo foi elaborado em duas vias, devendo todas as suas folhas ser rubricadas, as duas vias assinadas, uma ficando com o participante e a outra com a pesquisadora responsável.

Ao assinar o consentimento pós-informação, você concordará com o uso dos dados coletados para a pesquisa e sua divulgação.

Muito obrigada.

| | |
|---|---|
| _____ | _____ |
| Leonilda Procailo | Lêda Maria Braga Tomitch |
| Pesquisadora | Orientadora |

**Consentimento Pós-Informação**

Eu, _____
(nome completo), li o Termo de Consentimento Livre e Esclarecido que me foi entregue com antecedência e fui esclarecido(a) sobre a pesquisa entitulada *Working memory and hypertext reading: inferential comprehension across links and nodes* (Memória de trabalho e leitura de hipertexto: compreensão inferencial durante a leitura de textos eletrônicos {título provisório}).
Concordo que meus dados sejam utilizados para sua realização.

Florianópolis,_____, _____, _____.

Assinaturado participante: _____

RG: _____

**APPENDIX B – Statement of Consent- Institution** [back]

*Declaração de Anuência – Instituição*
*Carta de informação à instituição*

**A(ao) prezado chefe do DLLE – Departamento de Línguas e Literaturas Estrangeiras**

Eu, Leonilda Procailo, venho por meio desta solicitar a autorização desta instituição para a realização de minha pesquisa de Doutorado. Sou alunado Programa de Pós-graduação em Língua Inglesa da Universidade Federal de Santa Catarina(UFSC – Matrícula 201401093), meu trabalho se concentra na área de Linguagem e Cognição e é orientado pela professora Doutora Lêda Maria Braga Tomitch.

O objetivo deste estudo é verificar relações entre memória de trabalho e construção de sentido na leitura de textos em língua inglesa. Pesquisas têm demonstrado que nossa memória de trabalho, com sua capacidade limitada, está relacionada com diferenças na maneira como lembramos do que lemos e também na produção de sentido do texto.

Para tal, solicito a autorização desta instituição para a seleção de participantes, alunos do curso de Letras-Inglês da UFSC, e para a aplicação dos instrumentos de coleta de dados. O material coletado e o contato interpessoal não irão interferir na rotina dos acadêmicos. Espera-se que as tarefas desenvolvidas pelos alunos participantes durante a pesquisa enriqueçam suas experiências e conhecimentos da Língua Inglesa e auxiliem na sua formação profissional, já que a pesquisa trata de uso de estratégias em leitura em ambiente virtual.

Salienta-se que os alunos selecionados não serão obrigados a participar da pesquisa, podendo desistir de fazê-lo 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 (em duas vias: Uma cópia ficará coma instituição e outra com a pesquisadora).

Muito obrigada.

| | |
|---|---|
| Leonilda Procailo | Lêda Maria Braga Tomitch |
| Pesquisadora | Orientadora |

lprocailo@gmail.com
Fones: (48) 3365-9092 ou 9662-7565

**Declaração de Anuência - Instituição**

Declaro para os devidos fins e efeitos legais que, objetivando atender as exigências para a obtenção de parecer do Comitê de Ética em Pesquisa com Seres Humanos, e como representante legal da Instituição como **chefe do DLLE – Departamento de Línguas e Literaturas Estrangeiras** tomei conhecimento do projeto de pesquisa intitulado *Working memory and hypertext reading: inferential comprehension across links and nodes* (Memória de trabalho e leitura de hipertexto: compreensão inferencial durante a leitura de textos eletrônicos {título provisório}) e cumprirei os termos da Resolução CNS 466/12 e suas complementares, e como esta instituição tem condição para o desenvolvimento deste projeto, autorizo a sua execução nos termos propostos.

Florianópolis, _____, _____, _____.

**ASSINATURA:** ….....
**NOME :** .....
**CARGO:** .....

**CARIMBO DO/A RESPONSÁVEL**

## APPENDIX C – Demographic questionnaire: participant's profile

[back1] [back2]

**Questionário demográfico : perfil do participante:**

Idade: .....

Identificação: _____ (código a ser preenchido pela pesquisadora)

**Responda marcando um X na opção que melhor descreve seus hábitos:**

1- Como você classifica a sua prática com leitura em língua Portuguesa:

( ) diária - para fins acadêmicos ( ) diária - como entretenimento

( ) eventual - para fins acadêmicos ( ) eventual - como entretenimento

( ) rara outra: _____

2- Como você classifica a sua prática com leitura em língua Inglesa:

( ) diária - para fins acadêmicos ( ) diária - como entretenimento

( ) eventual - para fins acadêmicos ( ) eventual - como entretenimento

( ) rara

outra: _____

3- Qual a sua prática com leitura em ambiente virtual:

( ) diária - para fins acadêmicos ( ) diária - como entretenimento

( ) eventual - para fins acadêmicos ( ) eventual - como entretenimento

( ) rara ( ) resume-se às redes sociais

outra: _____

4- Nas suas práticas de leituras acadêmicas você prefere:

( ) ler textos impressos ( ) ler textos digitais

5- Como entretenimento, você prefere:

( ) ler textos impressos ( ) ler textos digitais

6- Ao ler textos na Internet você costuma:
( ) explorar todos os *links* disponíveis, navegando por várias páginas e textos;
( ) fazer leitura de um texto de cada vez e decidir no final de cada um se e qual *link* explorar;
( ) prefere imprimir os textos ao invés de lê-los online;
( ) outra: .....

7- Sua experiência de leitura com textos virtuais, numa escala de 1-10, se encaixa em :
( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10

8- Qual é a sua velocidade de leitura de um texto na Web:
( ) rápida ( ) cuidadosa ( ) a mesma de qualquer outro texto

9- Qual seu nível de concentração na leitura de um texto na Web:
( ) normal ( ) há esforço para uma concentração total
( ) a concentração fica sempre prejudicada ( ) depende do interesse no assunto

10- Que estratégias (sublinhar, negritar, anotar, resumir parágrafo, etc) você utiliza quando lê:
Textos impressos:
_____
Textos digitais, hipertextos, textos na Web:
_____

**Muito obrigada.**

## APPENDIX D - General instructions

**Instruções gerais**

Você vai participar de um estudo sobre memória e atenção em leitura em língua inglesa. O estudo compreende sete (7) sessões: na primeira, você responderá a um questionário demográfico. Na segunda, você fará um teste de memória composto de 60 frases. Na terceira, você lerá o texto A com um objetivo específico. Na quarta, fará uma atividade sobre o texto lido. Na quinta, lerá o texto B com outro objetivo. Na sexta, fará uma atividade sobre o texto lido. Na sétima, você responderá a um questionário auto-avaliativo acerca do processo pelo qual passou. Todas as sessões serão realizadas em um único encontro, que terá duração aproximada de uma hora e meia (1h e 30min).

**Muito obrigada.**

## APPENDIX E– Instructions on the memory test and practice test [back]

*Instruções e prática do teste de memória*

Você irá ler as 60 frases soltas individualmente em voz alta. As frases serão apresentadas uma a uma em grupos: iniciando-se em grupos de 2 frases, 3 sessões. Após encerrado cada grupo, você verá um ponto azul. Deverá, então, anotar as palavras finais de cada frase. Após cada sessão com o mesmo número de frases, haverá um acréscimo de uma frase. Assim, a sessão 1 terá 2 frases, 3x; a sessão 2 terá 3 frases, 3 x; a sessão 3 terá 4 frases, 3x; a sessão 4 terá 5 frases, 3x; e a sessão 5 terá 6 frases, 3x. Não utilize estratégia alguma para tentar memorizar as palavras. Somente leia as frases em voz alta e confie na sua memória.

Primeiramente, você fará um curto treinamento, com 3 rodadas de 2 frases cada. Ao final de cada rodada, anote as palavras que lembrar:

Promotores e defensores públicos disseram que o governo "não dialogou" com a **sociedade**. (13 palavras, UOL – 03 de dezembro de 2015).

1. Indústria quer diálogo com China para aumentar venda de soja com valor **agregado**. (13 palavras, UOL - 03 de dezembro de 2015).

2. O aperto dos produtores ficará maior em 2016, quando eles terão insumos com custos mais **salgados**. (16 palavras, UOL - 03 de dezembro de 2015).

3. No estado, assim como em todo o país, os tropeços vieram na vertente de emprego e **renda**. (17 palavras – Gazeta do Povo, 03 de dezembro de 2015).

4. Mostra de cinema estudantil no Rio de Janeiro apresenta possibilidades de aprendizagem por meio da produção **audiovisual.** (17 palavras, Ciência Hoje UOL, 03 de dezembro de 2015).

5. Concurso premiará projetos que incentivem o envolvimento das meninas com as ciências **exatas**. (13 palavras, Ciência Hoje UOL, 03 de dezembro de 2015).

**APPENDIX F– Reading Span Test** [back]
**Portuguese version devised by Tomitch (1995/2003)**
*(words to be recalled are highlighted)*

1- O intelsat-6 foi lançado em 1990, mas nunca funcionou – ficou numa órbita **errada**. (13 palavras – *Veja*, 20 de maio, 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, 1992, p.4).
3- A igreja do bispo extorque dinheiro dos fiéis, que são obrigados a fazer doações compulsórias nos **cultos**. (17 palavras – *Veja*, 3 de junho, 1992, p.33)
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- O governo desistiu de limitar a importação de carros, conforme proposta defendida pela Secretaria Nacional da **Economia**. (17 palavras – *Folha de S. Paulo*, 6 de setembro de 1992).
7- Para realizar as atividades cerebrais do pensamento, os neurônios tiram energia do oxigênio e da **glicose**. (16 palavras – *Superinteressante*, maio de 1992, p. 17).
8- O processo de fabricação é o problema que aflige a maior parte dos pequenos **empresários**. (15 palavras – *Folha de S. Paulo*, 29 de novembro de 1992).
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 presidente francês tem um câncer na próstata que pode ser tratado com **medicamentos**. (16 palavras, *Folha de S. Paulo*, 17 de setembro de 1992).
11- Uma manifestação estudantil ontem em Brasília foi marcada por atritos com a polícia **militar**. (14 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, 1992, p. 34.

14- Uma proteína do amendoim ajudou células retiradas de tumores do intestino grosso a se reproduzirem em **laboratório**. (17 palavras – *Folha de S. Paulo*, 17 de setembro de 1992).

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**. (14 palavras – *Veja*, 23 de setembro, 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, 1992).

23- Pesquisadores descobrem que o antílope das pradarias norte-americanas é o mais resistente dos mamíferos **terrestres**. (17 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- Depois de rejeitar acordo em plebiscito, a Dinamarca que alterar a tendência de centralismo da unificação **Europeia**. (17 palavras – *Folha de S. Paulo*, 23 de setembro de 1992).

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

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**. (17 palavras - *Superinteressante*, junho de 1992).

34- Cartão-postal sob suspeita: radiação eletromagnética das antenas da Avenida Paulista pode afetar a saúde **humana**. (16 palavras - *Superinteressante*, junho de 1992).

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- Não se vê um único exemplar das cem carpas japonesas que vivem no lago **artificial**. (15 palavras – *Veja*, 23 de setembro de 1992, p. 35).

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**. (16 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 de Mediterrand 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 – *Folha de S. Paulo*, 23 de setembro de 1992).

45- O IBGE lançou um Atlas que mostra trezentas e três espécies animais ameaçadas de **extinção**. (15 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. 34).

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 cardiorespiratória 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*, agosto 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- É quase impossível ter um critério justo, e a decisão acaba ficando nas mãos da **burocracia**. (16 palavras – *Veja*, 23 de setembro de 1992, p. 81).

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

## APPENDIX G - Verbal protocol training – practice text (hypertext mode)

[back]

**Instructions**

**Condition: Reading to criticize/give opinion**

*Instruções para leitura do texto-treino – hipertexto*

*Tarefa: Ler para criticar/expressar opinião sobre um tópico*

Você irá ler um texto com argumentos pró e contra o tópico *censura na Internet* para criticar/expressar sua opinião, que deve ser baseada nos melhores argumentos. Preste atenção aos emissores das opiniões no texto.

Leia o texto silenciosamente para obter uma compreensão geral.

Interrompa a leitura toda vez que notar algum problema de compreensão, ou para comentar algo que tenha chamado sua atenção. Comente e exponha sua opinião quando julgar necessário.

Ao final de cada parágrafo, você deverá fazer um comentário acerca das ideias expostas até então. Haverá um símbolo ✋ lembrando da necessidade dessa parada para o relato.

**Lembre-se de que:**

> o texto possui *hyperlinks* que acrescentam argumentos ao debate. Ao clicar na palavra more, mais informações serão acrescidas ao texto. Palavras sublinhadas com linhas pontilhadas apresentam definições/sinônimos ao aproximar o mouse. Ex.: *horrible*.

> a pesquisadora não irá interagir com você;

> você pode utilizar estratégias que desejar para ajudá-lo a lembrar do tópico: reler trechos curtos, destacar, anotar (no papel ou ao lado do próprio texto)

> após lido o texto todo, não refaça a leitura;

> você irá fazer uma tarefa solicitando sua avaliação e posicionamento sobre o tópico lido;

**SEU RELATO SERÁ GRAVADO EM ÁUDIO E SEUS MOVIMENTOS NA TELA SERÃO GRAVADOS.**

**A SUA IMAGEM NÃO SERÁ GRAVADA.**

## APPENDIX H – Practice Text

### History and Debate of Internet Censorship

Censorship refers to any action taken by a society to control access to ideas and information. Throughout history, many different types of societies, including democracies, have used censorship in various ways. The issue is increasingly important due to the rapid development of new communication technology. As innovators continue to create new ways for people to share information, many people are now arguing over the issue of censorship.

For some people, restricting the access of information is something that can provide benefits to society. By censoring pornography on the internet, children are less likely to encounter it. More For example, some would argue that society should censor material that is insulting to a particular religion in order to maintain societal harmony. In this way, censorship is viewed as a way to protect society as a whole or certain segments of society from material that is seen as offensive or damaging.

Others argue that censorship is necessary to preserve national security. Without using any kind of censorship, they argue that it is impossible to maintain the secrecy of information necessary for protecting the nation. More

Since censorship is control, some argue that the practice limits the freedoms of speech, the press and expression and that these limitations are ultimately a detriment to society. More Through ignorance, citizens are more easily controlled by special interest groups, and groups that are able to take power are able to use censorship to maintain themselves. More

Another main issue regarding censorship is a history of censorship abuse. More In this sense, they argue that people should control the government instead of the government controlling its people.

http://www.debate.org/internet-censorship/

Main text: 269 words
Nodes: 111 words
(380 words)

## APPENDIX I- Stimulus texts: Text 1 and Text 2: Linear and nonlinear hypertext versions [back]

Text 1 – Nonlinear hypertext version

### Should Animals Be Used for Scientific or Commercial Testing?

An estimated 26 million animals are used every year in the United States for scientific and commercial testing. Animals are used to develop medical treatments, determine the toxicity of medications, check the safety of products destined for human use, and other biomedical, commercial, and health care uses. Research on living animals has been practiced since at least 500 BC.

Proponents of animal testing say that it has enabled the development of many life-saving treatments for both humans and animals, that there is no alternative method for researching a complete living organism, and that strict regulations prevent the mistreatment of animals in laboratories.

Opponents of animal testing say that it is cruel and inhumane to experiment on animals, that alternative methods available to researchers can replace animal testing, and that animals are so different from human beings that research on animals often yields irrelevant results.

**Public opinion**

A public outcry over animal testing and the treatment of animals in general broke out in the United States in the mid-1960s. moreA farmer's pet Dalmation that was kidnapped and sold into experimentation is believed to have been the initial catalyst for the rise in anti-testing sentiment.

Many animal defenders say that “Animals, like humans can feel emotions. No living creature on this planet should be tested on harmfully, when there are other methods that are more accurate available, even cheaper.”

Still others complain, saying “If you are opposed to animal testing, you should not use anything that has been tested on animals (even historically). You should not use cleaning products, such as Windex, or Post-it notes, or Band-Aids, or condoms, or M&Ms, or Kleenex, or some pet foods, or Vaseline. more You cannot complain about the process while enjoying the benefits.”

Others say that “Animals were put here for a reason. In my opinion, I think that we should use more species of animals to be tested.

They are lower on the food chain for a reason. more Besides, aren't we just animals that have evolved more than others? Darwinism permits that we should use anything we can to further our species' survival. more We need to cut our morals out of the equation and think about the actual future of the human race."

On the opposite side, Clay defends that animal testing is crueler than eating the animals. The animals that are being butchered aren't suffering everyday. more Their pain is short and the death is swift. In Animal Testing, they are tortured everyday and become deformed."

**Specialized opinion**

Dario L. Ringach, PhD, MSc, Professor of Neurobiology and Psychology at the UCLA stated that "The contributions of animal research to medical science and human health are undeniable... When the majority of scientists see the work as scientifically justified, and so do the many professional medical and scientific organizations, the expert views cannot be simply dismissed based on wild claims of ulterior motives, self-interest and conspiracy theories."

Neurologist Aysha Akhtar, MD, MPH, says that "Failures of animal experiments have led to human harm. Moreover, misleading animal experiments may have caused the abandonment of effective drugs and cures." More One can't help wonder: how many people would have been saved if we used more effective human-based testing methods?"

In Defense of Animals (IDA), an international animal rights and rescue organization, stated that "Cutting-edge technology has forged new frontiers with the use of lasers, fiber optics, microchips, genomics, computer-based drug design, and digital imaging, to name a few... more These methods have contributed to a technological revolution in biomedical research and rendered the reliance on animals outdated."

On the other hand, the Foundation for Biomedical Research (FBR) stated that "From the discovery of antibiotics, analgesics, anti-depressants, and anesthetics, to the successful development of organ transplants, bypass surgery, heart catheterization, and joint replacement, practically every present-day protocol for the prevention, control, and cure of disease is based on knowledge attained through research with laboratory animals."

While scrutinizing on pros and cons of animal testing, benefits and costs should be considered in either case.

Adapted from: www.procon.org

TEXT 2 – Linear version

## Should Animals Be Used for Scientific or Commercial Testing?

An estimated 26 million animals are used every year in the United States for scientific and commercial testing. Animals are used to develop medical treatments, determine the toxicity of medications, check the safety of products destined for human use, and other biomedical, commercial, and health care uses. Research on living animals has been practiced since at least 500 BC.

Proponents of animal testing say that it has enabled the development of many life-saving treatments for both humans and animals, that there is no alternative method for researching a complete living organism, and that strict regulations prevent the mistreatment of animals in laboratories.

Opponents of animal testing say that it is cruel and inhumane to experiment on animals, that alternative methods available to researchers can replace animal testing, and that animals are so different from human beings that research on animals often yields irrelevant results.

**Public opinion**

A public outcry over animal testing and the treatment of animals in general broke out in the United States in the mid-1960s.A farmer's pet Dalmation that was kidnapped and sold into experimentation is believed to have been the initial catalyst for the rise in anti-testing sentiment.

Many animal defenders say that “Animals, like humans can feel emotions. No living creature on this planet should be tested on harmfully, when there are other methods that are more accurate available, even cheaper.”

Still others complain, saying “If you are opposed to animal testing, you should not use anything that has been tested on animals (even historically). You should not use cleaning products, such as Windex, or Post-it notes, or Band-Aids, or condoms, or M&Ms, or Kleenex, or some pet foods, or Vaseline. You cannot complain about the process while enjoying the benefits.”

Others say that “Animals were put here for a reason. In my opinion, I think that we should use more species of animals to be tested. They are lower on the food chain for a reason. Besides, aren't we just animals that have evolved more than others? Darwinism permits that we should use anything we can to further our species' survival. We need to

cut our morals out of the equation and think about the actual future of the human race."

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While scrutinizing on pros and cons of animal testing, benefits and costs should be considered in either case.

TEXT 2 – Nonlinear hypertext version

**Are social networking sites good for our society?**

74% of American adults online use social networking sites such as Facebook, Instagram, Twitter, LinkedIn, and Pinterest, as of Jan. 2014, up from 26% in 2008. On social media sites like these, users may develop biographical profiles, communicate with friends and strangers, do research, and share thoughts, photos, music, links, and more.

Proponents of social networking sites say that the online communities promote increased interaction with friends and family; offer teachers, librarians, and students valuable access to educational support and materials; facilitate social and political change; and disseminate useful information rapidly.

Opponents of social networking say that the sites prevent face-to-face communication; waste time on frivolous activity; alter children's brains and behavior making them more prone to ADHD; expose users to predators like pedophiles and burglars; and spread false and potentially dangerous information.

**Specialized opinion**

Companies worldwide struggle to balance employee social network access at work for business purposes. Sophos, a company that develops and sells computer security programs, stated that "Although productivity continues to be the dominant reason for companies to block social networks (a third of companies say this is the reason they block Facebook), there has been a dramatic rise since April 2009 in the number of businesses who believe malware *[malicious software]* is their primary security concern with such sites."

The National School Boards Association (NSBA) stated the following: "Almost 60 percent of students who use social networking talk about education topics online and, surprisingly, more than 50 percent talk specifically about schoolwork...*more* With words, music, photos and videos, students are expressing themselves by creating, manipulating and sharing content online..."

On the opposite side, Himanshu Tyagi, Specialist Registrar in Psychotherapy at the Springfield University Hospital in London, reflects that "It may be possible that young people who have no experience of a world without online societies put less value on their real world identities and can therefore be at risk in their real lives. More Perhaps more vulnerable to impulsive behavior or even suicide."

Still regarding the youngsters, Brendesha M. Tynes, PhD, Assistant Professor of Educational Psychology at the University of Illinois affirms that "Online social networking can facilitate identity exploration, provide social cognitive skills such as perspective taking, and fulfill the need for social support, intimacy, and autonomy. more As teens prepare to enter the adult social world, online social environments provide training wheels, allowing young people to practice interaction with others in the safety of their homes."

**Public opinion**

As for regular people who use social networking everyday Raul says "Thanks to Facebook you can talk with your family and your friends who are far. more It is very useful because it remembers the birthdays of everybody. On Facebook you can play many games with your friends and you can share information and pictures. more You can also meet new people. Facebook is dangerous only for people who aren't careful and who tell their life story."

Judy reflects on relationships and believes the following: "I believe that social networking sites aren't good for our society because they don't help us communicate socially in person. more The sites may give you a wider social circle, but are you truly friends with them or know them at least?"

Security is also under risk, according to Joan: ""Criminals use social media to follow people and get there information about their whereabouts also to promote their crimes. more Offline crime, like robberies, may result from posting personal information such as vacation plans, or stalkers gaining information."

To close the heated debate, Daniel concludes that ""The internet provides an equal work space for people of all kinds all over the world. With so much to present, there is new competition which will offer more products, consequently more job opportunities, more choices to users."

Proponents of social media cheer on the benefits and possible advances to society, while dissenters worry the dangers and wasted time far outweigh any benefit. Whether it is good or bad, it is up to everyone to define their personal involvement in networking.

Adapted from: www.procon.org

**TEXT 2 – Linear version**

**Are social networking sites good for our society?**

74% of American adults online use social networking sites such as Facebook, Instagram, Twitter, LinkedIn, and Pinterest, as of Jan. 2014, up from 26% in 2008. On social media sites like these, users may develop biographical profiles, communicate with friends and strangers, do research, and share thoughts, photos, music, links, and more.

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Opponents of social networking say that the sites prevent face-to-face communication; waste time on frivolous activity; alter children's brains and behavior making them more prone to ADHD; expose users to predators like pedophiles and burglars; and spread false and potentially dangerous information.

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Proponents of social media cheer on the benefits and possible advances to society, while dissenters worry the dangers and wasted time far outweigh any benefit. Whether it is good or bad, it is up to everyone to define their personal involvement in networking.

Adapted from: www.procon.org

**APPENDIX J - Instructions for reading Text 1/Text 2– Linear** [back]

**Condition: Reading to criticize/give opinion**

*Instruções para leitura do Texto 1/Texto 2 – Linear*

*Condição: Ler para criticar/expressar opinião*

Você irá ler um texto com argumentos pró e contra o tópico *uso de animais em testes de laboratórios/* a *influência das redes sociais na sociedade* para criticar/expressar sua opinião, que deverá ser baseada nos melhores argumentos. Preste atenção aos emissores das opiniões no texto.

Leia o texto silenciosamente para obter uma compreensão geral.

Interrompa a leitura toda vez que notar algum problema de compreensão, ou para comentar algo que tenha chamado sua atenção. Comente e exponha sua opinião quando julgar necessário.

Ao final de cada parágrafo, você deverá fazer um comentário acerca das ideias expostas até então. Haverá um símbolo lembrando da necessidade dessa parada para o relato.

Palavras sublinhadas com linhas pontilhadas apresentam definições/sinônimos ao aproximar o mouse. Ex.: *horrible*.

**Lembre-se de que:**

> a pesquisadora não irá interagir com você;

> você pode utilizar estratégias que desejar para ajudá-lo a lembrar do tópico: reler trechos curtos, destacar, anotar (no papel ou ao lado do próprio texto na tela)

> as anotações **não** poderão ser utilizadas na tarefa pós-leitura;

> após lido o texto todo, **não** refaça a leitura;

> você irá fazer uma tarefa solicitando sua avaliação e posicionamento sobre o tópico lido;

**SEU RELATO SERÁ GRAVADO EM ÁUDIO E SEUS MOVIMENTOS NA TELA SERÃO GRAVADOS.**

**A SUA IMAGEM NÃO SERÁ GRAVADA.**

**APPENDIX K– Text 1/Text 2 – Linear -Post-reading task: Reading to criticize/give opinion** [back]

Texto I/Texto 2 - Tarefa pós-leitura: *Leitura para criticar/expressar opinião sobre um tópico*

Texto 1 -**Should Animals Be Used for Scientific or Commercial Testing?**

Texto 2 **- Are Social Networking Sites Good for Our Society?**

**Responda as perguntas com base nas informações do Texto 1/Texto 2:**

1) Enumere 4 argumentos favoráveis ao uso de animais em testes de laboratório/ ao uso das redes sociais.

_____

2) Enumere 4 argumentos contrários ao uso de animais em testes de laboratório/ ao uso das redes sociais.

_____

3) Com quais argumentos você concorda? Por quê?

_____

4) Que critérios você utilizou para escolher os argumentos em que baseou sua opinião?

_____

5) Você considerou o emissor da opinião para embasar a sua?

_____

**APPENDIX L- Instructions for reading Text 1/Text 2 – Linear** [back]

**Condition: Reading to summarize**

*Instruções para leitura do Texto 1/Texto 2 – Linear*

*Leitura para resumir*

Você irá ler um texto com argumentos pró e contra o tópico *uso de animais em testes de laboratórios/* a *influência das redes sociais na sociedade* para resumir.

Leia o texto silenciosamente para obter uma compreensão geral.

Interrompa a leitura toda vez que notar algum problema de compreensão, ou para comentar algo que tenha chamado sua atenção. Comente e exponha sua opinião quando julgar necessário.

Ao final de cada parágrafo, você deverá fazer um comentário acerca das ideias expostas até então. Haverá um símbolo  lembrando da necessidade dessa parada para o relato.

**Lembre-se de que:**

> a pesquisadora não irá interagir com você;

> você pode utilizar estratégias que desejar para ajudá-lo a lembrar do tópico: reler trechos curtos, destacar, anotar (no papel ou ao lado do próprio texto na tela)

> as anotações **não** poderão ser utilizadas na tarefa pós-leitura;

> após lido o texto todo, **não** refaça a leitura;

> você irá fazer uma tarefa solicitando sua avaliação e posicionamento sobre o tópico lido;

**SEU RELATO SERÁ GRAVADO EM ÁUDIO E SEUS MOVIMENTOS NA TELA SERÃO GRAVADOS.**

**A SUA IMAGEM NÃO SERÁ GRAVADA.**

**APPENDIX M- Text 1/Text 2 – Linear -Post-reading task: reading to summarize**

Texto I/Texto 2 – Linear - Tarefa pós-leitura: leitura para resumir

Texto 1 -**Should Animals Be Used for Scientific or Commercial Testing?**

Texto 2 - **Are Social Networking Sites Good for Our Society?**

**Tarefa: Resuma o texto lido (200-250 palavras)**

_____

_____

**APPENDIX N- Instructions for reading Text 1/Text 2 – hypertext**

[back1] [back2]

**Condition: Reading to criticize/give opinion**

*Instruções para leitura do Texto 1 – hipertexto*

*Tarefa: Ler para criticar/expressar opinião sobre um tópico*

Você irá ler um texto com argumentos pró e contra o tópico *uso de animais em teste de laboratório/* a *influência das redes sociais na sociedade* para criticar/expressar sua opinião, que deve ser baseada nos melhores argumentos. Preste atenção aos emissores das opiniões no texto.

Leia o texto silenciosamente para obter uma compreensão geral.

Interrompa a leitura toda vez que notar algum problema de compreensão, ou para comentar algo que tenha chamado sua atenção. Comente e exponha sua opinião quando julgar necessário.

Ao final de cada parágrafo, você deverá fazer um comentário acerca das ideias expostas até então. Haverá um símbolo ✋ lembrando da necessidade dessa parada para o relato.

**Lembre-se de que:**

> o texto possui *hyperlinks* que acrescentam argumentos ao debate. Ao clicar na palavra more, mais informações serão acrescidas ao texto. Palavras sublinhadas com linhas pontilhadas apresentam definições/sinônimos ao aproximar o mouse. Ex.: *horrible*.

> a pesquisadora não irá interagir com você;

> você pode utilizar estratégias que desejar para ajudá-lo a lembrar do tópico: reler trechos curtos, destacar, anotar (no papel ou ao lado do próprio texto)

> as anotações **não** poderão ser utilizadas na tarefa pós-leitura;

> após lido o texto todo, **não** refaça a leitura;

> você irá fazer uma tarefa solicitando sua avaliação e posicionamento sobre o tópico lido.

**SEU RELATO SERÁ GRAVADO EM ÁUDIO E SEUS MOVIMENTOS NA TELA SERÃO GRAVADOS.**

**A SUA IMAGEM NÃO SERÁ GRAVADA.**

## APPENDIX O – Text 1/Text 2 – Hypertext -Post-reading task: Reading to criticize/give opinion

Texto I/Texto 2 - hipertexto - Tarefa pós-leitura:
*Leitura para criticar/expressar opinião sobre um tópico*

Texto 1 -**Should Animals Be Used for Scientific or Commercial Testing?**

Texto 2 - **Are Social Networking Sites Good for Our Society?**

**Responda as perguntas com base nas informações do Texto 1/Texto 2:**

1) Enumere 4 argumentos favoráveis ao uso de animais em testes de laboratório/ ao uso das redes sociais.

_____

2) Enumere 4 argumentos contrários ao uso de animais em testes de laboratório/ ao uso das redes sociais.

_____

3) Com quais argumentos você concorda? Por quê?

_____

4) Que critérios você utilizou para escolher os argumentos em que baseou sua opinião?

_____

5) Você considerou o emissor da opinião para embasar a sua?

_____

**APPENDIX P- Instructions for reading Text 1/Text 2 – Hypertext** [back]
**Condition: Reading to summarize**

*Instruções para leitura do Texto 1/Texto 2 – hipertexto*

*Leitura para resumir*

Você irá ler um texto com argumentos pró e contra o tópico *uso de animais em testes de laboratórios/* a *influência das redes sociais na sociedade* para resumir.

Leia o texto silenciosamente para obter uma compreensão geral.

Interrompa a leitura toda vez que notar algum problema de compreensão, ou para comentar algo que tenha chamado sua atenção. Comente e exponha sua opinião quando julgar necessário.

Ao final de cada parágrafo, você deverá fazer um comentário acerca das ideias expostas até então. Haverá um símbolo ✋ lembrando da necessidade dessa parada para o relato.

**Lembre-se de que:**

> o texto possui *hyperlinks* que acrescentam argumentos ao debate. Ao clicar na palavra more, mais informações serão acrescidas ao texto. Palavras sublinhadas com linhas pontilhadas apresentam definições/sinônimos ao aproximar o mouse. Ex.: *horrible*.

> a pesquisadora não irá interagir com você;

> você pode utilizar estratégias que desejar para ajudá-lo a lembrar do tópico: reler trechos curtos, destacar, anotar (no papel ou ao lado do próprio texto)

> após lido o texto todo, não refaça a leitura;

> você irá fazer uma tarefa solicitando sua avaliação e posicionamento sobre o tópico lido;

> você irá resumir o texto após a leitura.

**SEU RELATO SERÁ GRAVADO EM ÁUDIO E SEUS MOVIMENTOS NA TELA SERÃO GRAVADOS.**

**A SUA IMAGEM NÃO SERÁ GRAVADA.**

**APPENDIX Q -Text 1/Text 2 – Hypertext -Post-reading task: Reading to summarize**

Texto I/Texto 2 - hipertexto - Tarefa pós-leitura:

*Leitura para resumir:*

Texto 1 -**Should Animals Be Used for Scientific or Commercial Testing?**

Texto 2 - **Are Social Networking Sites Good for Our Society?**

**Tarefa: Resuma o texto lido (200-250 palavras):**

**_____**

**_____**

**APPENDIX R– Self-evaluation questionnaire** [back]

**Participante: ____**

**Questionário de auto-avaliação**

1- Que diferenças de desempenho na leitura você observou nos dois tipos de apresentação dos textos, com *links* e sem *links*?

2- Em qual dos dois textos você notou mais dificuldade de concentração: no hipertexto (com *links*) ou no texto digital linear (sem *links*)?

3- No texto com *links* seu procedimento se encaixa em:
( ) optou por não acessar os/alguns *links* ( ) não notou a presença de *links*
( ) acessou todos os *links*
outro: _____

4- Em qual dos dois textos (hipertexto ou texto digital linear) você sentiu que precisava ler novamente?

5- Os tópicos discutidos nos dois textos interessaram a você? Por quê?

## APPENDIX S - Reading Span Test score

1.

| | | |
|---|---|---|
| errada | cultos | vegetal |
| saudável | futuristas | economia |

2.

| | | |
|---|---|---|
| glicose | medicamentos | natureza |
| empresários | militar | laboratório |
| depressão | dedicação | demissões |

3.

| | | |
|---|---|---|
| foguetes | polêmico | pesados |
| paciente | animais | Europeia |
| delicado | atraentes | favores |
| perfeita | terrestres | qualidade |

4.

| | | |
|---|---|---|
| editais | cidade | planeta |
| sentidos | humana | físico |
| opacas | política | habitantes |
| comerciais | máximo | cabeça |
| ameaça | artificial | mercado |

5.

| | | |
|---|---|---|
| exterior | empresa | célula |
| gelada | barato | volume |
| extinção | dinheiro | polida |
| industriais | treinadas | vítimas |
| oceanos | corrida | burocracia |
| segredo | eleitores | organismo |

## APPENDIX T - Words recalled in the RST by participant

| P1 | | |
|---|---|---|
| errada | perfeita | política |
| saudável | polêmico | artificial |
| cultos | atraente | habitantes |
| futuristas | terrestres | mercado |
| economia | pesada | exterior |
| glicose | europeia | gelada |
| depressão | qualidade | segredo |
| medicamentos | editais | dinheiro |
| militar | opacos | empresa |
| dedicação | ameaça | corrida |
| demissões | cidade | eleitores |
| foguetes | humana | célula |
| | | organismo |

| P2 | | |
|---|---|---|
| errada | demissões | artificial |
| saudável | foguete | mercado |
| futuristas | delicada | oceanos |
| economia | perfeita | segredo |
| depressão | terrestres | eleitores |
| medicamentos | pesados | celular |
| polícia militar | europeia | polida |
| dedicação | qualidade | organismo |
| laboratório | ameaça | |

| P3 | | |
|---|---|---|
| errada | perfeita | físico |
| saudável | polêmico | habitantes |
| cultos | animais | cabeça |
| futuristas | atraentes | mercado |
| vegetal | terrestres | exterior |
| economia | pesados | extinção |
| glicose | Europeia | oceano |
| empresários | favores | segredo |
| depressão | qualidade | empresa |
| medicamentos | editais | barato |
| militar | comerciais | dinheiro |
| dedicação | ameaça | corrida |
| natureza | cidade | eleitores |

| | | |
|---|---|---|
| laboratório | humana | célula |
| demissões | política | volumes |
| foguetes | artificial | burocracia |
| paciente | planeta | organismo |

**P4**

| | | |
|---|---|---|
| errada | demissões | artificial |
| saudável | foguetes | físico |
| cultos | delicado | mercado |
| futuristas | perfeita | exterior |
| vegetal | polêmicas | gelada |
| economia | animais | segredo |
| glicose | terrestres | empresa |
| empresários | pesados | barata |
| depressão | Europeia | corridas |
| medicamentos | qualidade | eleitores |
| militar | editais | célula |
| dedicação | ameaça | volume |
| natureza | cidade | polidas |
| laboratório | humana | vítimas |
| | máximo | organismo |

**P5**

| | | |
|---|---|---|
| errada | perfeita | habitantes |
| saudável | polêmicos | cabeça |
| cultos | animais | mercado |
| futuristas | atraentes | gelada |
| vegetal | terrestres | segredo |
| economia | pesados | oceanos |
| glicose | Europeia | empresa |
| empresários | qualidade | corrida |
| depressão | opacas | eleitores |
| militar | ameaças | célula |
| dedicação | cidade | vítimas |
| natureza laboratório | política | burocracia |
| demissões | máximo | organismo |
| | artificial | |

| P6 | | |
|---|---|---|
| errada | foguetes | artificial |
| saudável | delicado | cabeça |
| cultos | perfeita | mercado |
| futuristas | polêmicos | exterior |
| vegetal | animais | gelado |
| economia | atraentes | oceanos |
| glicose | terrestres | segredo |
| empresários | pesado | empresas |
| depressão | favores | treinadas |
| medicamentos | Europeia | corrida |
| militar | qualidade | eleitores |
| dedicação | editais | célula |
| natureza | comerciais | volume |
| laboratório | ameaça | burocracia |
| demissões | cidade | organismo |
| humana | política | |

| P7 | | |
|---|---|---|
| errada | dedicação | ameaça |
| saudável | natureza | máximo |
| culto | demissões | artificial |
| futuristas | perfeita | habitantes |
| vegetal | animais | mercado |
| economia | atraentes | segredo |
| glicose | terrestres | corrida |
| depressão | europeia | eleitores |
| medicamentos | qualidade | vítimas |
| militar | opacas | organismo |

| P8 | | |
|---|---|---|
| saudável | paciente | artificial |
| futuristas | perfeita | planeta |
| vegetal | animais | físico |
| economia | terrestres | mercado |
| glicose | europeia | exterior |
| depressão | qualidade | extinção |
| dedicação | opacas | segredo |
| natureza | ameaça | empresa |
| demissões | humana | eleitores |
| foguete | política | organismo |

| P9 | | |
|---|---|---|
| errada | foguetes | máximo |
| saudável | perfeita | artificial |
| cultos | animais | planeta |
| economia | polêmica | mercado |
| glicose | terrestre | exterior |
| empresários | pesados | oceano |
| depressão | Europa | segredo |
| medicamentos | qualidade | corrida |
| militar | opacos | eleitores |
| dedicação | ameaça | célula |
| demissões | humana | organismo |

| P10 | | |
|---|---|---|
| errada | laboratório | mercado |
| saudável | demissões | exterior |
| cultos | foguetes | oceanos |
| economia | perfeita | segredo |
| glicose | terrestres | empresa |
| empresários | pesadas | corrida |
| depressão | favores | eleitores |
| medicamentos | qualidade | volume |
| militar | ameaça | organismo |
| dedicação | artificial | |
| natureza | físico | |

| P11 | | |
|---|---|---|
| errada | demissões | máximo |
| saudável | perfeito | artificial |
| futuristas | animais | planeta |
| economia | terrestres | mercado |
| glicose | europeia | oceano |
| depressão | qualidade | segredo |
| medicamentos | editais | empresa |
| militar | ameaça | eleitores |
| dedicação | humano | organismo |

| P12 | | |
|---|---|---|
| errada | demissões | artificial |
| saudável | foguetes | máximo |
| culto | paciente | planeta |
| futuristas | perfeita | mercado |
| vegetal | terrestres | exterior |
| economia | europeia | industriais |
| glicose | favores | segredo |
| empresários | qualidade | barato |
| depressão | sentidos | corrida |
| militar | comerciais | eleitores |
| dedicação | ameaça | célula |
| natureza | cidade | polida |
| laboratório | humanas | organismo |

| P13 | | |
|---|---|---|
| errada | foguetes | exterior |
| saudável | perfeita | gelado |
| cultos | terrestres | oceanos |
| futuristas | pesados | segredo |
| economia | europeia | empresa |
| glicose | qualidade | barato |
| empresários | edital | dinheiro |
| depressão | opaca | eleitores |
| medicamentos | ameaça | células |
| militar | cidades | polida |
| dedicação | humanos | democracia |
| natureza | máximo | organismo |

| | |
|---|---|
| laboratório | artificial |
| demissões | físico |
| pacientes | mercado |

| **P14** | | |
|---|---|---|
| errada | foguete | máximo |
| saudável | paciente | artificial |
| cultos | perfeita | planeta |
| futuristas | polêmico | cabeça |
| vegetal | animais | mercado |
| economia | atraente | gelado |
| glicose | terrestres | segredo |
| empresários | pesado | empresa |
| depressão | europeia | barato |
| medicamentos | favores | dinheiro |
| militar | qualidade | treinadas |
| dedicação | editais | corrida |
| natureza | opacas | eleitores |
| laboratório | ameaça | célula |
| demissões | cidade | volume |
| | | organismo |

| **P15** | | |
|---|---|---|
| errada | laboratório | artificial |
| saudável | demissões | cabeça |
| cultos | foguetes | mercado |
| futuristas | delicado | gelado |
| vegetal | perfeita | segredo |
| economia | terrestres | barato |
| glicose | favores | dinheiro |
| empresários | qualidade | eleitores |
| depressão | editais | célula |
| medicamentos | ameaça | polida |
| militar | política | organismo |
| dedicação | | |

| P16 | | |
|---|---|---|
| errada | paciente | físico |
| saudável | perfeita | mercado |
| futuristas | polêmico | gelados |
| vegetal | terrestres | oceano |
| economia | favores | segredo |
| empresários | qualidade | barato |
| depressão | editais | dinheiro |
| militar | ameaça | corrida |
| dedicação | cidade | eleitores |
| natureza | políticos | polida |
| mínimo | artificial | organismo |
| demissões | planeta | |

| P17 | | |
|---|---|---|
| errada | perfeita | artificial |
| saudável | terrestres | planeta |
| cultos | pesado | físico |
| futuristas | europeia | mercado |
| economia | favores | exterior |
| glicose | qualidade | segredo |
| empresários | comerciais | barato |
| depressão | ameaça | dinheiro |
| medicamentos | cidades | eleitores |
| militar | humanas | célula |
| dedicação | política | polida |
| laboratório | máximo | burocracia |
| demissões | | organismo |
| foguete | | |

| P18 | | |
|---|---|---|
| errada | foguete | planeta |
| saudável | paciente | mercado |
| cultos | perfeita | exterior |
| futuristas | animais | extinção |
| vegetal | terrestres | segredo |
| economia | Europeia | dinheiro |
| glicose | favores | corrida |
| empresários | qualidade | eleitores |

| | | |
|---|---|---|
| depressão | opacas | célula |
| medicamentos | ameaça | polida |
| militar | cidade | burocracia |
| dedicação | humanas | organismo |
| demissões | artificial | |

| **P19** | | |
|---|---|---|
| errada | perfeita | física |
| saudável | polêmico | habitantes |
| cultos | animais | mercado |
| futuristas | terrestres | exterior |
| vegetal | pesados | gelados |
| economia | europeias | extinção |
| glicose | favores | industrial |
| empresários | qualidade | segredo |
| depressão | opacas | empresa |
| medicamentos | ameaça | barato |
| militar | cidade | dinheiro |
| dedicação | humana | corrida |
| natureza | política | eleitores |
| laboratório | máximo | polida |
| demissões | exemplar | burocracia |
| foguetes | planeta | organismo |

| **P20** | | |
|---|---|---|
| errada | laboratório | cidade |
| saudável | demissões | humana |
| culto | paciente | artificial |
| futuristas | foguete | planeta |
| vegetal | perfeita | cabeça |
| economia | polêmico | mercado |
| glicose | terrestre | exterior |
| empresário | pesado | oceano |
| depressão | favores | segredo |
| medicamentos | qualidade | eleitores |
| militar | editais | polida |
| dedicação | ameaça | organismo |
| natureza | | |

| P21 | | |
|---|---|---|
| errada | demissões | máximo |
| saudável | foguetes | política |
| cultos | paciente | artificial |
| futuristas | perfeita | planeta |
| vegetal | polêmico | mercado |
| economia | terrestres | exterior |
| glicose | pesado | segredo |
| empresários | europeia | barato |
| depressão | qualidade | eleitores |
| medicamentos | opaco | polida |
| militar | ameaça | organismo |
| dedicação | | |

| P22 | | |
|---|---|---|
| errada | perfeita | oceano |
| saudável | polêmico | segredo |
| cultos | animais | eleitores |
| futuristas | terrestres | organismo |
| vegetal | pesado | |
| economia | favores | |
| depressão | qualidade | |
| medicamentos | ameaça | |
| militar | humano | |
| dedicação | artificial | |
| demissões | mercado | |

| P23 | | |
|---|---|---|
| errada | foguete | máximo |
| saudável | delicado | artificial |
| culto | perfeita | planeta |
| futurista | animais | físico |
| vegetal | atraente | mercado |
| economia | terrestres | oceanos |
| glicose | pesados | segredo |
| empresários | Europa | corrida |
| depressão | qualidade | eleitores |
| militar | editais | célula |

| | | |
|---|---|---|
| dedicação | ameaça | volume |
| natureza | cidade | polido |
| laboratório | política | organismo |
| demissões | | |

| **P24** | | |
|---|---|---|
| errada | demissões | político |
| saudável | foguete | cabeça |
| culto | perfeita | planetas |
| futuristas | polêmico | mercado |
| economia | animais | exterior |
| glicose | atraentes | segredo |
| empresários | terrestre | dinheiro |
| depressão | qualidade | eleitores |
| medicamentos | ameaça | burocracia |
| dedicação | cidade | organismo |
| laboratório | | |

## APPENDIX U- Instructions to raters [back]

Dear rater,

First of all, I would like to thank you for accepting the invitation to take part in the present study. You were selected for you expertise on assessment in the area of reading from the psycholinguistics and cognitive perspectives.

The present study investigated the reading processes and products of 30 participants reading two expository texts for two different purposes. In order to preserve the detachment and the objectivity in the evaluations, meanwhile the reading purposes are not identified in each verbal report transcription. Later, upon your request, more information may be given to you in this respect.

You are receiving the transcription of verbal utterances produced by some of those participants in order to classify their report in each paragraph according to the framework by Linderholm and van den Broek, (2002).

Along with the verbal reports, I am attaching the article "The effects of reading purpose and working memory capacity on the processing of expository text", by Linderholm and van den Broek (2002), and a summary of the framework adapted from their study (Table A). The framework is composed of nine categories of inferences and/or reading strategies that readers generate while reading aloud expository texts. As the stimulus texts are in L2 English and the participants report in Portuguese, other categories may emerge. In this case, we will discuss on the best new categories to add to the frame.

Remember that more than one category may apply to each paragraph. To make this clear, I am also attaching an example from the pilot study.

After finishing the categorizations, we will set a date and time to discuss the similarities and differences between the ratings and decide on the best interpretation.

I am really grateful for having you as a rater.

Table A
*Summary of the framework adapted from reading strategy categories by Linderholm & van den Broek (2002)*

| Inference type | Description |
|---|---|
| Associations | Concepts invoked by the text that are not necessary for comprehension |
| Evaluative comments | Readers' opinions about the text |
| Connecting inferences | Connection of content of the current sentence with meaning form immediately preceding sentence. |
| Elaborative inferences | Content of the current sentence is explained taking into account the reader's background knowledge |
| Predictive inferences | Anticipation of what will come next in the text |
| Reinstatement inferences | Explanation for the current sentence is based on prior text information that is not in the immediately preceding sentence |
| Metacognitive comments | Reflections of the reader's understanding or lack of understanding of the text |
| Paraphrases | The reader changes the current sentences into his/her own words giving a gist meaning of the sentence |
| Text repetitions | Exact wordings of the current sentence |

**APPENDIX V– Test of assumptions for parametric tests with variables related to research question 1** [back1][back2]

To test if the variables related to Research Question 1 meet the parameters to the ANOVA, the steps suggested by Kabacoff (2017) were followed. The steps are (1) verify the existence of significant outliers, (2) check the normality of the distributions and (3) check if the variances are homogeneous. The function aq.plot (package mvoutlier) was used in the first step. The output, shown in the plot below (Figure A), highlights the presence of significant outliers in red.

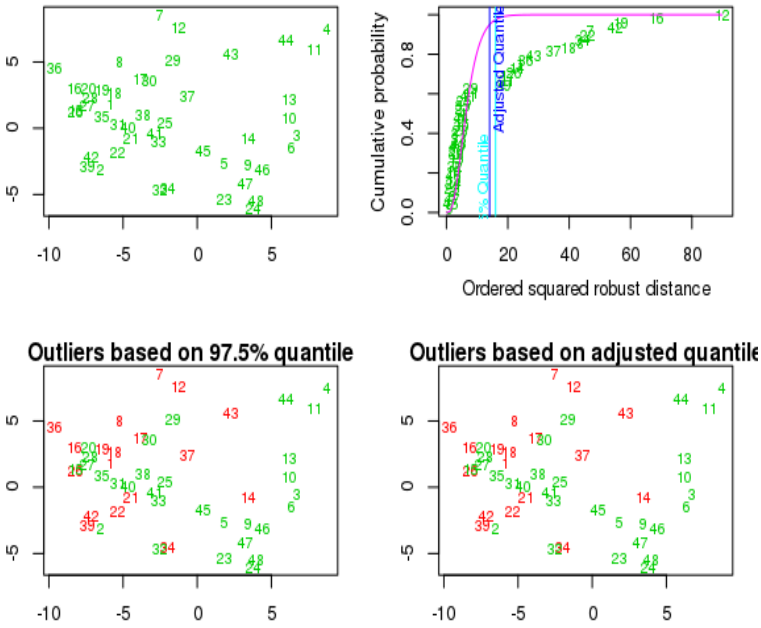
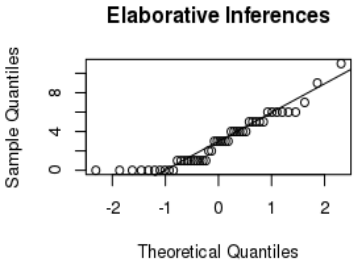
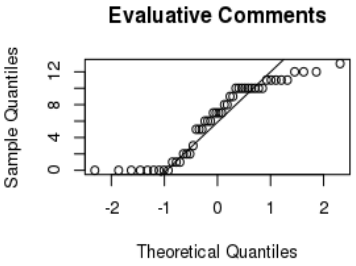
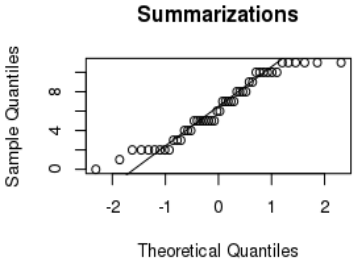


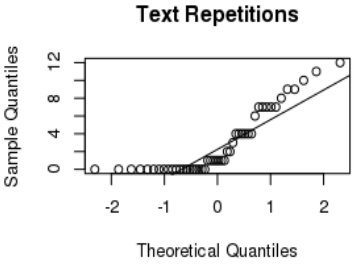

Figure A. Plot with outliers

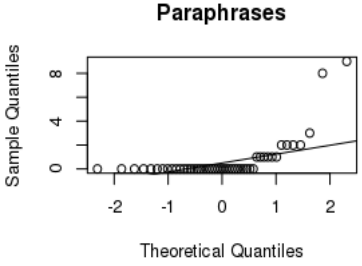
The normality of the distributions was assessed by the analysis of Normal Q-Q Plots and Shapiro-Wilk tests of normality for each variable. The outputs, shown below, suggest that none of the variables follows the normal distribution.

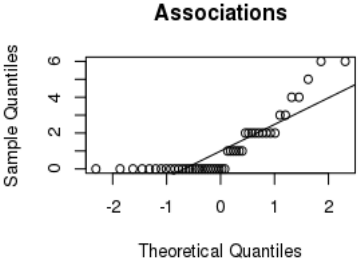

Elaborative Inferences
Sample Quantiles
Theoretical Quantiles

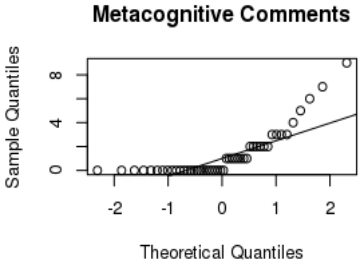

Evaluative Comments
Sample Quantiles
Theoretical Quantiles

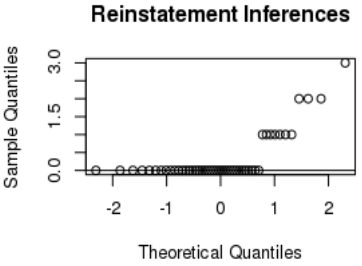

Summarizations
Sample Quantiles
Theoretical Quantiles


Text Repetitions
Sample Quantiles
Theoretical Quantiles


Paraphrases
Sample Quantiles
Theoretical Quantiles


Associations
Sample Quantiles
Theoretical Quantiles


Metacognitive Comments
Sample Quantiles
Theoretical Quantiles


Reinstatement Inferences
Sample Quantiles
Theoretical Quantiles

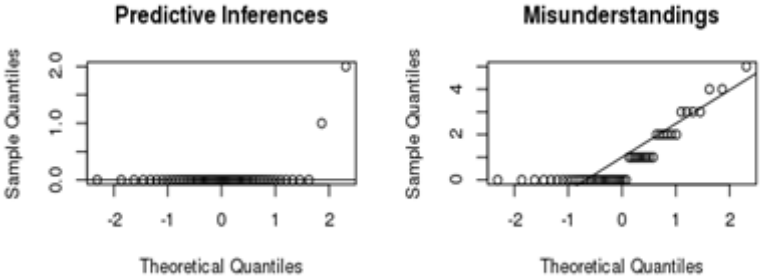



Table A1

*Shapiro-Wilk normality tests*

| Variable | *W* | *p* |
|---|---|---|
| Elaborative inferences | 0.90 | >.001* |
| Evaluative comments | 0.88 | >.001* |
| Summarizations | 0.93 | .009* |
| Text Repetitions | 0.80 | >.001* |
| Paraphrases | 0.44 | >.001* |
| Associations | 0.73 | >.001* |
| Metacognitive comments | 0.70 | >.001* |
| Reinstatement inferences | 0.55 | >.001* |
| Predictive inferences | 0.20 | >.001* |
| Misunderstandings | 0.75 | >.001* |

*Notes.* * Statistically significant. The null-hypothesis that the data follow the normal distribution may be rejected.

The function fligner.test was used to check the homogeneity of variances of the variables considering Working Memory Group, Text Mode and Condition. None of the tests returned a significant result, as shown in Table A2 below. Thus, there is not enough evidence to reject the null hypothesis that the variances are homogeneous.

# Table A2

*Fligner-Killeen test of homogeneity of variances*

| By Condition | *Med* $\chi^2(1)$ | *p* |
|---|---|---|
| Elaborative inferences | 0.45 | .503 |
| Evaluative comments | 0.70 | .403 |
| By Condition02 | *Med* $\chi^2(1)$ | *P* |
| Summarizations | 0.09 | .764 |
| Text Repetitions | 0.01 | .926 |
| Paraphrases | 0.10 | .751 |
| Associations | 0.37 | .542 |
| Metacognitive comments | 0.28 | .595 |
| Reinstatement inferences | 0.15 | .695 |
| Predictive inferences | 0.02 | .899 |
| Misunderstandings | 2.35 | .125 |
| By Text Mode | *Med* $\chi^2(1)$ | *p* |
| Elaborative inferences | 1.09 | .297 |
| Evaluative comments | 0.12 | .727 |
| Summarizations | >0.01 | .964 |
| Text Repetitions | 0.28 | .599 |
| Paraphrases | 0.10 | .751 |
| Associations | 3.02 | .082 |
| Metacognitive comments | 1.34 | .247 |
| Reinstatement inferences | 1.43 | .232 |
| Predictive inferences | 2.03 | .154 |
| Misunderstandings | 0.54 | .041 |

| By WM[a] Group | *Med* $\chi^2(1)$ | *p* |
|---|---|---|
| Elaborative inferences | 0.44 | .509 |
| Evaluative comments | 0.26 | .611 |
| Summarizations | >0.01 | .976 |
| Text Repetitions | 0.30 | .581 |
| Paraphrases | 0.21 | .645 |
| Associations | 1.74 | .188 |
| Metacognitive comments | 0.20 | .651 |
| Reinstatement inferences | 0.20 | .653 |
| Predictive inferences | 1.72 | .190 |
| Misunderstandings | 3.11 | .078 |

*Notes.* [a] Working Memory.

## APPENDIX W - Means and Standard Deviations of Repetitions and Metacognitive comments for each group in each condition; Effects of Condition on Inference Generation [back]

Table A3
*Means and Standard Deviations of Repetitions for each group in each condition*

| | | *Text Mode* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | *Hypertext* | | | | *Linear* | | | |
| | | Criticize | | Summarize | | Criticize | | Summarize | |
| | | M | SD | M | SD | M | SD | M | SD |
| WMC Group | High | 2.67 | 2.07 | 1.57 | 2.44 | 3.14 | 4.06 | 3.33 | 3.98 |
| | Low | 2.50 | 3.89 | 4.20 | 5.22 | 2.40 | 3.05 | 3.50 | 4.72 |

*Notes. N*=24.

Table A4
*Means and Standard Deviations of Metacognitive comments for each group in each condition*

| | | *Text Mode* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | *Hypertext* | | | | *Linear* | | | |
| | | Criticize | | Summarize | | Criticize | | Summarize | |
| | | M | SD | M | SD | M | SD | M | SD |
| WMC Group | High | 0.50 | 0.84 | 2.29 | 2.43 | 2.14 | 3.39 | 0.17 | 0.41 |
| | Low | 1.33 | 2.34 | 1.80 | 0.84 | 1.40 | 2.19 | 0.67 | 1.21 |

*Notes. N*=24.

Table A5
*Effects of Condition on Inference Generation*

| | Condition | | | | |
|---|---|---|---|---|---|
| | Criticizing | | Summarizing | | |
| Inference Category | *M* | *SD* | *M* | *SD* | *p* |
| Text Repetitions | 2.71 | 3.20 | 3.04 | 3.95 | .473 |
| Metacognitive | 1.38 | 2.36 | 1.25 | 1.67 | .781 |
| comments | | | | | |

*Note.* Means and Standard Deviations of the generation of inferences per participant in each reading condition.

**APPENDIX X - Summary of strategy use: reading time, link access and strategy analyses**

| | Cond | RT | Link access | Analyses of screen shots and paper-sheet note-taking: strategies/behavior |
|---|---|---|---|---|
| 1 | T1-HC | 04:31 | 5/7 | |
| | T2-LS | 04:57 | | |
| 2 | T1-LC | 13:25 | | -highlights: 5 x<br>- checks vocabulary in pop-up: 2/3<br>-rereads excerpts: 2x |
| | T2- HS | 12:14 | 7/7 | -Checks vocabulary in pop-up 2/3<br>-reaccesses 6 links<br>-rereads excerpts 3 x<br>-highlights 1x |
| 3 | T1-HS | 09:19 | 6/7 | -checks vocabulary in pop-up 3/3<br>-rereads primary text after reading link (2x) |
| | T2-LC | 07:31 | | - checks vocabulary in pop-up: 2x<br>-highlights: 12 x (all paragraphs) |
| 4 | T1-LS | 10:30 | | - checks vocabulary in pop-up: 1/3<br>- Rereads: 1x<br>-takes notes: 1x (screen)<br>-scrolls up: 1x |
| | T2-HC | 06:51 | 4/7 | - no vocabulary checking in pop-up<br>-highlights excerpts in most paragraphs<br>- goes back to primary text and highlights/rereads it (2X) |
| 5 | T1-HC | 04:55 | 0/7 | - subvocalizes while reading<br>-rereads excerpts : 2x |
| | T2-LS | 05:00 | | - highlights: 2x<br>- subvocalizes: 2x |

| | Cond | RT | Link access | Analyses of screen shots and paper-sheet note-taking: strategies/behavior |
|---|---|---|---|---|
| 6 | T1-LC | 04:34 | | -rereads: 1x<br>- checks vocabulary in pop-up: 1/3 |
| | T2-HS | 04:07 | 7/7 | -checks vocabulary in pop-up: 2/3<br>-rereads excerpts: 2 x<br>-skips paragraph<br>-reads aloud: 7 x or subvocalizes 1 x |
| 7 | T1-HS | 17:40 | 7/7 | -checks vocabulary in pop-up: 1/3<br>-copies and pastes to note-taking table in all paragraphs<br>-rereads excerpt: 1 x |
| | T2-LC | 23:49 | | -takes notes: 12 x (all paragraphs)<br>-copies/pastes: 7x<br>- checks vocabulary in pop-up: 1/3 |
| 8 | T1-LS | 07:40 | | -highlights: 6x |
| | T2-HC | 09:13 | 2/7 | - checks vocabulary in pop-up: 2/3<br>-highlights excerpts: 3 x |
| 9 | T1-LC | 06:42 | | -took notes in paper sheet: 2 x |
| | T2-HS | 04:06 | 1/7 | - forgets to report 2 paragraphs |
| 10 | T1-HS | 08:12 | 5/7 | -checks vocabulary in pop-up: 2/3<br>-rereads paragraph:3 x<br>-rereads link: 2 x |
| | T2-LC | 06:04 | | - checks vocabulary in pop-up: 2/3 |
| 11 | T1-HC | 05:34 | 2/7 | -copies and pastes 1 x<br>-rereads paragraph: 2 x<br>-forgets to report 1 paragraph |
| | T2-LS | 05:06 | | - checks vocabulary in pop-up: 2/3 |

| | Cond | RT | Link access | Analyses of screen shots and paper-sheet note-taking: strategies/behavior |
|---|---|---|---|---|
| | | | | - highlights: 2x |
| | T1-LC | 08:06 | | - checks vocabulary in pop-up: 1/3 |
| 12 | | | | |
| | | | 0/7 | -highlights words |
| | T2-HS | 05:16 | | |
| | | | | - checks vocabulary in pop-up: 2/3 |
| | T1-HS | 07:12 | 5/7 | - highlights excerpt: 4 x |
| 13 | | | | forgets to report 1 paragraph |
| | | | | -rereads paragraph: 1x |
| | | | | - checks vocabulary in pop-up: 2/3 |
| | T2-LC | 04:48 | | |
| | T1-LS | 03:12 | | |
| 14 | | | | |
| | T2-HC | 03:01 | 6/7 | |
| | | | | -takes notes in paper sheet |
| | T1-LS | 07:22 | | -highlights: 3x |
| 15 | | | | - checks vocabulary in pop-up: 1/3 |
| | | | | -checks vocabulary in pop-up: 1/3 |
| | T2-HC | 04:52 | 6/7 | -accesses 1 link while reporting |
| | | | | -highlights excerpts: 3x |
| | T1-LC | 08:36 | | -rereads: 1x |
| 16 | | | | |
| | T2-HS | 04:49 | | -rereads paragraph 1x |
| | | | 1/7 | |
| | | | | -rereads 1 link |
| | T1-HC | 06:25 | 1/7 | -rereads paragraph 1x |
| 17 | | | | -highlights 1x |
| | T2-LS | 03:21 | | - highlights: 1x |

| | Cond | RT | Link access | Analyses of screen shots and paper-sheet note-taking: strategies/behavior |
|---|---|---|---|---|
| 18 | T1-HS | 05:18 | 7/7 | -checks vocabulary in pop-up: 2/3<br>-highlights words: 2x<br>- checks vocabulary in pop-up: 2x |
| | T2-LC | 04:05 | | |
| 19 | T1-LC | 07:27 | | -reads aloud (all paragraphs)<br>-highlights: 1x<br>- rereads: 3x<br>- checks vocabulary in pop-up: 1/3 |
| | T2-HS | 05:30 | 3/7 | -checks vocabulary in pop-up: 2/3<br>-reads aloud all paragraphs<br>-highlights: 4x<br>-rereads: 1 x<br>-forgets to report: 1 x |
| 20 | T1-HC | 04:07 | 0/7 | - forgets to report : 2x |
| | T2-LS | 05:46 | | - checks vocabulary in pop-up: 2/3 |
| 21 | T1-LS | 1:10 | | -takes notes in paper sheet: 9x<br>- checks vocabulary in pop-up: 2/3 |
| | T2-HC | 05:00 | 4/7 | -checks vocabulary in pop-up: 1/3<br>-accessed the link after reporting:1x<br>-accessed the link while reporting: 1x<br>-takes notes in paper sheet: 6x |
| 22 | T1-HC | 6:34 | 5/7 | - highlights and takes notes in paper sheet in every paragraph before reporting<br>-checks vocabulary in pop-up: 3/3 |

| | Cond | RT | Link access | Analyses of screen shots and paper-sheet note-taking: strategies/behavior |
|---|---|---|---|---|
| 23 | T2-LS | 3:58 | | -takes notes in paper sheet in most paragraphs<br>-highlights in most paragraphs<br>- checks vocabulary in pop-up: 2/3<br>-forgets to report: 1x<br>-rereads: 2x |
| | T1-LS | 05:31 | | -forgets to report: 1x<br>-subvocalizes: 2x |
| | T2-HC | 05:15 | 2/7 | -accesses the 2 links after finishing reading the whole text |
| 24 | T1-HS | 07:21 | 6/7 | -checks vocabulary in pop-up:3/3<br>-after reading 1 link, returns to primary text and seems to be lost |
| | T2-LC | 05:12 | | - checks vocabulary in pop-up: 3/3<br>-rereads: 1x |

## APPENDIX Y -Effect of instruction: summary of data

| Partic | Question 4: Criteria to choose arguments on which to base your own | Question 5: Did you consider the issuer? |
|---|---|---|
| P1 | previous knowledge | no |
| P2 | personal believes | no (previous knowledge) |
| P3 | previous knowledge | no |
| P4 | personal opinion | yes (but used previous knowledge) |
| P5 | previous knowledge | yes (but used personal opinion) |
| P6 | previous knowledge | no |
| P7 | yes (previous knowledge and SO) | yes |
| P8 | own experience | yes (In fact, used previous knowledge |
| P9 | yes (considered SO and PO) | No (Did not see the author) |
| P10 | previous knowledge | no (previous knowledge) |
| P11 | Previous knowledge | yes (but used her own opinion) |
| P12 | previous knowledge | yes/No (if he agreed with the opinion) |
| P13 | previous knowledge | not clear |
| P14 | personal opinion | No (not clear) |
| P15 | previous knowledge | no (personal opinion) |
| P16 | not clear | yes (if he agreed with the opinion) |
| P17 | not clear | Yes |
| P18 | previous knowledge | no |

| Partic | Question 4: Criteria to choose arguments on which to base your own | Question 5: Did you consider the issuer? |
|---|---|---|
| P19 | previous knowledge | yes |
| P20 | previous knowledge | yes/No |
| P21 | previous knowledge | (previous knowledge) not clear issuer |
| P22 | previous knowledge | not clear |
| P23 | if well supported and developed | no (previous knowledge) |
| P24 | previous knowledge | no (previous knowledge) |

**APPENDIX Z - Total inferences per participant in each condition**

| Participant | Cond. | RST | Elab | Eval | Sum | Repe | Para | Asso | Meta | Rein | Pred | Misu | Total per participant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | T1-HC | 35,50 | 03 | 13 | 08 | 04 | | | | | 01 | | 29 |
| | T2-LS | | 06 | 10 | 11 | | | | | 01 | | 01 | 29 |
| 2 | T1-LC | 24,50 | | | 09 | 07 | 01 | | 02 | | | 01 | 20 |
| | T2- HS | | | | 02 | 12 | | | 02 | | | 03 | 19 |
| 3 | T1-HS | 51,00 | | 02 | 07 | 01 | 08 | | 01 | 01 | | | 20 |
| | T2-LC | | | | 09 | 06 | | | | | | 03 | 18 |

[back]

| Participant | Cond. | RST | Elab | Eval | Sum | Repe | Para | Asso | Meta | Rein | Pred | Misu | Total per participant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | T1-HS | | | | 05 | 07 | 03 | | 01 | | | | 16 |
| 7 | T2-LC | 29,50 | 04 | | 07 | 04 | 09 | | | | | 02 | 26 |
| | T1-LS | 29,00 | 06 | 11 | 05 | | | 02 | | | | | 24 |
| 8 | T2-HC | | 11 | 08 | 03 | | | 06 | 01 | | | 01 | 30 |
| | T1-LC | | 02 | 07 | | | | 02 | 05 | | | 02 | 18 |
| 9 | T2-HS | 30,50 | 01 | 10 | 02 | | | 02 | 03 | | | 01 | 19 |

| Participant | Cond. | RST | Elab | Eval | Sum | Repe | Para | Asso | Meta | Rein | Pred | Misu | Total per participant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P10 | T1-HS | 32,50 | 01 | 11 | 02 | | | 03 | 02 | | | 01 | 20 |
| | T2-LC | | 05 | 10 | 02 | | | 01 | | 02 | | | 20 |
| P11 | T1-HC | 25,50 | 01 | 09 | 06 | | | | | | | | 16 |
| | T2-LS | | | 11 | 08 | | 01 | | | | | | 20 |
| P12 | T1-LC | 37,50 | 01 | 02 | 11 | 01 | | | | 01 | | | 16 |
| | T2-HS | | | | 11 | 01 | | | | | | 01 | 13 |

| Participant | Cond. | RST | Elab | Eval | Sum | Repe | Para | Asso | Meta | Rein | Pred | Misu | Total per participant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | T1-HS | | 03 | 06 | 05 | 01 | 02 | 01 | 03 | 02 | 02 | 04 | 29 |
| P13 | | 37,50 | | | | | | | | | | | |
| | T2-LC | | 06 | 12 | 07 | 01 | 02 | 04 | 02 | | | | 34 |
| | T1-LS | | 06 | 10 | 04 | | | | | | | | 20 |
| P14 | | 45,00 | | | | | | | | | | | |
| | T2-HC | | 05 | 10 | 03 | | | 02 | | | | | 20 |
| | T1-LS | | 04 | 10 | 07 | 09 | | | | | | | 30 |
| P15 | | 32,50 | | | | | | | | | | | |
| | T2-HC | | 06 | 10 | 08 | 07 | | 01 | 01 | 01 | | 01 | 35 |

| Participant | Cond. | RST | Elab | Eval | Sum | Repe | Para | Asso | Meta | Rein | Pred | Misu | Total per participant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | T1-LC | 32,50 | 05 | 08 | 05 | | | | | | | | 18 |
| P16 | | | | | | | | | | | | | |
| | T2-HS | | 03 | 06 | 11 | | | 01 | | | | | 21 |
| | T1-HC | | 04 | 05 | 06 | | 01 | 02 | 02 | | | 01 | 21 |
| P17 | | 38,00 | | | | | | | | | | | |
| | T2-LS | | 07 | 03 | 11 | | | 03 | 01 | | | | 25 |
| | T1-HS | | 04 | 10 | 05 | | | | 02 | | | | 21 |
| P18 | | 37,00 | | | | | | | | | | | |
| | T2-LC | | 09 | 11 | 01 | | | | | | | | 11 |

| Participant | Cond. | RST | Elab | Eval | Sum | Repe | Para | Asso | Meta | Rein | Pred | Misu | Total per participant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | T1-LC | | 03 | 05 | 05 | 03 | 01 | 02 | 09 | 01 | | | 29 |
| P19 | | 46,00 | | | | | | | | | | | |
| | T2-HS | | 04 | 07 | 05 | 01 | 01 | 01 | 03 | | | | 21 |
| | T1-HC | | 04 | 12 | 11 | | | 02 | | | | | 29 |
| P20 | | 33,50 | | | | | | | | | | | |
| | T2-LS | | 05 | 07 | 05 | | | 02 | | | | 02 | 21 |
| | T1-LS | | 05 | 07 | 08 | 02 | | 02 | 03 | 03 | | 05 | 35 |
| P21 | | 32,50 | | | | | | | | | | | |
| | T2-HC | | 06 | 10 | 10 | | | 06 | | | | | 32 |

| Participant | Cond. | RST | Elab | Eval | Sum | Repe | Para | Asso | Meta | Rein | Pred | Misu | Total per participant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | T1-HC | | | 06 | 04 | 08 | | | 06 | | | | 24 |
| P22 | | 25,00 | | | | | | | | | | | |
| | T2-LS | | 02 | 01 | 02 | 10 | | 01 | 01 | 01 | | 03 | 21 |
| | T1-LS | | 03 | 05 | 10 | 04 | 02 | | | | | 02 | 26 |
| P23 | | 36,50 | | | | | | | | | | | |
| | T2-HC | | | 01 | 10 | 04 | | | | | | | 15 |
| | T1-HS | | 01 | 01 | 10 | 02 | 01 | | 01 | | | 03 | 19 |
| P24 | | 30,50 | | | | | | | | | | | |
| | T2-LC | | | | 10 | 01 | | | | 02 | | 04 | 17 |

*Note.* T1: text 1 T2: Text 2 HC: Hypertext/criticize HS: Hypertext/ summarize LC: Linear/ criticize LS: Linear/ summarize

**APPENDIX AA -Summary of the demographic questionnaire**

| | **Questions** | | **Options** | | |
|---|---|---|---|---|---|
| | *Everyday-academic purposes* | *Occasional – academic purposes* | *Everyday-entertainment* | *Occasional - entertainment* | *Restricted to social networking* |
| 1. Reading practice in L1 | P1-P3-P5-P7-P8-P10-P13 -P14-P15-P18-P20-P21-P22-P24 | P1-P4-P6-P9-P11-P12-P16 -P17-P19-P23 | P1-P4-P5- P9-P10-P11-P12-P13-P18-P19-P20-P23 | P2-P3-P8-P14-P15-P16-P17-P22-P24 | |
| T o t a l | 14 | 10 | 12 | 09 | 0 |
| 2. Reading practice in L2 | P2-P3-P4-P7-P8-P10-P12 -P14-P15-P18-P20-P21-P22-P23 | P1-P5-P6- P9-P11-P13-P16-P17-P19-P24 | P1-P4-P5- P9-P10-P11-P12-P14-P19-P22 | P8-P13-P15-P16-P17 -P18-P20-P23-P24 | |
| T o t a l | 14 | 10 | 10 | 09 | |
| 3. Reading practice in virtual environment | P3-P7-P8-P10-P12-P13-P14-P15-P20-P21 | P1-P4-P5-P6- P9-P11-P16-P17-P18-P19-P23-P24 | P1-P2-P3-P4-P5-P6-P7- P9-P10-P11-P14-P15-P16 -P18-P19-P22-P23-P24 | P8-P17-P20 | P12-P13-P16 |
| T o t a l | 10 | 12 | 18 | 03 | 03 |

| Questions | Options | |
|---|---|---|
| 4. Academic reading preferences | **Printed texts** | **Digital texts** |
| | P1-P2-P4-P5-P6-P8- P9-P10-P12-P13-P15-P16-P17-P19-P21-P22-P23-P24 | P3-P7-P11-P14-P18-P20-P21 |
| T o t a l | 18 | 07 |
| 5. Entertainment reading preferences | P4-P5-P8-P10-P13-P16-P18-P21-P23 | P1-P2-P3-P4-P6-P7- P9-P11-P12-P14-P15-P17-P19 -P20-P21-P22-P24 |
| T o t a l | 09 | 17 |

| Question | Options | | | |
|---|---|---|---|---|
| 6.Internet reading practice | *Explore all links* | *Read a text to the end and deciding on accessing links at the end* | *Print text instead* | *Other* |
| | P1-P5-P6-P7-P11-P12-P13-P14-P15-P17-P18-P23-P24 | P2-P3-P4-P8- P9-P10-P16 -P19-P20-P21-P22 | P16-P23 | |
| T o t a l | 13 | 11 | 02 | |

| Question | Options | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7. Experience with digital texts: 1-10 scale | 1 | 2 | 3<br>P2 | 4 | 5 | 6<br>P17 | 7<br>P5-P8-P11-P12-P13-P24 | 8<br>P4-P6-P7-P9-P10-P15-P16-P18-P19-P22-P23 | 9<br>P1-P3 | 10<br>P14-P20-P21 | |
| T o t a l | | | 01 | | | 01 | 06 | 11 | 0<br>2 | 0<br>3 | |

| Question | Options | | |
|---|---|---|---|
| 8. Reading speed on Internet | *Fast* | *careful* | *The same as for other texts* |
| | P1-P6-P8-P9-P11-P13-P14-P18-P23-P24 | P2-P3-P4-P7-P15-P16 | P4-P5-P10-P12-P14-P16-P17-P19-P20-P21-P22 |
| T o t a l | 10 | 06 | 11 |

| Question | Options | | | |
|---|---|---|---|---|
| 9. Level of concentration on Internet reading | *Normal* | *Effort to concentrate* | *Concentration is always impaired on Internet* | *It depends on topic interest* |
| | P12-P18-P20 | P4-P5-P16-P23 | P2- P9-P13 | P1-P3-P4-P5-P6-P7-P8-P10-P11-P13-P14-P15-P16-P17-P19-P21-P22-P23-P24 |
| T o t a l | 03 | 04 | 03 | 19 |

| Question | Answers |
|---|---|
| 10. Strategies when reading: | |
| printed texts | P1: underline, take notes, rewrite.<br>P2: underline, take notes, highlight, summarize<br>P3: take notes, summarize in keywords<br>P4: underline, take notes (in the text, page number)<br>P5: highlight, take notes<br>P6: underline, take notes<br>P7: underline, take notes<br>P8: underline, take notes, highlight<br>P9: underline, take notes, summarize<br>P10: underline, take notes, highlight, summarize, use symbols (heart, star, question mark)<br>P11: underline, highlight using a dot<br>P12:occasionally underline and take notes |

| | |
|---|---|
| printed texts | P13: underline<br>P14: take notes<br>P15: underline, take notes on the page, summarize<br>P16: underline, take notes<br>P17: underline<br>P18: underline keywords<br>P19: underline, take notes<br>P20: underline, take notes<br>P21: underline, take notes (keywords)<br>P22: underline, take notes, summarize<br>P23: underline, take notes<br>P24: underline, take notes |
| Strategies when reading digital texts, hypertexts | P1: Underline<br>P2: Underline, highlight<br>P3: summarize in keywords (in paper)<br>P4: use mouse, copy excerpts to a DOC file<br>P5: Save in favorite<br>P6: no strategies<br>P7: summarize in paragraphs or keywords<br>P8: highlight, make comments<br>P9: save text<br>P10: highlight, take notes, use symbols<br>P11: focus on highlighted parts, on links |

| | |
|---|---|
| Strategies when reading digital texts, hypertexts | P12: highlight<br>P13: underline in PDF<br>P14: summarize paragraph<br>P15: take notes in another file or in paper sheet<br>P16: highlight<br>P17: take notes<br>P18: take notes in paper<br>P19: copy and paste important parts to doc file, save links<br>P20: underline, take notes when possible<br>P21: take notes in paper, summarize and copy citations<br>P22: summarize, highlight important parts<br>P23: reads the whole paragraph first, then accesses the link if important<br>P24: highlight |