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WORKING MEMORY CAPACITY AND FLUENT L2 SPEECH PRODUCTION

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MAILCE BORGES MOTA

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Opção Língua

Prof. Dr. José Roberto O' Shea
COORDENADOR

Profª. Drª. Barbara Oughton Baptista
SUPERVISOR

BANCA EXAMINADORA:

Profª.Drª. Barbara Oughton Baptista

Profª.Drª. Leda Mª. Braga Tomitch

Profª. Drª Loni Kreis Taglieber

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ABSTRACT

Working Memory Capacity and L2 Fluent Speech Production

Mailce Borges Mota

Universidade Federal de Santa Catarina
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Supervisor Professor: Barbara Oughton Baptista

Researchers in the second/foreign language (L2) acquisition/use area have recently pointed out the need for integration of L2 acquisition/use studies with the research of cognitive science, which seeks to understand human cognition, as a possible way of clarifying some of the complex phenomena involved in both the acquisition and use of a L2. However, applications of cognitive theory to L2 acquisition/use have involved mainly language comprehension, with only a few studies examining L2 production. The purpose of the present study was to verify whether working memory capacity, a construct of current information processing theory would correlate with L2 fluent speech production. The study was based on Daneman (1991), who found a significant correlation between individuals' working memory capacity and the fluency with which they can speak in the first language (L1). Adapting Daneman's (1991) methodology, a set of seven experiments was applied to 16 speakers of English as a foreign language, involved in MA research in English, at UFSC. Working memory was assessed by means of the Speaking Span Test (Daneman and Green, 1986; Daneman, 1991) and the Reading Span Test (Daneman and Carpenter, 1980 and 1983), the two of them both in Portuguese and English. L2 fluency was assessed by means of the Speech Generation Task, the Oral Reading Task, and the Oral Slip Task (Motley and Baars, 1976). Working memory capacity, as measured by the Speaking Span Test in English, correlated significantly only with the Speech Generation Task. Working memory capacity, as measured by the Reading Span Test, both in Portuguese and English, correlated significantly only with the reading-related task, the Oral Reading Task. The results of the present study corroborate the task-specific view of working memory capacity (see Cantor

and Engle, 1993), which poses that this capacity is functional, varying according to the individual's efficiency in the processes specific to the cognitive task with which it is being correlated.

Number of pages: 196

RESUMO

Pesquisadores da área de aquisição e uso de segundas línguas/línguas estrangeiras (L2) têm enfatizado a necessidade de integrar os estudos de L2 à pesquisa da ciência cognitiva, a qual busca compreender a cognição humana, como uma maneira possível de esclarecer alguns fenômenos complexos presentes tanto na aquisição quanto no uso de L2. Entretanto, aplicações da teoria cognitiva à área de L2 tem se dado sobretudo no que diz respeito à compreensão de língua, com apenas alguns estudos examinando a produção de L2. O presente estudo teve como objetivo verificar se a capacidade da memória operacional, um construto da teoria contemporânea de processamento da informação, correlaciona-se com a produção oral fluente de L2, baseando-se no trabalho de Daneman (1991), que verificou uma correlação significativa entre a capacidade individual da memória operacional e a fluência com se fala a língua materna. Adaptando-se a metodologia de Daneman (1991), sete experimentos foram realizados com dezesseis falantes de inglês como língua estrangeira, os quais estavam desenvolvendo pesquisas para suas dissertações de mestrado em inglês na UFSC. A capacidade da memória operacional foi medida através do Speaking Span Test (Daneman and Grenn, 1986; Daneman, 1991) e do Reading Span Test (Daneman and Carpenter, 1980 e 1983), ambos aplicados em português e inglês. Fluência oral em L2 foi medida através da Speech Generation Task, da Oral Reading Task e da Oral Slip Task (Motley and Baars, 1976). A capacidade da memória operacional, medida pelo Speaking Span Test em inglês correlacionou-se significativamente apenas com a Speech Generation Task. Já quando medida pelo Reading Span Test, tanto em português como em inglês, esta capacidade correlacionou-se significativamente apenas com a Oral Reading Task. Os resultados do presente estudo corroboram a visão de especificidade de tarefa sobre a capacidade da memória operacional, a qual postula que esta capacidade é funcional e varia de acordo com a eficiência do indivíduo nos processos específicos da tarefa cognitiva a que está sendo correlacionada.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

Page

CHAPTER 1

INTRODUCTION

1.1 Cognition and L2 Acquisition and Use

In the past few years cognitive processes involved in second/foreign language (L2) acquisition and use have gained increased importance in L2 acquisition/use research. The complexity of the phenomena involved in both the acquisition and use of L2 requires that researchers look for answers to their problems in related areas of study such as the fields of first language (L1) acquisition/use, psycholinguistics, and sociolinguistics. More recently, however, the need for the integration of L2 acquisition/use into the research of cognitive science has been advocated by a number of researchers, since the former seems to be one of the areas which has yielded the greatest advances as regards human cognitive behaviour.

Cognitive science is an interdisciplinary field of research which seeks to understand and explain the processes involved in human thought, that is, in a number of cognitive tasks such as perceiving, remembering, understanding, learning, and reasoning (Ashcraft,1994; Stillings et al., 1987). In trying to understand the human mind, cognitive scientists draw on research developed in diverse areas, among which artificial intelligence, the neurosciences, linguistics, psycholinguistics, and cognitive psychology stand as the most significant. Language, as a fundamental human capacity, as well as its relationship with thought, has received massive attention on the part of cognitive scientists. Nevertheless, as Tomlin and Gernsbacher (1994) point out, L2 phenomena, at either the acquisition or use levels, have not been an item of relevance in the research agenda of cognitive science, in spite of L2 acquisition/use being a well-established field of study in itself. Among prominent applications of cognitive theory to L2 acquisition/use are Bialystok's long-standing work on analysis and control, and the work of McLaughlin (1987) and his group, who have applied theories of automaticity and restructuring to the area. Nevertheless, the integration of cognitive models

with L2 studies has been limited to certain aspects of the L2, with research accumulating in the area of language comprehension--mainly reading--and only a few studies in language production,(e.g. Faerch and Kasper, 1983; de Bot, 1992).

Cognitive psychology, a branch of psychology, is one of the fields contributing to research in the cognitive sciences and has been the area of research which has stimulated L2 acquisition/use theoreticians in their attempt to understand cognitive processes learners carry out when performing tasks in the L2. Cognitive psychology, whose most significant development dates from the 1960s, is concerned with the experimental study of human information processing in various modalities such as attention, pattern recognition, learning, memory, language processing, problem solving, and reasoning (Haberlandt,1994). Being interdisciplinary in itself, this field of research draws on studies developed in related disciplines including linguistics, psycholinguistics and computer science.

The research of cognitive psychologists, "who view the human mind as a complex system that receives, stores, retrieves, transforms, and transmits information" (Stillings et al., 1987:1), has been guided by the principles of the information processing approach. Within this approach, cognition is assumed to be the coordinated operation of various mental processes which take place in a multicomponent memory system, the human information processing system (Ashcraft,1994). In seeking to understand and explain these mental processes, cognitive psychologists' crucial questions concern how knowledge is represented, structured, and processed in the human mind. Attempts at answering these questions have depended largely on the dichotomy between declarative and procedural knowledge (Anderson, 1983, 1995; Stilling et al., 1987; Ellis, 1993; Ashcraft, 1994; Haberlandt, 1994), which has drawn the attention of L2 acquisition/use researchers in a number of ways as possible concepts to cast light on areas such as L2 instruction (Ellis, 1993).

1.2 Fluency in L2 Acquisition/Use

One of the most important aims of L2 teaching is to develop student's oral fluency. For most students, being able to speak fluently in the language they are learning is their main objective. However, neither teachers nor students know exactly what it means to be fluent in a L2, and the literature in the area is still lacking consistency, in spite of the importance of the notion in L2 instruction.

We all have an intuitive concept of what it is to be fluent and upon hearing someone talk, we immediately judge him as more (+) or less (-) fluent, although we might not be aware of what makes us consider the speaker as such. Fillmore (1979), one of the first researchers to point out individual differences in fluency, suggests we may judge speakers to be fluent in their L1 in four main ways. In his view, the first kind of fluent speaker is the one who has the ability to fill time with talk, generally fast talk, like a sports announcer or a disk-jockey. The second kind of fluent speaker is the one who has as a main characteristic the semantic density of his talk, which is always complex. The third kind is the one who can perform in several pragmatic aspects of language with no difficulties, being able to talk about a variety of subjects in different situations and conversational contexts. Finally, the fourth kind of first language fluent speaker is the one who is able to speak with creativity and imagination, building metaphors, punning and making jokes with the meanings and sounds of words, on line. Highlighting the multidimensional nature of the phenomenon in each of these kinds of fluency, Fillmore proposes that different types of knowledge and skills are involved, and thus that speakers vary in their vocabulary size, in their knowledge of linguistic forms and formulaic expressions, in their ability to create new expressions, and in their ability to access and use syntactic constructions in various conversational settings and discourse patterns, and thus in their knowledge of appropriateness of language.

While these four kinds of fluency might well be considered valid also for second languages, L2 fluency has been judged and defined in a rather different fashion. As Riggenbach

(1991) points out, the notion of fluency has played a much more central role in L2 research than it has in L1, since fluency has been considered an important factor in assessing L2 proficiency.

As Ejzenberg (1992,1995) highlights, most studies dealing with L2 fluency have described the phenomenon at isolated levels of occurrence, from the utterance to the discourse level. As a result, fluency has been defined in a number of different ways. Traditional definitions of fluent speech are "speech that lacks unnatural pauses" or "speech that exhibits smoothness, continuity, and naturalness" (Riggenbach, 1991: 423-24). In an attempt to organise the ways in which L2 fluency has been understood, Lennon (1990) suggests that the term fluency is generally used in two senses. In its broader sense, it is equated to oral proficiency: a fluent speaker would be the one whose oral production is native-like in all aspects--vocabulary range, grammatical correctness, pronunciation, idiomaticness, appropriateness, and relevance.[1] In its narrower sense, Lennon argues, fluency in a L2 is one component of oral proficiency and is basically related to speech rapidity, to the flow of speech unimpeded by hesitations. In this narrower sense, fluency is contrasted to other components of oral proficiency such as lexical range, grammatical correctness, pronunciation, idiomaticness, appropriateness, and relevance. It is this sense that is generally taken by professionals of the L2 area, who frequently make a contrast between fluency and grammatical correctness, or accuracy--"a command over the grammatical and syntactical structures of the target language" (Davies, 1980:99).

This narrower sense is related to the definition Lennon (ibid.) gives for fluency as the perception we have, when hearing someone talk, that the speaker's psycholinguistic processes involved in speech planning and production are working easily and efficiently (p.391). In line with this view, Schmidt (1992) defines fluency as an *automatic procedural skill (*cf. Carlson, Sullivan, and Schneider, 1989). For him, "fluent speech is automatic, not requiring much

[1]Extending Lennon's point of view, Eyzenberg (ibid.) states that, in Applied Linguistics, fluency has generally been equated to language proficiency, that is, to the individual's overall ability in the L2.

attention or effort" (p 358), in contrast to nonfluent speech, which is effortful and which demands focused attention on a number of processes involved in the various stages of speech production.

Most studies of L2 fluency have aimed at describing and quantifying fluency variables without making any reference to the psycholinguistic processes which might be involved in speech production (e.g. Lennon, 1990; Riggenbach, 1991; Ejzenberg, 1995). There have been, however, studies aimed at identifying the psycholinguistic processes that take place during speech production by analysing the use of formulaic language and hesitation phenomena such as filled and silent pauses, repetitions, and restarts (e.g. Dechert, 1983; Möhle, 1984).

There have been very few attempts to relate L2 fluency to cognitive models based on information processing theory, at either the theoretical or empirical levels. Nevertheless, as Schmidt (1992) states, the notions of controlled and automatic processing, which are also central to cognitive psychology, may shed new light on our understanding of L2 oral fluency. The most well-known model of automatization is that of Shiffrin and Schneider (1977), who stress that, during executions of a complex cognitive task there are some processes which require our conscious attention to operate, and others which seem not to demand any conscious effort at all.

Several researchers (e.g. McLaughlin et al, 1983; Rehbein, 1987; Levelt, 1989; Schmidt, 1992; de Bot, 1992) have emphasised that the notion of controlled and automatic processing is useful in accounting for fluency in speech production. McLaughlin et al. (1983), for instance, claim that fluent and nonfluent bilinguals differ in their degree of automatization of lexical processing, and that the more fluent ones demonstrate additional characteristics of automatic processing such as speed and reallocation of attention. There also seems to be a consensus among theorists that the production of speech at a normal rate is possible only when most of the procedures responsible for this production have been automatized. Indeed, Levelt (1989), who considers the speaker a "highly complex information processor", argues

that most components of the processing system responsible for speech production work in an automatic, reflex-like way, which also allows for work in parallel, a fundamental condition for fluent speech (p.2). Furthermore, temporal variables of speech production such as speech rate and length of fluent runs might be straightforward indicators of automaticity, as Lennon (1990) has suggested.

For the purposes of the present study, and following Lennon (1990) and Ejzenberg (1995), fluency is here restricted to the oral mode and is considered a component of language proficiency, defined as the impression the listener has that the speech being produced is smooth, continuous, with few hesitation phenomena, coherent and adequate to the context. This definition was adopted because fluency in the present study was analysed from a cognitive perspective; that is, the focus was on the cognitive processes responsible for the production of fluent L2 speech production--more precisely on the capacity the speaker has to coordinate the various mental processes involved in this production. A current concept adopted by cognitive psychologists--working memory--is assumed to be involved in fluent speech production.

1.3 Fluency and Working Memory

As noted earlier, in the literature relating psycholinguistic or cognitive processes to L2 acquisition/use, studies dealing with speech production are outnumbered by studies of comprehension (Schmidt, 1992; Crookes, 1990). Daneman and her colleagues have developed research in language comprehension by means of a construct from the information processing approach, the working memory model. The Reading Span Test (Daneman and Carpenter, 1980), an index which taxes an individual's ability to process and store information in working memory while comprehending language, has been extensively used by researchers developing work in the reading area. Nevertheless, Daneman and Green (1986) and Daneman (1991) have also investigated individual differences in fluency in speech production. Their argument is that individual variation in oral fluency is related to individual working memory capacity--the capacity to process and store information in the performance of complex tasks.

It is now widely accepted that memory is composed of two major systems--long-term and short-term memory--although there is still some controversy on how these systems should be conceptualised. With respect to short-term memory, this notion is generally referred to today as working memory, as proposed by Baddeley and Hitch (1974) and Hitch and Baddeley (1976) in their elaboration of a previous influential model by Atkinson and Shiffrin (1968). Contrary to Atkinson and Shiffrin's view of a passive unitary short-term memory system, Baddeley and Hitch's working memory is a tripartite model, composed of a central executive, which functions as an attentional controller, and two slave components-- the phonological or articulatory loop, responsible for speech-based information, and the visuospatial scratchpad, which controls visuospatial material. Evidence for the phonological loop comes mainly from a variety of laboratory findings, such as the phonological similarity effect, the word length effect, and articulatory suppression. Evidence for the existence of a visuospatial scratchpad, which is also assumed to have a brief store and control processes, is far more limited than that for the phonological loop (Baddeley, 1990 and elsewhere). Finally, the central executive, which stands as the most important and interesting component of this model, is the least studied and understood , since the other two components seem to show more tractable problems.

As Baddeley (1992a) suggests, research on working memory has been developed along two main lines. The first one, the psychometric approach, is concerned with correlations existing between working memory capacity and the performance of complex cognitive tasks. Within this approach working memory is defined as the system which stores and manipulates information concurrently. Thus, theorists attempt to devise tasks in which both storage and processing of information are necessary, and subsequently use the individual's results of performance on these tasks to predict his/her skills in other cognitive tasks, as for instance, reading. The second approach, although also defining working memory as the system which temporarily stores and manipulates information necessary for complex cognitive tasks, focuses on the analysis of the structure of the system. In this case, the methodology consists of the application of dual tasks and the study of neuropsychological evidence.

Daneman (1991, and elsewhere) and her colleagues take the first approach to investigate the extent to which working memory capacity predicts verbal skills, particularly reading. Their hypothesis is that individuals with small working memory capacities perform weakly on cognitively demanding tasks, while individuals with larger capacities tend to perform better. To test this hypothesis, Daneman and Green (1986) first devised a Speaking Span Test which taxes individual's working memory capacity in first language production. Daneman (1991) expands this study and shows a correlation between individuals' working memory capacity and L1 fluency.

In this more extensive study, Daneman (ibid.) found significant correlations between working memory capacity and fluency in verbal production by means of a set of five experiments, namely, the Speaking Span Test, a Speech Generation Task consisting of the description of a picture, an Oral Reading Task, and an Oral Slip Task aimed at eliciting spoonerisms. In addition, Daneman also applied a Reading Span Test to verify whether there was a correlation between working memory spans in comprehension and production tasks. Each of these tests was applied to 29 university students, all native speakers of English.

1.4 This Study

In the present study, aimed at verifying whether individual differences in working memory capacity correlate with individuals' oral fluency in English as a foreign language (L2), Daneman's methodology (1991) was adapted. Seven experiments were carried out, four aimed at assessing working memory and three aimed at assessing fluency in English.

This set of experiments consisted of two Speaking Span Tests, one in Portuguese (the native language of all subjects) and one in English, to assess individual's working memory during language production; two Reading Span Tests, one in Portuguese and one in English, in order to assess individuals' working memory in language comprehension; a Speech Generation

Task, consisting of a picture description in English, aimed at assessing fluency; an Oral Reading Task, in which subjects were required to read a passage aloud, and an Oral Slip Task aimed at eliciting spoonerisms. These latter two tasks also aimed at assessing fluency in English.

Based on Daneman (1991), the present study investigated the following set of hypotheses:

(1) Individuals with a larger working memory capacity as measured by the Speaking Span Test, in Portuguese and English, would be more fluent at generating speech, more fluent at reading aloud, and less prone to making spoonerisms in the L2.

(2) Speaking Span strict and lenient are sensitive to different aspects of L2 oral fluency: the former would correlate better with fluency in articulation of words, as measured by the Oral Reading Task and the Oral Slip Task, and the latter would correlate better with fluency in producing smooth, continuous, coherent and adequate speech, as assessed by the Speech Generation Task.

(3) The Reading Span Test, like the Speaking Span Test, would correlate with fluency in oral reading, but would not correlate with the other two nonreading-related tasks.

1.5 Importance of the Study

As already pointed out, theorists in language acquisition/use have emphasised studies in language comprehension rather than language production. This neglect is even more striking when the focus shifts to the area of L2 acquisition/use, in either writing or speaking. Thus, the first contribution that I hoped to make with this study concerns the gap existing in the literature on L2 speech production as compared to L2 comprehension. Furthermore, there have been no studies, to my knowledge, investigating L2 oral fluency under the assumptions of information processing theory specifically with the purpose of verifying a correlation between working memory capacity and oral fluency at the empirical level. In this sense, the second contribution this study might offer concerns the study of the psycholinguistic mechanisms

involved in L2 fluency from the perspective of information processing theory. Finally, this study expresses an attempt to validate the interdisciplinary nature of cognitive science by seeking to integrate L2 acquisition/use studies in this field of research.

1.6 Organisation of the dissertation

This dissertation is organised as follows:

Chapter 2, which contains a review of the literature relevant in the areas of memory and fluency, is divided into eight sections. Section 2.1 gives an overview of the long-term/short-term memory dichotomy and section 2.2, subdivided in 3 sections, deals with some basic aspects of long-term memory. Section 2.3 reviews the short-term/working memory distinction while section 2.4 describes Baddeley and Hitch's (1974) and Hitch and Baddeley's (1976) current version of the Working Memory Model. Section 2.5, divided in two smaller sections, reviews the literature on individual differences in working memory capacity and section 2.6, Daneman's research on working memory capacity and L1 fluency. Section 2.7 deals with L2 fluency, and, finally, section 2.8 describes Levelt's model of speech production.

In chapter 3 the method used in the present study is presented. Chapter 4 contains the analysis and discussion of the results found, based on the research on individual differences in working memory and verbal abilities. Chapter 5 summarises the findings of the present research and includes the limitations of the study as well as suggestions for further research.

CHAPTER 2

REVIEW OF LITERATURE

In this chapter, a review of the literature related to both memory and L2 fluency is presented. It is divided as follows: section 2.1 gives an overview of the long-term/short-term memory dichotomy and section 2.2, subdivided in 3 sections, deals with some basic aspects of long-term memory; section 2.3 reviews the short-term/working memory distinction while section 2.4 describes Baddeley and Hitch's (1974) and Hitch and Baddeley's (1976) current version of the Working Memory Model; section 2.5, divided in two smaller sections, reviews the literature on individual differences in working memory capacity and section 2.6, Daneman's research on working memory capacity and L1 fluency; section 2.7 deals with L2 fluency, and, finally, section 2.8 describes Levelt's model of speech production.

2.1 The Dichotomy Long-Term Memory and Short-Term Memory: Overview

The study of human memory is one of the most fascinating areas of cognitive science, with research accumulating in various topics as a result of different approaches to this aspect of our cognition. Despite the number of connotations the term *memory* can have, for the purpose of the present study memory will be defined as "the mental processes of acquiring and retaining information for later retrieval, and the mental storage system that enables these processes" (Ashcraft, 1994:11). This seems to be a reasonable definition since it captures three essential aspects of human memory: acquisition, retention, and retrieval of information The memory system together with other mental processes such as perception, thinking and understanding, constitutes human cognition (Ashcraft, ibid.). It is now widely accepted that memory is composed of two major systems--long-term and short-term memory--but there is still some controversy on how these systems should be conceptualised.

Evidence for the existence of separate memory systems came first from the studies of Brown (1958) and Peterson and Peterson (1959, cited in Baddeley, 1990), which demonstrated that information is forgotten within seconds if rehearsal is prevented. This finding stimulated a great deal of further research, including the development of the short-term forgetting paradigm, based on the Brown-Peterson distractor technique (Peterson and Peterson, ibid., cited in Baddeley, ibid.) and on the assumption that certain kinds of task reflect the work of a short-term memory with limited capacity, somewhat distinct from the system responsible for long-term learning (Broadbent, 1958; Baddeley, 1990). The classic studies carried out under the free recall paradigm, in which subjects had to learn lists of unrelated material, generating the primacy and recency effects, also provided evidence for such distinct systems. In addition to these studies, another source of evidence for the fractionation of memory was the experiments in coding during immediate and delayed recall (Baddeley, 1990; Baddeley 1992b). Conrad and Hull (1964, cited in Baddeley, 1990) showed that acoustic similarity of the material to be learned severely interfered with immediate recall, whereas Baddeley (1966a cited in Baddeley, 1990) showed that this interference seemed to decrease if material was similar in meaning. In case of delayed recall, similarity in meaning would be the interference factor. Baddeley (1966b, cited in Baddeley, 1990) also showed that, under delayed recall conditions, similarity in meaning becomes a crucial factor affecting performance.

Thus, the results of the studies done in acoustic and semantic coding led theorists to believe that there were at least two different memory stores: one, a short-term store, which relied on a phonological code, and another, which relied primarily on meaning. In addition, neuropsychological research (e.g. Baddeley and Warrington, 1970 cited in Baddeley, 1990) showed that patients suffering from classic amnesia with severe long-term learning deficits demonstrated no impairment in short-term learning. Also, the opposite may occur.

Neuropsychological researchers have described patients who show defective short-term memory, but normal long-term learning (Shallice and Warrington, 1970 in Baddeley, ibid.)

Evidence from all the above sources (the Brown-Peterson paradigm, the free recall paradigm, coding in immediate and delayed recall, similarity in meaning, and neuropsychological research) supports the view that human memory is composed of at least two major systems.

2.2 Long-Term Memory

Concerning long-term memory, as Baddeley (1992a) suggests, researchers in cognitive psychology have tended to conceptualise this system along two main lines. In the first one long-term memory is dichotomised into episodic and semantic memory, a distinction introduced by Tulving (1972, 1983, 1985). In the second one, the system is dichotomised into declarative and procedural memory, terms widely adopted after the work of Anderson (1983). There is still a third line of research, in which long-term memory is referred to as being subdivided into implicit and explicit memory, these terms being more often employed by neuropsychologists such as Schacter (1987).

2.2.1 The Semantic/Episodic Distinction

The distinction between semantic and episodic memory was first captured by Tulving (1972, 1983, 1985). Semantic memory is our storage of generic information about the world: it contains our knowledge about facts of nature, things we have learned at school, our mental models of the world, encompassing information such as the meanings of words, symbols, and rules. The content of semantic information is not tied to any specific individual experience; that is, the exact moment or event in which a certain kind of information was acquired and stored in semantic memory is not preserved (Searleman, 1994). Episodic memory, on the other hand, stores the information we acquire through personal events: situations and facts, people and objects we have had contact with in personal experiences, constituting thus the memory of our life stories. This memory system refers explicitly to the specific events, experiences and conditions in which the memory was formed and allows us to establish

temporal relations among our individual experiences in subjective time and space (Tulving, 1985). It is within this memory system that our autobiographical memory is stored.

In his earlier elaboration of the semantic/episodic distinction, Tulving considered the two systems to be separate and to work in parallel (Searleman and Hermann, 1994). However, as other researchers presented evidence which disputed the view of separate memory systems, Tulving (1983, 1985) reviewed his notions and included one more component, procedural memory, proposing, then, a monohierarchical model of long-term memory. In these latter redefinitions, Tulving claims that procedural memory is at the lowest level of the hierarchy--a sort of more primitive memory system-- responsible for the retention of learned stimulus-response connections and for the mechanisms which allow us to adapt to the environment. At the intermediate level of the hierarchy is semantic memory and at the highest level, episodic memory. These three systems are interconnected and each higher system is supported by the lower systems, although each one of these has its unique characteristics. The onset of any kind of memory is considered to be episodic since any incoming information and its subsequent retention is part of the individual's personal experience. Within the monohierarchical tripartite model of long-term memory proposed by Tulving, only procedural memory is not available to conscious recollection.

2.2.2 The Declarative/Procedural Distinction

In the second main line along which long-term memory has been dichotomised, this system is subdivided into declarative and procedural memory, or declarative and procedural knowledge. The distinction between these two different kinds of knowledge (or memory) has its roots in the work of the philosopher Ryle (1949, cited in Ellis, 1993), who first noted that our knowledge may be distinguished in terms of things we 'know about' and things we 'know how'. In cognitive psychology and science this distinction was adopted by Anderson as part of his ACT* Model (1983, 1995) and has since then been used as a main premise. The distinction between declarative and procedural knowledge has not always been clear-cut and,

although acknowledged by neuropsychological researchers (e.g. Paradis, 1994; Schacter, 1985), it has proved difficult to perceive at the empirical level. In addition, the very notion of what constitutes declarative and procedural knowledge suffers from a lack of precision, with theorists considering these two kinds of knowledge to be either two different types of representation, or one kind of representation (declarative knowledge) plus one kind of processing operation (e.g. Stillings et al., 1987).

Declarative knowledge/memory is a static fact-like kind of knowledge, generally characterised as dealing with facts that can be acquired explicitly, are accessible to consciousness, and are often verbalizable (Paradis, 1994; Searleman and Hermann, 1994; Stillings et al., 1987). Both episodic and semantic memory (propositional network models) are assumed to be part of declarative memory (Anderson, 1983).

In contrast, procedural knowledge/memory is our knowledge of how to do things, including the mental procedures (processes) employed in cognitive activities and motor skills (Ashcraft, 1994; Haberlandt, 1994). Theorists generally give as examples of procedural knowledge such tasks as riding a bike, driving a car, doing arithmetics or decoding print. While these are complex tasks which might involve declarative knowledge as well, the main difference between these two types of knowledge/memory is generally considered to be the ease with which they can be verbalised and expressed. Thus, for instance, provided we have the necessary vocabulary and terminology required, we are able to express declarative knowledge relatively easily, which demonstrates the explicit nature of this kind of knowledge. Procedural knowledge/memory, on the other hand, proves to be much more difficult to express. In trying to explain how to put words together in a sentence when speaking so that this sentence can be understood, or trying to show a Spanish speaker the difference in pronunciation between the Portuguese words 'avô' and 'avó' we will find a number of difficulties and will not be able to do much more than show how we do these things (i.e., actually putting words together or pronouncing 'avô' and 'avó'). Although we might be able to articulate and express part of procedural knowledge/memory, this is evidently much more

difficult to do since most part of this type of knowledge is not available to conscious awareness. Declarative and procedural knowledge/memory are also distinct in terms of the speed with which we use them. Procedures are retrieved and used much faster than declarative knowledge/memory, as can be inferred from studies in recognition and sentence verification. As Haberlandt(1994), for example, sustains, it takes about 1/10 of a second for a subject to recognise a letter and over 1 second to verify whether a sentence like "a canary is a bird" is true or false (p.115).

Most models of skill acquisition, such as Anderson's ACT*, assume that procedural knowledge/memory develops from declarative knowledge/memory by means of practice. This assumption seems to be controversial, however, since neuropsychological research has demonstrated that amnesics who can acquire little or no declarative knowledge/memory seem to be able to acquire new skills (Paradis, 1994). While clearly two different categories of knowledge, there is still much controversy over how each kind of knowledge is acquired and represented. Theorists suggest that declarative knowledge/memory is represented in terms of propositions, schemas and images whereas procedural knowledge/memory is represented in terms of if/then rules. In spite of the difference in quality between these two kinds of knowledge/memory, declarative and procedural knowledge/memory are claimed to work together both in the acquisition and use of skills.

2.2.3 The Explicit/Implicit Distinction

Finally, in the third line of research which dichotomises long-term memory, this system is considered to be fractionated into explicit and implicit memory. By noting that some memory tasks require subjects to make explicit reference to and consciously recall items in a specific test situation (e.g. free recall or recognition) while other tasks require subjects to encode information and subsequently retrieve it with no deliberate or conscious recollections, Graf and Schacter (1985, 1987) claim that at least two memory systems are involved in such tasks--one explicit and the other implicit. In their 1985 definition, Graef and Schacter argue

that 'explicit memory is revealed when performance on a task requires conscious recollection of previous experiences" (p 501). In contrast, implicit memory is the system which allows performance on certain kinds of tasks such as word completion, in which 'knowledge is expressed implicitly and does not give rise to a conscious experience of knowing, perceiving or remembering' (Schacter, 1987:514). The existence of such distinct kinds of memory systems has been supported by neuropsychological research (e.g. Schacter, 1987), in which a number of patients with different brain deficits are reported to demonstrate implicit knowledge although being unable to perceive or identify stimuli explicitly.

In summary, there are three main lines of research in which long-term memory has been dichotomised, resulting in distinctions between episodic/semantic memory, between declarative/procedural knowledge/memory, and, within the field of neuropsychology, between explicit and implicit memory. It is noteworthy to point out that some theorists (e.g. Paradis, 1994) use the terms declarative/procedural and explicit/implicit interchangeably.

2.3 The Short-Term Memory/Working Memory Distinction

The human short-term memory system has been more widely referred to as working memory, after Baddeley and Hitch's (1974) elaboration of a previous model of short-term memory, that of Atkinson and Shiffrin (1968). As Ashcraft (1994) suggests, the two terms--short-term memory and working memory--have historically different roots, and as the latter is a more complex theoretical proposal than the former, it seems reasonable to keep the terms as separate constructs. In this sense, short-term memory is the terminology used when we refer to the input and storage of new information, as commonly required in traditional digit or word span tasks. In these types of tasks, subjects are rapidly presented with a series of strings of digits or words and are required to recall them immediately after presentation. Also, it is the terminology adopted when we want to observe the role of rehearsal, a control process generally employed by subjects in tasks such as the digit or word span. Thus when the focus is on the short retention--for about 15 or 20 seconds--and rehearsal of information, and when

no transfer of information to long-term memory or other kind of processing is involved, it is generally short-term memory that is being tested.

Working memory, a more recent term, usually refers to 'the mental workplace for retrieval and use of already known information' (Aschcraft, ibid. p. 145), where all of our mental effort employed in reasoning, understanding, and retrieval of information takes place. The traditional task adopted when testing working memory is the concurrent task, in which subjects have to rehearse a string of words or numbers (secondary task) while performing a more cognitively demanding task such as sentence comprehension (primary task), thus requiring both storage and processing of information. As Baddeley (1990) suggests, short-term memory is but a component of working memory.

Among a number of short-term store models that emerged in the late 1960s, Atkinson and Shiffrin's (1968), which was also an elaboration of a previous model by Broadbent (1958), came to be the most influential one. This was, in fact, a general model of memory, which included a sensory memory (echoic and iconic), a short-term store, and a long-term store. Atkinson and Shifrin's modal model assumes that incoming information first enters sensory memory, then proceeds to the short-term store, and finally reaches long-term memory. The most important component of this model is the short-term store, which is conceptualised as being a unitary system of limited capacity and as a necessary step both in the acquisition and use of information; that is, on its way in or out of long-term memory information must be processed by the short-term store. Atkinson and Shiffrin's notion of a short-term store encompassed the idea that this store was not simply a temporary activation of information retrieved from long-term memory. In their view short-term memory was equated with consciousness (or attention), thus being the arena of what they termed control processes:

> "Because consciousness is equated with the short-term store and because control processes are centred in and act through it, the short-term store is considered a working memory: a system in which decisions are made, problems are solved and information flow is directed.
>
> (Atkinson and Shiffrin, 1971: 83)

Among the control processes claimed to take place within the short-term store, rehearsal was the one most focused on. The probability of an item being transferred to long-term memory was considered to be greater if this item were kept longer in the short-term store by means of rehearsal, a recycling type of mental activity. Although aware of the existence and relevance of the semantic aspects of the material to be maintained, Atkinson and Shiffrin were concerned mainly with rote rehearsal.

Although able to account for a variety of problems inherent to a conceptualisation of human memory, the Atkinson and Shiffrin model was particularly deficient in dealing with the evidence from patients with short-term memory problems who had long-term store unimpaired and could lead a normal life. In addition, the assumption made that the longer an item is maintained in short-term memory the greater its possibility of being transferred to long-term memory seemed to be falsified by a number of studies which showed that previous rote repetitions did not necessarily bring about learning (Tulving, 1966 cited in Baddeley 1990).

Noticing that the modal model did not account for the neuropsychological evidence mentioned above, Baddeley and Hitch decided to investigate the issue by using the concurrent task, a dual-task technique in which subjects are asked to remember a digit string of up to six items while performing a cognitively demanding task. According to the modal model, performing a digit task would occupy most of the subjects' system capacity, leading to great impairment in the performance of the cognitive task. Baddeley and Hitch found, in fact, that the concurrent digit span task did interfere in the cognitive task. Nonetheless, as Baddeley (1992c) puts it, 'the degree of disruption was far from being catastrophic' (p. 284). By means of the concurrent task, Baddeley and Hitch were able to claim that if performance on one task

did not interfere with the other, then the tasks relied on different components of the system. In contrast, if one task did interfere with the other, then the same cognitive pool was being used. They thus decided to propose a multicomponent model of short-term store, which they termed working memory, abandoning the idea of a unitary short-term system.

2.4 The Working Memory Model

Baddeley and Hitch's (1974) and Hitch and Baddeley's (1976, cited in Baddeley, 1990 and elsewhere) current working memory model consists of a central executive, which functions as an attentional controller, and two slave components--the phonological or articulatory loop, responsible for speech-based information, and the visuospatial scratchpad or sketchpad, which controls visuospatial material.

The central executive, the main component of the model, is responsible for (1) directing attention and mental resources, (2) making decisions, (3) initiating rehearsal processes, (4) coordinating the flow of information, (5) retrieving information from long-term memory, and (6) coordinating the processes required to store and process information while it is being held in memory (Ashcraft, 1994; Smyth et al., 1994). Baddeley (1990) postulates that the central executive is also in charge of the integration of actions and activities, controlling the two slave systems. Baddeley (1990 and elsewhere) sustains that the central executive is the least studied of the three components, since research in working memory has tended to concentrate on the subsidiary systems, which deal with what he calls more 'tractable' problems. He proposes to use Norman and Shallice's (1980) Supervisory Attentional System (SAS) model of attentional control as a hypothesis for the central executive. Smyth et al. (1994) suggest that the SAS is required in situations in which planning and decision making are involved or in which subjects have to sort out errors, perform poorly learned tasks or avoid the use of well-learned schemas when these are not required. The central executive is assumed to perform all of these activities.

The phonological or articulatory loop was postulated in order to account for the importance of speech coding in short-term memory (Baddeley, 1990). This subsystem is assumed to have two components--a phonological store, which holds speech-based information for one or two seconds, and an articulatory control process, which is similar to subvocal rehearsal (Baddeley,1990, 1992a, 1992b, 1992c). This process allows information to be maintained in the phonological store by recycling the memory trace. The articulatory control process reads off the material and feeds it back into the store by subvocalization. Baddeley (ibid.) argues that auditory spoken information has automatic and obligatory access to the phonological store. In reading, it is the articulatory control process which takes written material, transforms it into a phonological code and registers it in the phonological store.

This subsystem of Baddeley and Hitch 's (1974) working memory model has been able to account for a variety of laboratory findings. Evidence for the existence of a system within working memory which deals specifically with speech-based material comes from a number of sources. Thus, for instance, the phonological similarity effect, in which memory span is affected by the similarity in articulatory or sound features of the material being presented, is interpreted as evidence for the claim that this system is based on a phonological, rather than semantic code. Similarly, the unattended speech effect seems to disrupt immediate recall--this effect is obtained by presenting subjects with material to be immediately recalled accompanied by irrelevant speech, which gains access to the phonological store, thus affecting performance on recall (Salamé and Baddeley, 1982).

Another source of evidence for the phonological loop comes from the word length effect, which shows that memory span for long words is smaller than for short words. Baddeley (1990) argues that subjects are more likely to recall monosyllabic words than polysyllabic ones, if there is a difference in spoken duration of these words. As Baddeley, Thomson, and Buchanan (1975) have shown, there is a correlation between the rate at which subjects speak and their memory span. Baddeley (1992c) sustains that this word length effect occurs because subjects have to rehearse material in real time. As longer words take longer to

recycle, the degree of trace decay between rehearsal cycles is also greater. Baddeley (1990) and Baddeley and Andrade (1994) point out that the crucial aspect is spoken duration of words rather than number of syllables, since words which have longer vowels are spoken more slowly--leading to shorter memory spans--than words which have the same number of syllables but shorter vowels that can be spoken more rapidly. Baddeley (1990) suggests that the articulatory control process of the phonological loop involves establishing and running speech motor mechanisms which take place in real time. The result is that the longer the word, the longer it will take to be articulated. This assumption, in Baddeley's view, explains why a subject may have different memory spans when he/she is tested in different languages.

The word length effect is removed when subvocal rehearsal is prevented by articulatory suppression, which takes place when subjects are required to utter a string of sounds while trying to perform a digit or word span task. Baddeley, Lewis, and Vallar, (1984) argue that the word length effect reflects the process of articulation. Thus the uttering of this string of sound, which prevents articulation of the to-be-remembered material, is assumed to use the articulatory control process, which can not enter into play to maintain the information the subject is being presented in the phonological store.

However enthusiastic Baddeley seems to be about this hypothetical component of working memory, the fact is that it is not clear what use the phonological loop might have in the acquisition, comprehension or production of language, despite the number of laboratory findings emphasising the importance of speech-based information to a short-term store. Some theorists (e.g. Ashcraft, 1994) tend to equate the phonological loop to the view of the short-term store depicted in classical memory span tasks. Baddeley and colleagues, however, have attributed greater importance to this component, where it seems to play a principal role in vocabulary learning in the native language (Baddeley, Papagno, and Vallar, 1988; Gathercole and Baddeley, 1989 and 1990), in a foreign language (Papagano, Valentine, and Baddeley, 1991), and in the comprehension of discourse (Baddeley and Wilson, 1988). As regards native language and foreign language vocabulary learning at the practical level, however, Baddeley,

Papagno and Vallar (ibid.) and Papagno, Valentine, and Baddeley (ibid.) are careful to say that the phonological loop seems to have no relevant participation in the establishment of semantic values, and that subjects are likely to compensate for short-term phonological constraints by making use of the semantic aspects of the material to be learned.

The other slave system, the visuospatial scratchpad or sketchpad, is in charge of dealing with visual and spatial information in working memory. Baddeley (1990) assumes this subsystem has a brief store and a control process which registers visuospatial material and refreshes it through rehearsal. The amount of evidence for this particular subsidiary system has been far less than for the phonological loop. Nevertheless, research has indicated that maintenance in the visuospatial component may be disrupted when visually irrelevant material is presented (Logie, 1986 cited in Baddeley, 1992c), which generates the unattended picture effect, and when a visual task is simultaneously tested with a spatial task. Baddeley (1990) suggests that it seems possible for the visuospatial sketchpad to be a multi-faceted system, with related but separate visual and spatial dimensions. Farah (1988, cited in Baddeley, 1990 and Baddeley 1992c) brings evidence from research with normal and brain-damaged patients which suggests that the visual and the spatial components of the system are anatomically and functionally related. As regards the use of this subsystem, Baddeley (1990) claims that it seems to be important in the performance of planning spatial tasks and in geographical orientation.

Clearly, the Baddeley and Hitch (1974) and Hitch and Baddeley (1976) model of short-term memory is a more complex and elaborate proposal than that of earlier models. Contrasting it to an influential model of the late 1960s, the Atkinson and Shiffrin model (1968), the crucial difference is that Baddeley and Hitch emphasise a multicomponent system consisting of at least three components, each of these being further subdivided. Most importantly, the emphasis is also on the processing efficiency of this limited capacity system, which is able to deal with a multitude of different types of information from the environment, being involved in the performance of tasks such as reasoning, problem-solving, and

comprehension. The studies done in the classical short-term paradigm, with traditional digit or word span tasks, did not cast light on the actual work and mental effort human short-term memory was able to perform in order to execute cognitive demands. A view of this system as being an undifferentiated unitary system could not account for this working capacity. Short-term memory as it has been described in cognitive psychology is now assumed to be only a small fragment--the phonological loop--of this more powerful working memory system. Ashcraft seems to have grasped the fundamental difference between working memory and short-term memory:

> "Short-term memory is *short* ---- it doesn't last very long. The very term embodies the notion of a limited-capacity system. Where is the limitation capacity? It's in short-term memory. Why is short-term memory limited? It's too short! Working memory, on the other hand, uses the active verb *work*. This is an action-packed, busy place, a place where mental activity happens. Where is the limitation in the system? It's in ***how much work*** can be done at one time, how much working memory capacity there is to share among several simultaneous processes" (p.146).

Baddeley and Hitch's tripartite working memory model is a more sophisticated alternative to the traditional short-term store and it has been particularly successful in accounting for neuropsychological phenomena such as the performance of brain-damaged patients suffering from impaired short-term memory (Baddeley, 1990). Yet, the importance of a working memory system is enormous in practically any activity we perform, from the most simple everyday task to the most cognitively complex one. As Goldman-Rakic (1992) sustains, the coordination of moment-to-moment awareness and the retrieval of already stored information in a coherent, strategic way in working memory stand as the most significant achievement of human evolution (p.73). Working memory, the interface between long-term memory and cognition (Baddeley, 1992c), allows us to string together thoughts and ideas, to retrieve past information and to plan for the future, and is necessary for the perception and integration of information in learning, comprehending, reasoning, and thinking. It was for this reason that Just and Carpenter (cited in Goldman-Rakik ibid.) referred to working memory as the blackboard of the mind.

Baddeley (1992a, 1992c) highlights the fact that research on working memory has been developed under two different but complementary approaches. One is the approach he himself seems to be most concerned with, which he terms the dual-task and neuropsychological approach. Studies within this approach attempt to verify the structure of working memory by means of the dual-task methodology and neuropsychological evidence. The other approach, the psychometric correlational, emphasises the correlation existent between one individual's working memory capacity and his/her performance on important cognitive skills. Theorists following this line of research define working memory as being the system responsible for the simultaneous storage and processing of information (Baddeley, 1992, 1992c; Daneman, 1991). The methodology generally applied consists of devising laboratory tasks which require both storage and processing of information and correlating performance on these tasks with performance on demanding cognitive tasks such as reading comprehension. Results of studies of this type have consistently shown that individual differences in working memory capacity predict performance on such cognitive skills. While Baddeley and those following the dual-task neuropsychological approach focus on the structure of the working memory system, emphasising the slave subsystems, researchers on the psychometric correlational approach are mainly concerned with the central executive--the system in charge of the coordination of mental resources applied to the processing and integration of information--rarely making any explicit reference to subsidiary systems. The present study has been carried out under the psychometric correlational approach, since the objective was to verify whether there is a correlation between subjects' individual working memory capacity and the fluency with which they can speak in English as a L2.

2.5 Individual Differences in Working Memory Capacity

There is a consensus among theoreticians that working memory is involved in the performance of a number of cognitive tasks. As already said above, the psychometric correlational approach assumes that individual differences in working memory capacity are good predictors of performance on important cognitive tasks, individuals with larger working

memory capacity performing better on these tasks than individuals with smaller capacity. The research on individual differences in working memory capacity has been more extensively developed in the areas of reasoning, and first language (L1) reading comprehension (Baddeley, 1992c). In the area of language, Daneman (1991), reviewed later in this chapter, is to my knowledge the only study which deals specifically with individual differences in working memory and L1 speech production, the others all involving reading comprehension.

Daneman and Carpenter (1980) is the most classic study carried out in the psychometric correlational approach examining the correlation between working memory capacity and reading. Under the assumption that working memory has the dual function of storing and processing information and that traditional digit or word span tasks do not reflect the processing function efficiently, the authors devised a complex measure of working memory span which they termed the Reading Span Test. In their view, there is a trade-off between storage and processing in working memory, which is likely to be a source of individual differences in reading comprehension. They propose (Daneman and Carpenter, 1980 and 1983), then, that the processing and storage functions of working memory compete for its limited capacity.

The Reading Span Test, as it was first devised by Daneman and Carpenter (1980), requires subjects to use both functions of working memory: the processing component is sentence comprehension while the storage component is maintaining and retrieving the final word of each sentence of a presented set. A subject's reading span is the maximum number of sentence-final words recalled in the order they were presented and is taken as an index of his working memory capacity. The hypothesis is that better readers have more efficient processes, thus leaving most of their capacity free for storage. Indeed, in this study, Daneman and Carpenter found a strong correlation between the Reading Span Test and two components of reading comprehension--fact retrieval and pronominal reference.

It is now widely accepted that traditional word or digit span tests do not correlate with measures of reading. Thus, the Reading Span Test has been the basis for most of the research on individual differences in working memory and reading comprehension and has been extensively used as a predictor of performance on various other aspects of reading: (1) the ability to detect inconsistencies in sentences with homonyms (Daneman and Carpenter, 1983); (2) the ability subjects have to make inferences of ideas not explicitly mentioned in the text (Masson and Miller, 1983); (3) the ability to make use of contextual cues to infer the meaning of new words in the text (Daneman and Green, 1986); (4) the resolution of lexical ambiguity in reading (Miyake, Just and Carpenter, 1994); and (5) the perception of text structure (Tomitch, 1995). Various researchers (e.g. Daneman and Carpenter, 1980; Turner and Engle, 1989; Masson and Miller, 1983) have also found strong correlations between the Reading Span Test and standardised measures of reading ability such as the Verbal Scholastic Aptitude Test (VSAT) and the Nelson-Denny reading test.

2.5.1 Three Views of Working Memory Capacity

Research on individual differences in working memory capacity and reading comprehension has stimulated the emergence of alternative theories of working memory. Cantor and Engle (1993) suggest these theories can be classified into (1) the task-specific view, (2) the processing efficiency view, and (3) the activation view.

According to these authors, the task-specific view poses that the greater an individual's efficiency in processing information, the greater the capacity left available for storage of the products of this processing and of material retrieved from long-term memory. However, the singularity of this view is that this more efficient processing capacity is highly task-specific (Daneman and Green, 1986); that is, an individual's working memory capacity will vary according to his/her efficiency in the processes specific to the task with which working memory capacity is being correlated. Thus, for instance, good readers will have a functionally larger working memory capacity in reading-related tasks, but not necessarily in language

production tasks. The implication of this view is that the processing component of the span test must require the same processes present in the cognitive task whose performance is being predicted.

Further elaborations of the task-specific view have led to the processing efficiency view, which claims that there are general skills which are employed in any task demanding the manipulation of language. For instance, Daneman and Tardiff (1987, cited in Engle et al., 1992) argue that individual differences in working memory capacity can be measured through processing efficiency alone, without including a simultaneous storage component in the task. Daneman and Tardiff examined the relationship between three span tasks (verbal span, math span, and spatial span) and comprehension. The span tasks had both a processing and a storage component. The verbal and math span tasks correlated with verbal abilities. However, to show that the crucial variable in individual differences in working memory is processing efficiency, Daneman and Tardiff (ibid.) added three storage-free span tasks in which only processing was tested. They also found a correlation between these tasks and comprehension which led them to conclude that it is individual differences in processing that explain differences in verbal abilities. Thus, the emphasis is on the efficient processing skills individuals have when performing language-related tasks. The difference between the task-specific and the processing efficiency views is that in the latter the processing component of the span task need not specifically require the same processes of the task being predicted.

The third view of working memory capacity defines this system as information in long-term memory that is temporarily activated to a level that makes it available for cognitive activity (Cantor and Engle, 1993). The capacity of this system is the total amount of activation an individual has available to retrieve information form long-term memory in order to carry out a cognitive task. Individuals with higher or lower spans, as measured by the span test, differ in their limits of activation. This limited capacity, in the activation view, is independent of the nature of the task, being, thus, a single unitary resource.

2.5.2 Working Memory Capacity and L2

As mentioned above, research on individual differences in working memory has focused mainly on first language reading comprehension. There has been, however, an attempt to relate L2 working memory capacity and L2 reading comprehension (Harrington and Saywer, 1993). In this study, memory span tests were applied in both L1 and L2 to 34 advanced Japanese students of English as a L2, and compared to their reading comprehension measures. The memory span tests consisted of a reading span test based on Daneman and Carpenter (1980), a digit span test and a word span test. The reading comprehension measures consisted of the Grammar and Reading sections of the TOEFL and a cloze passage containing 350 words. L2 proficiency was controlled by means of subjects' overall scores on the TOEFL, which they had recently taken, with scores ranging from 620 to 503 and a mean of 534.[2] The researchers report that they made some modifications in the design of the L2 reading span test to avoid floor effects on task difficulty. Thus it consisted of 42 sentences syntactically simpler than those of Daneman and Carpenter's (ibid.) study and ranging from 11 to 13 words in length rather than the 13 to 16 words of the L1 study. The results show that the mean scores for the digit and word span tests in subjects' first language were significantly higher than in English, the subject's second language. However, the researchers report that there was no significant difference between L1 and L2 reading span, between which a moderate correlation was found. As expected, no significant correlation was found between L2 digit or word span and L2 reading measures. Nevertheless, the authors report a strong correlation between the L2 reading span (which reflects working memory capacity) and the results on the TOEFL Grammar and Reading sections, similar to the results found in L1 reading comprehension studies. They found no significant correlation between the L2 reading span measures and the close passage.

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[2] In fact, Harrington and Sawyer report that the criterion for inclusion in the experiment was a TOEFL score of 500 or above.

As previously observed, the literature on individual differences in working memory deals mostly with reading comprehension.[3] Except for Daneman (1991), none of the researchers mentioned above refer to this system as participating in language production, though all of them firmly believe working memory plays an important role in the performance of cognitive tasks. The present study is both theoretically and methodologically based on a study carried out by Daneman (1991), which attempted to verify whether individual differences in working memory capacity could account for differences in L1 verbal fluency.

2.6 Individual Differences in Working Memory Capacity and L1 Verbal Fluency

Claiming that individuals differ considerably in the fluency with which they can speak, Daneman (1991) attempted to verify whether individual differences in working memory could account for this variation in speech, by means of a set of experiments assessing subjects' working memory capacity and L1 fluency. In fact, this study is an expansion of previous research developed by Daneman and Green (1986), in which they examined individual differences in vocabulary production fluency.

The proposal of the earlier study was that, when individuals speak, they vary in the fluency with which they can retrieve the appropriate words to convey their ideas. Daneman and Green (ibid.) argue that speaking is a cognitively demanding task, which involves complex coordination of processing and storage--speakers have to plan what to say, store these plans temporarily, and execute them in the form of words, phrases and sentences.[4] These processing and storage functions are assumed to take place in working memory. Among the processes required in speech production, selection of context-appropriate words from our mental lexicon is seen by Daneman and Green (ibid.) to be a fundamental one. Based on the work of Goldman-Eisler (1968), Clark and Clark (1977), and Tannenbaum, Williams, and Hillier (1965,

[3] For an extensive review of the literature on individual differences in working memory and reading comprehension, see Tomitch (1995).

[4] Although they do not make reference to any particular model of speech production, Daneman and Green's (1986) suggestion that speaking involves planning, temporary storage of the products of this planning, and execution is in line with Levelt's (1989) model of speech production.

cited in Daneman, 1991), these researchers claim that hesitation pauses during speech production occur more frequently before the first content word of a phrase or sentence, as can be seen from the example they give of a speaker trying to describe his/her visit to a French bistro: ' The chef tossed the Caesar salad with great um...um...' (Daneman and Green, 1986:11). According to these researchers, the pause before the first content word indicates that the speaker started the execution of his/her speech before he/she had finished its planning. The idea or concept the speaker wanted to convey had already been generated; however, he/she still had to select the precise word which best expressed this idea or concept. Accessing words in real time during speech production is assumed, by Daneman and Green, to be related to the speaker's ability to coordinate the processing and storage requirements of speech production, which taxes working memory. Thus they proposed a method to measure working memory during speech production, which consists of the Speaking Span Test which, as the Reading Span Test on which it was modelled, requires simultaneous storage and processing.

The Speaking Span Test focuses on sentence level speech production processes, in contrast to the Reading Span Test, which focuses on sentence comprehension processes. The procedures for the Speaking Span Test consisted of presenting subjects with increasingly longer sets of unrelated words, which they had to read silently. Each word was seven letters in length and was individually presented for 1 second on a computer video screen. Words were organised in five sets each of two, three, four, and five words, with intervals of 10 milliseconds between the words of each set. At the end of a set, when words were no longer visible on the screen, subjects were required to produce aloud a sentence for each individual word presented. There were no restrictions on the length of the sentences or the position of the word within the sentences, but they had to be grammatical as regards syntax and semantics. In addition, there were no restrictions on the time subjects took to generate the sentences. Speaking span, which is assumed to measure working memory capacity, was operationalized in terms of 'maximum set size' and 'total performance'. The maximum set size measure consisted of the highest set size in which a subject was correct on three out of the five sets. Thus, for instance, if a subject was able to produce a sentence for each individual word of at least 3 out of five sets of

four words, his span was four--the size of the set. Subjects were given half a credit if they were correct on two out of the five sets. The total capacity measure, in turn, consisted of the total number of sentences subjects were able to make. As the test was done with 70 words, the highest span would be 70. In addition to the Speaking Span Test, Daneman and Green also applied a Reading Span Test, following the same procedures of previous studies by Daneman and Carpenter (1980 and 1983).

Daneman and Green (ibid.) applied the Speaking Span Test to 34 English L1 university students and correlated the results obtained to these subjects' performance on a Contextual Vocabulary Task. This task consisted of presenting subjects with a context represented by means of a sentence fragment such as 'The chef tossed the Caesar salad with great... ' (p. 12). Following the context, which was removed from the screen after the subject had read it silently and pressed a button, was a concept expressed in a single word such as 'artistry'. Subjects were required to produce aloud a word whose meaning was as close as possible to that of 'artistry'. Subjects' time to produce the item was recorded in milliseconds. The authors report that small speaking span subjects were less fluent in generating a context-appropriate word, i.e., they took a longer time to access and retrieve the appropriate lexical items than high span subjects. The researchers also found a significant correlation between the Speaking Span Test and the Reading Span Test, which led them to suggest that the two tests tap similar systems. However, the Speaking Span Test was a better predictor of word production.

Daneman (1991), the study on which the present research is based, was an expansion of the Daneman and Green proposal. The study investigated the Speaking Span Test, which measures individual differences in working memory capacity, as a predictor of L1 verbal fluency. Considering that speaking is a complex cognitive task which requires coordination of storage and processing of information in the various stages of the speech production process, Daneman hypothesised that individuals with larger working memory capacities--the capacity to store and process information in real time--would perform better on the three tasks measuring fluency--a speech generation task, an oral reading task, and an oral slip task. In addition,

Daneman applied a Reading Span Test, which she hypothesised would correlate with the Oral Reading Task, but not as strongly as the Speaking Span Test. The study was carried out with 29 English L1 university students at the University of Toronto. The measures of working memory and fluency were designed in Daneman's study as follows:

Speaking Span Test (measure of individual differences in working memory capacity): This test was constructed like the Speaking Span Test of the 1986 study, with the difference that this time there were 100 words organised in five sets of two, three, four, five, and six words. A subjects' speaking span was operationalized in terms of total capacity, as in Daneman and Green (1986)--the total number of words for which he/she was able to produce a grammatical sentence. This total capacity was expressed in two speaking span scores: speaking span strict, counting only those sentences with the exact form of the word presented, and the speaking span lenient, counting also sentences containing the word in a different form.

Daneman hypothesised that the two speaking span scores would differ in the aspects of fluency they predicted. The speaking span strict was expected to be a better predictor of speed and accuracy in the articulation of words, as required by the Oral Reading Task and the Oral Slip Task. The speaking span lenient was expected to be a better predictor of creativity and flexibility in speech production, as the Speech Generation Task demands.

Speech Generation Task (measure of fluency): Daneman used the speech generation task as a global measure of fluency, under the assumption that it involves the processing and storage requirements necessary in all stages of speech production. This task consisted of the description of a picture which portrayed, in detail, the scene of a family having a meal in a dining room full of gadgets for serving and removing food. Subjects were instructed to speak about the picture for 1 minute, as fluently and continuously as possible. The main measure of fluency in this task was number of words completely articulated, counting contractions as one word, and not counting hesitation pauses, whether filled--e.g. 'uhm', 'uh'--or silent. Subjects' tape-recorded protocols were analysed by two independent judges for number of words (the

main measure) and for richness and originality of content (a secondary measure), the latter on a scale of 1 (repetitious, semantically empty) to 5 (creative, semantically rich speech).

Oral Reading Task (measure of fluency): In this task subjects were required to read aloud a 320 word passage taken from *The Great Gatsby*. Subjects were explicitly instructed to read the passage as fast as they could, their reading times measured in seconds with a stopwatch. Apart from reading time, the main measure, emphasis was also given to accuracy in the articulation of words. As in the speech generation task, two independent judges transcribed subjects' recordings and analysed them for errors, classified into 6 main categories: (1) repetitions, (2) false starts, (3) mispronunciations, (4) additions, (5) omissions, and (6) substitution errors.

Oral Slip Task (measure of fluency): This was the most complex measure of fluency included in the study. Daneman adapted Motley and Baars' (1976) SLIP technique devised to elicit spoonerisms in the laboratory. A spoonerism is a kind of speech error which consists of 'the transposition of phonemes in adjacent or near-adjacent syllables or words' (Motley, Baars, and Camden, 1983). Daneman's oral slip task was devised with a list of 309 pairs of words, which were presented one by one on a computer video screen, for 1 second each pair--900 milliseconds of exposure and 100 of interval between one pair and the next. From the 309 word pairs, 69 pairs were cued via a beep. Subjects were instructed to attend to all pairs and to say each cued pair as soon as they heard the beep, which was sounded 500 milliseconds after the removal of the pair, thus entering 400 milliseconds into the presentation of the next word pair.[5] The other non-cued pairs were read silently. From the 69 cued word pairs, 39 were filler pairs aimed at disguising 30 target pairs aimed at eliciting spoonerisms. Each of the 30 target word pairs was immediately preceded by three phonological interference word pairs, aimed at inducing the spoonerism error. The interference word pairs were phonologically

[5] This procedure ensured that subjects would attend to all of the word pairs of the task since, they did not know when the beep would sound. When the beep sounded, the to-be-spoken word pair was no longer visible on the screen and the next one was already being shown.

similar to the spoonerism error subjects were expected to make. The 39 filler pairs were preceded by a different number of word pairs without the phonological interference feature.

Responses were tape-recorded and analysed by two independent judges, who classified errors into the following types of spoonerisms: (1) complete spoonerisms, in which errors consisted of a complete reversal of initial sounds--*pick soap* produced as *sick pope*; (2) anticipations, in which a partial spoonerism error was made in the first word of the pair only -- *pick soap* produced as *sick soap*; (3) perseverations, which also consisted of a partial spoonerism error made in the last word of the pair--*pick soap* produced as *pick pope.*

Reading Span Test (measure of individual differences in working memory capacity): In addition to the Speaking Span Test--the measure of working memory during speech production--and the tasks aimed at assessing fluency, Daneman included a Reading Span Test, which measures working memory capacity for reading comprehension. The main reason given for the inclusion of the Reading Span Test in a study of oral fluency is that fluency in oral reading (the second task assessing fluency) demands a certain degree of comprehension of the message. Thus, the Reading Span Test was applied as in Daneman and Carpenter (1980, 1983), with the difference that the test was constructed with 100 unrelated sentences organised in increasingly longer sets of two, three, four, five, and six sentences, presented on a computer video screen, one at a time. As in Daneman and Green (1986), subjects' working memory span was their total performance on the test.

In general Daneman's hypotheses were confirmed. She reports finding similar means between scores of the Speaking Span and Reading Span Tests, which she interprets as evidence that the two tasks tap a common limited system. However, she did not report having tested for correlation between the two measures. She also reports that the two span tasks differed in their power of predicting performance in language production--the Speaking Span Test correlated significantly with the speech generation task, the oral reading task, and the oral slip task, while the reading span task correlated significantly only with the oral reading

task. Also, as predicted, the strict and the lenient scores of the Speaking Span Test differed in the aspects of fluency they could predict. Speaking span strict correlated better with the oral reading task and the oral slip task, while speaking span lenient correlated more significantly with both measures of the speech generation task. As regards the types of reading errors subjects made, speaking span strict correlated significantly with repetitions, false starts, and mispronunciations. The findings of Daneman's (1991) study are consistent with Daneman and Green's (1986) previous finding that working memory capacity is involved in speech production and stands as an important source of individual differences in the ease of access and storage of the information necessary in each of the stages of this process.

These results are explained by the claim that the Speaking Span Test is a complex measure of working memory span for language production, which taxes both the storage and processing functions of this limited system during the production of speech. While the storage component of the test is to recall the words presented, the processing component consists of generating grammatical sentences containing these words. Both functions compete for the limited capacity of this system. Daneman argues that the ability with which an individual coordinates storage and processing in this task is related to his/her ability to produce fluent speech, which also requires efficient coordination of storage and processing of information. It is important to note that the Speaking Span Test and the Reading Span Test are recall tests which were devised to measure working memory span under language production or comprehension processing demands. The tests do not measure processing efficiency per se; rather they are assumed to reflect the storage capacity an individual has left as a result of his/her processing efficiency while producing or comprehending language. Thus, as claimed by Daneman and colleagues, good readers have a larger working memory capacity for storing products of the reading comprehension process--such as facts, pronoun referents, and propositions (Turner and Engle, 1989)--because their processing is more efficient and thus they use less of their capacity. Accordingly (Daneman, 1991), more fluent speakers have a larger working memory capacity as measured by the Speaking Span Test, because they are more efficient in executing the processes required during speech production, leaving greater

resources available for the storage of the intermediate products of this processing. However, as already observed, this processing efficiency is task-specific.

Daneman (ibid.) does not distinguish between verbal and oral production, although what she is examining is clearly fluency in oral production as opposed to written production. Nor does she supply a definition of fluent verbal (oral) production. However, we can infer from her 1991 study that she would agree that fluency in speech production is a multidimensional concept, since she points out that the measures she used do not test all aspects of fluency. In addition, she emphasises the complex cognitive nature of speech production and its three general stages--planning, storage and execution. It seems reasonable to state that a fluent speaker is one who performs the processes involved in these three general stages with a degree of facility which results in speech which runs with few pauses, is accurately articulated, and is constructed in such a way that the idea is adequately conveyed. Daneman's study does not encompass all aspects of fluency. Rather this researcher decided to assess fluency in terms of speech rate, and speed and accuracy in articulation of words.

However limited Daneman's view of fluency in language production might be, it is important to note that the very notion of fluency is multidimensional and that only some aspects of these different dimensions were tapped by the tasks aimed at assessing it. In general, theorists have limited themselves to saying that working memory is involved in different complex cognitive tasks, with research accumulating in the areas of reasoning and language comprehension, especially reading. Daneman and Green (1986) and Daneman (1991) have shown that this limited-capacity system also seems to play an important role in language production, as regards lexical access in context (Daneman and Green ibid.), planning and execution of speech, and speed and accuracy of articulation (Daneman ibid.).

The next section of this chapter reviews the relevant literature on L2 fluency as regards oral production. As we shall see, this aspect of L2 studies has also been largely neglected, with only a few studies addressing the topic directly.

2.7 Second Language/Foreign Language (L2) Fluency

In addition to the lack of studies on L2 fluency, there is also a certain lack of consensus as to the terminology used when theorists classify variables constituting fluency, with the same terms sometimes being used with different connotations.

Lennon (1990) attempted to quantify the components of fluency by analysing speech samples of a group of four adult German university students of English as a second language. To assess fluency, Lennon asked his subjects to narrate a story based on a six-picture sequence. The subjects had their speech samples recorded on two occasions, with the same picture sequence as stimulus--two weeks after they had arrived in England, where they would stay for six months--and two weeks before they left. This allowed the researcher to evaluate any developments in his subjects' fluency.

Lennon devised a wide range of measures of fluency, which encompassed both temporal variables and dysfluency markers, many of them in the tradition of Goldman-Eisler (1968). In total, he assessed 8 temporal variables (unpruned and pruned words per minute, total unfilled and filled pause time, speech runs between pauses, T-units followed by pauses, total and mean pause time at T-unit boundaries), and 4 dysfluency markers (repetitions, self-correction, filled pauses, percentage of repeated and self-corrected words).[6] In addition to analysing the recorded narratives according to these variables, Lennon also submitted them to a panel of ten native-speaker teachers of English as a L2, who rated the subjects' fluency on the basis of a subjective judgement.

By comparing each subjects' first and last narratives, Lennon (ibid.) found that there had been improvements in their fluency, especially in terms of speech rate and number of filled

[6] Unpruned words consist of all words produced in the count, whereas pruned words include all words except self-corrected words, repeated words (excluding words repeated for rhetorical effects), words constituting comments on the task, and words addressed to the experimenter. Lennon (ibid.), following Hunt (1974) and Vorster (1980), defines a T-unit as 'one main clause and all its subordinate clauses and nonclausal units' (p.496).

pauses. He reports that subjects' speech was faster, with fewer repetitions and filled pauses per T-units, less time occupied by unfilled pauses, longer fluent runs between pauses and T-units, and a reduction of pause time at T-unit boundaries. Lennon points out, however, that there was no reduction in the number of self-corrections. It is noteworthy that in this study Lennon was able to identify at least two key components of fluency in second language: a temporal component, revealed in terms of speech/pause relationships, and a vocal dysfluency marker component, realised as filled pauses and repetitions. In addition, the three variables that were found to be significant were pruned words, filled pauses per T-unit and percent of T-units followed by a pause, which, he argues, should be considered as constituting the core of any set of measures of fluency. Also interesting in this limited study is the fact that Lennon (ibid.) suggests that teachers of second languages could possibly identify each learner's fluency problems by taking these measures as points of reference. Another suggestion he makes for classroom instruction is that, in trying to develop oral fluency in his/her students, a teacher has to consider that there might be different types of fluency, according to different contexts and situations and different types of speakers.

Riggenbach (1991) analysed the speech of 6 Chinese students of English as a L2, three rated as very fluent, and three as very nonfluent. Her primary goal was to identify which features of the speech of highly fluent nonnative speakers differed form the ones of those speakers considered to be highly nonfluent. As a secondary goal, the researcher addressed the question of whether nonnative speakers' fluency differed across two genres--dialogue and monologue.

To pursue her main goal, Riggenbach asked her subjects to record a dialogue on any topic. After having these dialogues rated for fluency by 12 English as a L2 teachers, she analysed 5-minute excerpts of each subjects' dialogue in terms of fluency/dysfluency markers and rate of speech, the latter measured by number of words per minute. The analysis included specific fluency-related items such as hesitation phenomena, repair phenomena, rate and quantity of speech, interactive phenomena, and turn change types. Each of these categories

contained a set of sub-items, summing up 19 variables. Thus, in hesitation phenomena, for instance, Riggenbach examined micropauses, hesitation, unfilled and filled pauses, the latter subdivided into nonlexical, sound stretches, and colons.

Riggenbach reports that the quantitative analysis showed few significant differences in features between fluent and nonfluent subjects. However, she was able to verify that fluent and nonfluent nonnative speakers differed in terms of speech rate and number of filled pauses, supporting Lennon's (1990) findings. Moreover, this study also indicates that hesitation, repair phenomena, rate of speech, and interactive features do not have equal weight, each of these items having a different role as an indicator of fluency. Particularly, hesitation phenomena stand as salient features in fluent and nonfluent speech, making it possible to judge speakers as more (+) or less (-) fluent solely on the basis of these features.

In addition to hesitation phenomena, the most salient feature identified in this study, Riggenbach also found speech rate and repair phenomena to have a high degree of salience. As her source of speech samples was dialogues, she also points out that interactive features might play an important role in the production of fluent speech, which implies that having a conversation, telling a story or describing a picture (the latter two consisting of monologue-type speech) may involve different types of fluency. In conversations, for instance, some of the interactive aspects that Riggenbach observed in her subjects' fluent speech include the ability to initiate topic changes, to carry on the conversation through demonstrations of comprehension, to show anticipation of ends-of turn, and also the amount of speech produced in relation to the interlocutor. Finally, Riggenbach suggests that an initial model of nonnative speaker fluency in conversations would include, in order of importance: (1) filled and unfilled pauses as regards their frequency, placement, degree of chunking, and type; (2) rate of speech; and (3) frequency and function of repair.

Möhle (1984) compared speech samples of advanced L2 learners of German and French, in an attempt to verify whether processes in language planning and production vary

among speakers of different native and second languages during L1 and L2 speech production. She also investigated whether these learners' problem-solving strategies in L2 language production are the same or different, by assessing temporal variables and by linguistic analysis of the speech produced. She tape-recorded three French students of German as a L2 and six German students of French as a L2 at the beginning and end of one semester of study abroad. The study involved two tasks--description and free discourse. For the description task, subjects were asked to describe a series of two cartoons both in L1 and L2. For the discourse task subjects were required to answer two questions about their stay in the foreign country, also in L1 and L2. Möhle assessed subjects' speech rate, articulation rate, length of speech units, number of pauses per 100 syllables and length of pauses in seconds.[7] She reports that the German subjects demonstrated higher speech and articulation rates than the French subjects, both in the cartoon and in the free discourse tasks, in both L1 and L2. However, speech and articulation rates were lower for both groups in the cartoon description task. Mohle suggests that description is a highly pre-structured task, which demands more time to be carried out than the free discourse task, and which limits language planning (but see Ejzenberg, 1995).

The linguistic analysis of subjects' L2 speech samples showed that the French subjects produced rather non-fluent speech in German, characterised as halting, choppy, and with few complete semantic units, but with complex and sophisticated syntactic structures. The German subjects demonstrated a lack of lexical and grammatical knowledge in French, and considerable L1 interference, but had higher speech and articulation rates. Möhle argues that the French subjects focused their attention on the form and accuracy of grammatical aspects of their speech production, which interfered with the flow of speech, while the German subjects focused on the content of their message, rather than on grammatical correctness or idiomaticity, causing a general acoustic impression of fluent speech. Comparing subjects' speech samples recorded at the beginning and end of their stay abroad, Möhle reports that

[7] Mohle (1984) measures speech rate as the number of syllables per minute produced in the entire recording time (p. 29). Articulation rate is measured by the number of syllables articulated per second during net speaking time (p.31).

speech and articulation rate were the most salient temporal variables of improvement in both groups, and that there were, besides, improvements in terms of qualitative linguistic aspects. Finally, as regards strategies to solve communication problems, Möhle mentions that there were no significant differences between the two groups.

Rehbein (1987), based on the analysis of speech produced in German as a second language, developed a set of hypotheses concerning second language fluency. He posits that fluency is dependent on the activity of planning, which requires the L2 speaker to create a global scheme for his/her utterance, arguing that the planning and uttering of speech take place in part simultaneously, as shown by analysis of pauses during speech production. Although emphasising speech production processes, Rehbein points out that fluency is also dependent on the type of task the speaker is required to perform, the type of event he/she is involved in, the type of discourse being carried out, and the expectations of the hearer. Finally, Rehbein suggests that the use of formulaic speech might also help L2 speakers to produce fluent stretches of speech.

Dechert (1983) proposes that the production of L2 fluent speech is largely based on what he calls 'islands of reliability' (p. 183), a term roughly equivalent to formulaic speech. In this study, Dechert (ibid.) analyses a narrative produced by an advanced L2 speaker of English in terms of falling intonation contours, pauses, speech errors and self-corrections as indicators of speech planning, and notices that her speech is segmented into two different kinds of speech. One type is marked by hesitations, repetitions, corrections, false starts, and the like. The other type is characterised by native-like utterances consisting of formula-like linguistic units of varying length and syntactic complexity, which form the islands, serving as anchoring points for further planning and execution processes. Examples of such islands of reliability are utterances as 'shorter and shorter' or 'a little dog is sitting in the garden' (p. 183). Dechert assumes that for learners to speak an L2 competently they have to create knowledge sources that may allow for the formation of such islands.

The assumption that formulaic speech is an important characteristic of fluent speech led Gatbonton and Segalowitz (1988) to propose a theory of 'creative automatization' to be applied in L2 classroom settings. In this theory fluency in speech is related to at least two broad aspects of language. One aspect of fluency reflects the speaker's communicative ability to convey his/her message, which involves knowing what to say, when, where, and how, attending to complex sociolinguistic and intercultural factors. The other aspect reflects the ease with which the mental processes involved in the actual production of utterances take place, thus emphasising the linguistic aspect of communication. In the L2 it might be lack of linguistic knowledge--i.e., lexical, syntactic and phonological knowledge--that causes nonfluent speech. The search for this kind of information, in Gatbonton and Segalowitz' view, demands a great part of the speaker's attentional resources, resulting in discontinuous speech, full of hesitations. They suggest, then, that one way of developing fluency in L2 learners' speech is to provide them, within the communicative framework, with formulaic speech or 'speech forms produced as unanalysed wholes, prepatterned expressions, or routinized utterances' (Gatbonton and Segalowitz, ibid.: 473), which would free the L2 speaker's attentional resources to be placed in other more complex aspects of speech production. The creative automatization theory proposes that the automatization of specific utterances or sentence frames reflecting language functions (e.g. requesting, directing, describing past activities) can be developed in the L2 classroom by means of activities in which the learner is given extensive practice in using these items while conveying messages.

The studies reviewed above all focused on L2 fluency as a product of the speech process and attempt to identify the features of this fluency. As noted in chapter 1, the present study focuses on fluency from the cognitive perspective, thus being primarily concerned with the cognitive processes involved in the production of L2 speech that is characterised as smooth, continuous, coherent, with few pauses and hesitations, and adequate to the context.

The next section presents a review of Levelt's (1989) model of the whole speech production process, which is crucial for the understanding of concepts involved in the present study.[8]

2.8 Levelt's (1989) Model of Speech Production

Various researchers (e.g. Clark and Clark, 1977; Levelt 1989; Crookes, 1990; Smyth et al 1994) have suggested that speech production has at least two main general stages, namely, a planning and an execution stage. Among the models of speech production proposed in the literature, Levelt's (1989) appears to be the most comprehensive and promising one, since it seems to capture in detail the events present in speech production.

In Levelt' s (1989) view, speaking is a highly complex skill which takes all of our childhood to develop. According to this researcher, "the speaker is a highly complex information processor who can, in some still rather mysterious way, transform intentions, thoughts, feelings into fluently articulated speech" (p.1). In order to speak, the individual has to go through a number of steps. First, he/she has to apply conceptual processes such as making an initial choice of purpose or conceiving an intention to speak. These processes, Levelt argues, depend on the speaker's state of motivation, the amount of knowledge he/she shares with the interlocutor, and the speaker's discourse record or his/her record of the discourse that is being created by him/her and the others in the course of the interaction in the context in which he/she is. Conceptual processes such as these are necessary to create the message to be expressed.

In addition to the conceptual processes, there are specifically linguistic processes to be carried out. After having in mind the concepts to be expressed, the speaker has to access words that map onto these concepts, retrieve syntactic forms that correspond to these words, and build a grammatical structure. These grammatical structures, or surface structures as

[8]For an extensive review of the literature on L2 fluency within Applied Linguistics, the reader is referred to Eyzenberg (1992).

Levelt calls them, have to be given a phonetic plan which will, in turn, activate the processes of the articulatory system and finally be executed in terms of words, phrases and sentences.

The processes taking place from the conception of the message to its development into phonetic plans and activation of the articulatory system are assumed to be in a general planning stage. Delivering speech in actual sounds, i.e., as overt speech, is the general execution stage. Obviously, these processes do not take place in a linear way. Levelt argues that many of them happen in parallel fashion since execution may begin at any moment of the planning stage. Thus, when speaking, the individual starts executing one piece of the message while still planning the following piece, thus carrying out the two stages concurrently.

Levelt (1989) distinguishes four major components in his model of speech production: a *Conceptualizer*, a *Formulator*, an *Articulator*, and a *Speech-Comprehension System.* Each of these components is responsible for specific processes. Thus, it is in the *Conceptualizer* that the intention to speak originates and the conception of the message takes place by selection and ordering of relevant information. This information, organised in terms of concepts, expresses the message that the speaker intends to convey. Levelt distinguishes two stages in the conception of a preverbal message--macroplanning and microplanning.

While it appears rather difficult to make a distinction between the two stages, macroplanning consists of the elaboration of a communicative goal into a series of subgoals plus the retrieval of the information necessary to realise these goals. On the other hand, microplanning consists of providing an informational perspective for each speech-act. For instance, if a speaker has the intention to give information about how to get to a certain place (goal), he/she develops a series of subgoals, like first saying the precise location of the place, then informing the person of the directions to take, then checking understanding, and so on, plus the retrieval of information to realise the goals and subgoals--assertions, questions, commands. The output of macroplanning is a series of speech-act intentions. Besides forming speech-act intentions, the speaker has to make decisions with regard to the content of these

speech-acts, such as what is going to be expressed as given and new information, and what he/she will focus on. The output of microplanning, and thus of the *Conceptualizer*, is the preverbal message. Levelt assumes that it is not necessary to finish macroplanning for microplanning to begin--a speaker can start giving directions without having finished planning all its details in terms of message organisation.

In addition to the formation of the intention to speak and the conceptualisation of the preverbal message, it is also in the *Conceptualizer* that attention to what has already been said and monitoring (self-correction) of what and how is being said take place.

Levelt sustains that in order to conceive a message, the speaker has to have procedural and declarative knowledge. He adopts Anderson's (1983) definition of procedural knowledge, i.e., condition/action pairs that are represented by means of rules. The *Conceptualizer*, in Levelt's terms, is a structured system of such pairs, which are part of the component themselves, i.e., the generation of a preverbal message takes place through message-generating procedures. The results of these procedures are stored, according to Levelt, in working memory. Declarative knowledge, in turn, consists of the speaker's knowledge of the world and of him/herself, plus situational knowledge, ie, knowledge of the present discourse situation, and the discourse record or the speaker's record of what he/she and the others have already said. Thus, in order to conceive the preverbal message the speaker has to make use of both procedural and declarative knowledge--procedural knowledge being message-generating procedures and declarative knowledge being the kind of knowledge necessary to make the message suitable to the context in which the speaker is inserted.

The conception of the preverbal message or the conceptual structure, which takes place in the *Conceptualizer*, is the input for the next processing component. It is in the *Formulator* that the preverbal message is developed into a phonetic plan through the selection of the right lexical units and the application of grammatical and phonological rules. The translation of the conceptual structure into a linguistic structure takes place in two stages, namely, a grammatical

encoding and a phonological encoding. After the preverbal message has been generated, the speaker has to access the lexical units that match the conceptual information of the preverbal message.

Levelt distinguishes concepts from words. Concepts refer to meaning representations in our long-term memory. Words, or lexical items, are the linguistic configurations of these concepts. Words, or lexical items, consist of two parts--the lemma and the lexical form (or the lexeme, as it is referred to by de Bot, 1993). Grammatical encoding consists of accessing lemmas--that part of the lexical item which contains semantic and syntactic information--and of building syntactic constructions. During lemma access the speaker has available the information, in the form of declarative knowledge, about the use of the word (stylistic and pragmatic conditions), the word's syntactic category, its grammatical function, and all specific information about the word's syntactic encoding such as number, tense, aspect, mood, case, and pitch. When a lemma is accessed, it also brings with it the information necessary to apply syntactic procedures, in the form of procedural knowledge. The result of lemma access and syntactic building is a surface structure of the message, which is kept temporarily in a *Syntactic Buffer.*

The second stage of the translation of the conceptual message into a linguistic structure, the phonological encoding, consists of building a phonetic plan for each lemma in the utterance. The construction of this phonetic plan is carried out through the information contained in the lexeme (de Bot, 1992)--the information about the word's morphology and phonology. After the surface structure is formed and stored in the Syntactic Buffer, the phonetic plan is constructed. The output of the *Formulator* ,i.e., the phonetic plan, is the input for the *Articulator*, the next processing component. Levelt also proposes that the phonetic plan resulting from the processes that take place in the *Formulator* is equivalent to internal speech and can be scanned through the *Speech-Comprehension System.*

It is in the *Articulator* that internal speech, in the form of a phonetic plan, is converted into actual overt speech. According to Levelt, articulating consists of "executing the phonetic plan by the musculature of the respiratory, the laryngeal, and supralaryngeal systems" (p. 12), requiring the coordination of a set of muscles. Articulation, in Levelt's view, is highly procedural. He argues that the generation of internal speech is ahead of articulatory execution. Thus, the phonetic plan, while not being executed, is temporarily stored in an *Articulatory Buffer*. The product of the articulator is what Levelt calls overt speech.

Finally, Levelt proposes that the *Speech-Comprehension System* allows the speaker to monitor not only his overt speech, but his internal speech as well. Monitoring may take place at all linguistic levels and allows the speaker to compare what was intended to what was linguistically planned.

The relevance of Levelt's proposal for the present study relies on the fact that the model gives us a clear idea of the cognitive work speakers have to do in order to express thoughts through words, thus imposing demands on working memory.

CHAPTER 3

METHOD

3.1 The Study

The purpose of the present study was to verify whether there was a correlation between individuals' working memory capacity and their fluency in English as a L2. A set of experiments was applied in order to assess subjects' working memory capacity and their L2 fluency: the Speaking Span Test, in Portuguese and in English, aimed at assessing individuals' working memory capacity; and three tasks aimed at assessing their L2 fluency: a speech generation task, an oral reading task, and an oral slip task. Because oral reading requires, in addition to speech articulation and print decoding, a certain amount of comprehension, the Reading Span Test, in both Portuguese and English, was also included. As Daneman (1991 and elsewhere) claims, this test is sensitive to comprehension processes.

Based on Daneman (1991), the present study investigated the following set of hypotheses:

(1) Individuals with a larger working memory capacity as measured by the Speaking Test, in Portuguese and English, would be more fluent at generating speech, more fluent at reading aloud, and less prone to making spoonerisms in the L2.

(2) Speaking Span strict and Speaking Span lenient are sensitive to different aspects of L2 oral fluency: the former would correlate better with fluency in articulation of words, as measured by the Oral Reading Task and the Oral Slip Task, and the latter would correlate better with fluency in producing smooth, continuous, coherent and adequate speech, as assessed by the Speech Generation Task.

(3) The Reading Span Test, like the Speaking Span Test, would correlate with fluency in oral reading, but would not correlate with the other two non-reading related tasks.

Applying the span tests in both Portuguese and English made it possible to address two secondary questions in this study: (1) whether working memory capacity, as measured by the span tests would be constant across the two languages, and (2) whether working memory capacity, as measured by the Speaking Span in the two languages, would correlate with subjective ratings of fluency, in terms of richness of content.

3.2 Subjects

The 16 subjects who participated in this study were graduate students taking their MA in English Language or Literature at the Federal University of Santa Catarina (UFSC). Of the 16 subjects, 12 were women and 4 were men, ages ranging from 22 to 39 with a mean of 27.5, thus a predominantly young adult sample.

A major difficulty in selecting subjects to participate in this study concerned the control of their level of proficiency in English, the second language in which their fluency would be assessed and later correlated to their working memory capacity. Controlling their level of proficiency was fundamental to this study in order to minimise the effects of this variable on their results both on the second language span tasks and the fluency tasks. However, attempting to rigorously assess subjects' level of proficiency in the L2 would become in itself another study. A brief review of recent articles addressing proficiency assessment showed that the very notion of proficiency is still far from being clarified in the second language acquisition/use research, with theorists using the term in different ways for different reasons and with different purposes (Thomas, 1994; Snow, 1987). Thomas (ibid.), for instance, highlights the fact that much of the experimental and observational research developed in the L2 acquisition/use area assesses L2 learners' proficiency on the basis of institutional status (p. 317), according to their positions in a structure organised hierarchically by the institution to which these learners belong. Thus, the first reason why graduate students of English were selected to participate in this study was the fact that the institution where they are carrying out their research recognises them as proficient in English, proficiency defined here as the subjects'

global ability in the L2. All of the subjects were working either on their research proposal or on their dissertation itself, and thus had gone through a number of courses which required them to perform in English at a high standard in both the oral and written modes.. All of the subjects had previously dealt with English professionally, mainly teaching. Except for three subjects, all of them held undergraduate degrees in Letters Portuguese/English. Subjects' experience in an English-speaking country varied from short study visits to longer periods of residence, again with the exception of three subjects (not the same three) who had never been abroad. Thus, for the purpose of the present study, these subjects are considered to form a relatively homogeneous group in terms of L2 proficiency, sufficient to allow them to use it successfully at least for academic purposes, including speaking.

The second reason why these subjects were chosen is that, as university students, they characterise the type of subjects who generally participate in the studies developed in the psychometric correlational approach to working memory, predominantly university students who presumably have more highly developed cognitive skills.

Finally, there is a third and pragmatic reason why MA students of English were chosen: as Tomasello and Herron (1991) point out, problems in rigorously controlling L2 proficiency justify an acceptable 'real-world compromise' (p. 515), since we generally lack time, money, and, most importantly, ideal research conditions. These subjects were all available and willing to participate at the time the study was carried out, thus allowing the experimenter to follow her research agenda.

3.3 The experiments

The data of this study were collected individually with each subject in a small room at the CCE/UFSC during the last two weeks of March and throughout April 1995, in two sessions which took place on different days for each subject (see procedures in section 3.5). There were a computer XT, a tape-recorder and a few chairs in the room.

In the first session, subjects' working memory capacity was assessed through the application of the four span tests. In the second session subjects' L2 fluency was assessed through the other three tasks.

3.3.1 Measures of working memory during language production

Subjects' working memory capacity for language production was assessed by means of the Speaking Span Tests (SST) in Portuguese (SSTP) and English (SSTE). Instructions were given orally and in Portuguese in all of the tests carried out (see Appendix H, for a sample of instructions), and subjects were explicitly told that this was a memory test and that it was necessary to focus their attention on the stimuli, since the time of presentation of words would be only 1 second. When explaining how the tests would take place, the experimenter first gave sample items. Then, actual previous training was given only if subjects required it and would last until they decided to stop.

The SSTE was constructed with 42 unrelated one-syllable words, arranged in two sets each of two, three, four, five, and six words (see Appendix C, for the organisation of words in sets). Each word was presented on the middle line of a computer video screen for 1 second and was accompanied by a beep. Subjects were instructed to read the words silently. Ten milliseconds after the word had been removed, the next word in the set would appear beside the place the previous word had been presented, on the same line. This procedure was followed, each word slightly farther to the right, until a blank screen signalled that a set had ended. Subjects were then required to produce orally a sentence for each word in the set, in the order they had appeared and in the exact form they were presented. Thus, for instance, after being presented with the set:

duck pen gas

a subject generated the sentences:

"The duck is in the pond."

"The pen is mine."

"I need some gas."

Subjects were told that there were no restrictions as to the length of the sentences, but they were required to make them grammatical as regards syntax and semantics. After each subject finished generating the sentences for a given set, the next set would be presented and this procedure was followed until all sets had been presented. The two-word sets were presented first, followed by the three-word sets, the four-word sets, and so on. Following Daneman (1991) and Daneman and Green (1986), the measure applied to a subject's speaking span in English in the present study was his/her total performance on the test, i.e., the total number of words for which a grammatical sentence was produced--in this case, the maximum being 42.

Subjects' responses were tape-recorded, and from the analysis of their responses two types of scores were obtained, as in Daneman (1991): a speaking span **strict**, when all the grammatical sentences the subject produced contained the target word in its exact form of presentation, and a speaking span **lenient**, when credit was given for grammatical sentences that contained the target word in a form other than that of presentation (e.g. target word being "dog" and the word in the sentence produced being "dogs"). The main measure of individuals' working memory capacity was the speaking span strict.

There were a few cases in which subjects recalled words out of their order of presentation or in which they inserted or repeated words of previous sets. In these cases, no credit was given for the sentences produced. No subjects produced ungrammatical sentences in terms of syntax and semantics.

The words constituting the SSTE were taken from the word span test used by Harrington and Sawyer (1993)--devised to measure individuals short-term memory in the L2 and from the fan test used by Cantor and Engle (1993). The words were randomly organised in the sets, but an effort was made to avoid phonologically similar words in the same set. In

order to minimise processing constraints in sentence production and to avoid a possible word-length effect (Baddeley 1990 and elsewhere), this test was constructed only with monosyllabic words, of three to five letters. Despite the fact that this test did not aim at measuring L2 linguistic knowledge, at the end of the test subjects were shown the list of words presented and asked whether there were any words that they did not know or remember the meaning of, in which case the word would be taken out of the subject's responses during the analysis. Fortunately, there were no cases in which a word was unknown to subjects.

The Speaking Span Test in Portuguese (SSTP) was devised and applied as the SSTE (see Appendix A, for organisation of words in sets). Instructions were similarly given and subjects underwent a training section only if they found it necessary (see Appendix H, item I for instructions). Procedures during test application were also the same as in the SSTE. Subjects' responses were tape-recorded and two speaking span scores were obtained. As in the SSTE, no credit was given for words recalled out of their original order of presentation or words from previous sets that were inserted or repeated. No ungrammatical sentences were produced.

The only difference between the SSTP and the SSTE was that all words in the former were seven letters in length, in replication of Daneman (1991). Daneman's seven-length specification was maintained in order to keep as close as possible to the design of her tests, although number of syllables or spoken duration might have been a more adequate criteria, if we assume that what is maintained in memory is an acoustic rather than a visual image of the word. The SSTE was included in the present study in order to verify whether subjects' working memory capacity, as assessed by the speaking span test, would be the same across languages.

3.3.2 Measures of Working Memory during Language Comprehension

Individuals' working memory capacity for language comprehension was assessed by means of the Reading Span Test --RST--(Daneman and Carpenter, 1980, 1983; Daneman and Green, 1986; Daneman, 1991), which was also carried out both in English (RSTE) and in Portuguese (RSTP). According to Daneman (1991), oral reading (one of the tasks aimed at assessing oral fluency) involves, in addition to fluency of articulation, comprehension processes that are better captured by the RST. Again, as in Daneman (1991), the hypothesis was that the RSTE would correlate with subjects' oral reading fluency in English, as measured by their oral reading time.

The RSTE was constructed with 42 unrelated sentences arranged in two sets each of two, three, four, five, and six sentences (see Appendix D for organisation of sentences in sets). The sentences were adapted from Harrington and Sawyer (1993)--see 2.5.2. Some of them were slightly modified in order to avoid words contained in the SSTE to be repeated as target-words in the RSTE. The sentences were made syntactically simpler and 3 to 4 words shorter than the ones used in Daneman (1991, e.g.), and each one ended in a different word.

Each sentence was presented one at a time on a computer screen and subjects were asked to read them aloud, trying to comprehend them. At the end of a set, when a blank screen appeared, subjects had to recall the last word of each sentence in the set in the order they were presented. Instructions were given orally and subjects were explicitly told that this was also a memory test and that they were thus encouraged to recall as many sentence-final words as they could (see Appendix H, item IV for a sample of instructions). The time of presentation in this test was not controlled, but depended on the speed of the subjects. The subjects would read each sentence aloud, and as soon as they finished, the experimenter would press the "enter" key on the computer keyboard, causing the next sentence in the set to be presented. This procedure was followed until the 42 sentences had been presented. As in the

SSTE, the two-sentence sets were presented first, followed by the three-sentence sets, the four-sentence sets, and so on. Subjects were told that the sets would be increasingly longer.

In order to make sure that subjects were attending to the meaning of sentences and were indeed applying comprehension processes, a grammaticality judgement was included in the test, as in Harrington and Sawyer (1993)--see 2.5.2. This consisted of incorporating one or two ungrammatical sentences in the sets, in initial, middle or final position. The procedures for making sentences ungrammatical in this test were even simpler than the ones suggested by Harrington and Sawyer (ibid.): ungrammatical sentences did not make any sense and had unacceptable subject-verb agreement, unacceptable sequences of nouns and unacceptable verb tenses, thus being ungrammatical both syntactically and semantically.

Subjects were explicitly told that they would find such ungrammatical sentences and were instructed to tell the experimenter when this was the case. They were also told to ignore the ungrammatical sentences during recall of the sentence-final words. For example, in the following set of three sentences, the fourth and ungrammatical sentence was included, which should be recognised as ungrammatical and its final word not included during recall, which would include, then, only dog, church, and nut[9]:

> The young woman and her boyfriend thought they saw a **dog.**
> Suddenly the taxi opened its door in front of the **church.**
> All that remained in the lunch box was one salted **nut.**
> *Car go break stars don't see the house.
> < blank screen>

In case they did not recognise a sentence as ungrammatical, the experimenter would tell them so before the next sentence was presented.

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[9] In the test, to-be-remembered words did not appear in bold and ungrammatical sentences were not preceded by an asterisk.

Again as in Daneman (1991), a subject's working memory span for language comprehension was his total performance on the test, i.e., the maximum number of sentence-final words he/she could recall in the exact order they were presented--in this case 42. There were a few cases in which subjects gave a word out of order or repeated words from previous sets. In these cases, no credit was given. In the RSTE there was no lenient score, since no word was recalled in a form other than the one in which it was actually presented.

The Reading Span Test in Portuguese (RSTP) was applied in the same manner as the RSTE. The test was constructed with 42 unrelated sentences, of 12 to 17 words in length (as in Daneman, 1991), taken from current magazines and newspapers (see Appendix B, for sentences). Each sentence ended with a different word. Similar to the RSTE, to ensure that subjects were attending to sentence meaning, an obstacle to comprehension, rather than a grammatical judgement, was incorporated. This consisted of omitting the Portuguese diacritical marks which distinguish one word from another (the verb *é* from the conjunction *e*) or which facilitate recognition and pronunciation of the word (the cedilla in *açougue*, for instance). Thus, in order to recognise the words and pronounce them correctly, subjects had to make judgements based on comprehension of the rest of the sentence.

Unlike the RSTE, subjects were not told that there would be such sentences in this test and were expected to notice the absence of the diacritics, especially when the meaning was not clear. Instructions were given orally and training was given only to those subjects who found it necessary. Subjects were instructed to recall all sentence-final words of each set presented, in their original form and order of presentation, which would be in increasingly longer sets (see Appendix H, item II for instructions).

3.3.3 Measures of L2 Fluency

As stated in 3.1, subjects' L2 fluency was assessed by means of a Speech Generation Task (SGT), an Oral Reading Task (ORT), and an Oral Slip Task (OST). In the SGT subjects

were presented with a picture and required to describe it as well as make comments about it for the duration of 1m and 30s (see Appendix H, item V for instructions). The picture, adapted from a L2 textbook and painted in watercolours on a 20 x 25 cm card, portrayed a detailed scene of a middle-class family at home. In the living-room, there were five members of the family, each one doing a different activity. In the kitchen the family maid was involved with the housework (see Appendix E, for picture).

Although picture description is generally considered a highly pre-structured task because of the number of cues the speaker has available to organise his/her speech (Ejzenberg, 1995), the scene portrayed in this particular picture left it open to subjects to decide on the sex of one adult character, who was not clearly defined and was ironing clothes, and on the hierarchical position of a female character, who could either be a mother or a daughter. It was believed that these two aspects of the picture used in the present study would make the task more demanding.

Subjects were explicitly instructed to give as much information as they could about the picture in their descriptions as well as in their comments. Their oral protocols were tape-recorded and then transcribed so that they could be scored. The main measure of fluency was that used by Daneman in her 1991 study, the total number of words produced during the time allotted, or their speech rate. As pointed out in Chapter 2, speech rate as measured by number of words per minute seems to be a distinctive feature of fluent and nonfluent speakers.

Subjects' tape-recorded protocols were also submitted to the evaluation of two independent judges, native speakers of American English. These judges, who were also L2 teachers, were asked to rate subjects' fluency in terms of their richness of content, this aspect being subjectively defined by the two judges themselves, on a scale of 1 (repetitious, semantically empty) to 5 (creative, semantically rich)--see Appendix I, for raters' instructions.

Since the two independent judges did not receive any training to experimentally assess fluency or detailed instructions about this study, their ratings were given solely on their subjective impression of richness of content as native speakers and L2 teachers. For this reason, the average rating of the two independent judges was used to correlate with individuals' working memory capacity. It is noteworthy, however, that the main measure of L2 fluency, for the purposes of this study, is the total number of words subjects produced in the time allotted. This second subjective measure provided by the two judges was correlated to subjects' working memory capacity for fluent L2 speech production in order to answer another secondary question of this research: whether the SST was a good predictor of fluency as directly measured by the listener's subjective impression.

The Oral Reading Task (ORT), another measure of fluency, consisted of requiring subjects to read aloud a 327 word passage extracted from *The Great Gatsby,* by Scott Fitzgerald (see Appendix F, for complete passage). The passage was selected because it was induced from an example given by Daneman to have been the passage used in her study.

Subjects were told that the emphasis was on reading speed and were explicitly instructed to read the passage as quickly as possible, but not to slur words. They were also given extra time to read the passage silently first, in order to check for vocabulary and pronunciation problems. However, not all of them found this necessary. Reading time, the measure of fluency, was measured in seconds (s) with a stop watch. Subjects' protocols were tape-recorded.

The third task used to assess subjects' L2 fluency was an Oral Slip Task (OST), aimed at eliciting spoonerisms in the laboratory. In her original study Daneman adapted this task from Baars, Motley, and MacKay (1975). The task devised for the present study is different from Daneman's as regards (1) the number of word pairs with which the test was constructed--84 in total--and (2) the word pairs themselves, some of which were collected from Fromkin's (1973) Appendices and others devised by the experimenter, since Daneman does not provide

Appendices for the items constituting her experiments. In all other aspects this task was devised as Daneman describes it (see Appendix G for word pairs).

Subjects were presented with the 86 pairs of words on the middle line of a computer video screen, one pair at a time at a rate of 1s each--900 milliseconds (ms) of exposure and 100 ms of interval--and were required to read them silently. Upon hearing a beep, subjects were to speak aloud the pair which immediately preceded the beep. There were 24 cued (via the beep) word pairs. From these, 8 were target word pairs aimed at eliciting the spoonerism errors, and 16 were filler pairs aimed at disguising the targets. Subjects were expected to speak aloud 24 pairs of words, making 8 spoonerism errors and pronouncing correctly the remaining 16 pairs of words. The measure of fluency in this task was the total number of spoonerism errors the subject made.

Spoonerism errors were induced by provoking a predisposition toward it. This was done by presenting three phonological interference word-pairs immediately before the target word pair. The phonological interference word pairs were similar to the spoonerism expected, therefore biasing the pronunciation of the target word pair. Thus, for instance, subjects were presented with the following pairs of words (one at a time):

sea ships

seek sheeps

see shears

she sees

<beep>

On hearing the beep subjects were expected to say "sea shees" instead of "she sees", as the s/sh phoneme pattern in the beginning of words was established by the three phonological interference pairs.

To ensure that subjects would attend to all word pairs, the beep only sounded 500 ms after the removal of the to-be-spoken pair from the computer screen, entering 400 ms into the 900 ms presentation of the next pair. This procedure did not allow subjects to perform the task by ignoring noncued pairs since they did not know when the beep would sound nor which pairs would be beeped.

Subjects were explicitly instructed to attend to each word pair and were also told that the beep would sound after the removal of the to-be-spoken pair (see Appendix H, item VII for instructions). All subjects' protocols were tape-recorded.

3.4 Pilot Study

The pilot study was carried out through the months of September-December 1994 and the two first weeks of March 1995. It was a lengthy pilot study of crucial importance for this research, since the final design of the experiments and the procedures resulted from successive attempts made during the pilot study. Among the contributions of the pilot study, the following stand as the most important ones:

(1) Selection of subjects: In the beginning of this research it had been decided that subjects would be selected both from the graduate and undergraduate courses of Letters/English at UFSC, the latter being in the 7th, 8th and 9th semesters. Contacting graduate students was a simple task compared to the difficulties encountered in making contacts with undergraduate students. As a result of visists to several classes, when students were invited to participate in the study, 15 undergraduate students from the various semesters and 10 graduate students volunteered. However, from talks with their teachers and informal questions asked related to their background in learning English as a L2, I found out there were huge differences in undergraduate students' competence that would interfere with their performance on the tests. This was corroborated by applying the experiments to 10 undergraduate students, whose difficulties with the language affected their performance on the tests. It would be necessary to find a way to control for the undergraduates' level of proficiency by means of tasks, which

they absolutely refused to perform. Thus, the undergraduate students were dismissed and 5 of the graduate students taking their MA in English language or literature participated in the pilot study. From their performance on the tests it was then decided that subjects for this study would be selected from the MA program. The two fundamental criteria for selection were that students be (1) native speakers of Portuguese and (2) involved in their MA dissertation project or in their actual MA dissertation research.

(2) The span tests: From the trials with graduate students a number of problems were detected as regards the design of the experiments. Firstly, neither in the Speaking Span nor in the Reading Span test does Daneman (1991) make it clear whether her subjects were required to produce sentences for each word in exactly the same order these words were presented (serial recall) or in any order (free recall). In Daneman and Carpenter (1980 and 1983), these theoreticians explicitly state that words should be recalled in the order they were presented. Nevertheless, in reviewing Daneman's procedures in the Reading Span test, Turner and Engle (1989) point out that she allows subjects to recall sentence-final words in any order. Similarly, Harrington and Sawyer (1993) seem to allow their subjects to recall target-words in any order. In the pilot study of this research it was observed that such a procedure was making the task less complex than it is assumed to be. In order to avoid this problem, at the end of the pilot study it was decided that in the span tests recall would be serial. Secondly, it could also be observed from the pilot study that subjects' processing of the sentences in the Reading Span tests should be made more rigorous. Merely asking them to try to comprehend the sentences did not seem to be a safe procedure. Thus it was decided to add a grammatical judgement task to the Reading Span test. Thirdly, the span tests in English were not initially included in this research. As a result of talks with colleagues and the advisor throughout the pilot study, it was decided that the span tests would also be carried out in English, since this seemed to be a more precise methodology for the objectives of this study, which could address other interesting issues besides. Thus, the span tests in English were devised and piloted only beginning March 1995 with those subjects who had been chosen to participate in the pilot study. None of these subjects were told they were pilot subjects.

(3) The fluency tasks: It had already been decided that the time allotted for subjects to perform the Speech Generation Task (SGT) would be 1m30s. The pilot study showed that this seemed to be sufficient for a one-picture description task. With respect to the Oral Slip Task, since Daneman (1991) does not provide an appendix for the experiments she reports, the pairs of words constituting this task had to be collected from Fromkin's Appendices for speech errors or devised by myself. The problem with speech errors is that it has to be ascertained that the error will be in accordance with morphological and phonological rules of the language, ie, the words constituting the speech errors have to be of possible occurrence in that language. It is for this reason that researchers in the area keep with them a notebook to collect actually made errors and use these in their studies. However, in Fromkin's Appendix of spoonerisms there are only a few examples, and for most of them it was difficult to find phonological interference pairs. Thus it was decided that these invented target word pairs aimed at causing the spoonerism in the OST would be kept.

(4) Number of sessions: The pilot study showed that the seven experiments could be carried out in two sessions. The first one consisted of the application of the span tests and lasted about 30 minutes. The second one consisted of the assessment of fluency and lasted about 15 minutes.

(5) Order of experiments: At the time of testing the design of the span tests in English as a L2, it was decided that the ones in Portuguese would be applied first, followed by the span tests in English. The reason for this decision was that since subjects also had to learn the task, i.e., the procedures to be followed in each experiment, the language in which they would perform the tests could be an obstacle in the very beginning. Applying the tests first in Portuguese, their native language, would make things easier for them as regards the steps to be followed in the tests. The pilot study showed that the order seemed to be a good one. It was established that the span tests would follow this order: (1) Speaking Span test in Portuguese; (2) Reading Span test in Portuguese; (3) Speaking Span test in English; (4) Reading Span test in English. With

regard to the fluency tasks these were applied in the following arbitrary order: (1) the SGT; (2) the ORT, (3) the OST.

(6) Instructions: Instructions given orally and by means of examples seemed to be enough for subjects' comprehension of the tasks. Thus it was established that training would be given only to those who felt it was necessary and would last until they felt confident enough to perform the task.

3.5 Procedures

The data was collected from each subject individually in two different sections. In the first section, the subject' s working memory capacity was assessed by means of the four span tasks. In the second, his/her L2 fluency was assessed by means of the other tasks. Subjects were contacted before-hand to schedule the first session. At the end of the first session of each subject, the second one was scheduled. The interval between one session and the other varied among subjects and depended on the time they had available. Instructions were given before the beginning of each experiment and these were applied in the order described above.

CHAPTER 4

RESULTS AND DISCUSSION

The data resulting from the application of the set of seven experiments were complex and non-systematic across tests. As previously stated, this study investigated the following set of hypotheses:

(1) Individuals with a larger working memory capacity as measured by the Speaking Test, in Portuguese and English, would be more fluent at generating speech, more fluent at reading aloud, and less prone to making spoonerisms in the L2.

(2) Speaking Span strict and Speaking Span lenient are sensitive to different aspects of L2 oral fluency: the former would correlate better with fluency in articulation of words, as measured by the Oral Reading Task and the Oral Slip Task, and the latter would correlate better with fluency in producing smooth, continuous, coherent and adequate speech, as assessed by the Speech Generation Task.

(3) The Reading Span Test, like the Speaking Span Test, would correlate with fluency in oral reading, but would not correlate with the other two non-reading related tasks.

Since the span tests were applied in both Portuguese and English it was possible to address two secondary questions in this study: (1) whether working memory capacity, as measured by the span tests, would be constant across the two languages, and (2) whether working memory capacity, as measured by the Speaking Span in the two languages would correlate with subjective ratings of fluency, in terms of richness of content.

The discussion of the results obtained in the current study will be presented as follows: section 4.1--the span tests; section 4.2--working memory capacity and speech generation; section 4.3--working memory capacity and oral reading, and section 4.4--working memory capacity and the Oral Slip Task.

4.1 The Span Tests

As Table I shows, the Means (M) and Standard Deviations (SD) of the span tests tended to be similar within tests, i.e. within the speaking span tests and the reading span tests, irrespective of language.

Table I - Mean Performance and Standard Deviations for Measures of Working Memory Capacity

	Mean	SD
Speaking Span Test in Portuguese (SSTP)-strict	21.5	2.7
Speaking Span Test in Portuguese (SSTP)-lenient	23.3	2.1
Speaking Span Test in English (SSTE)-strict	21.4	2.8
Speaking Span Test in English (SSTE)-lenient	23.4	3.5
Reading Span Test in Portuguese (RSTP)	27	4.7
Reading Span Test in English (RSTE)	24.1	5.1

However, as the results of Pearson Product Moment Correlation show in Table II, only the RST in Portuguese and English reached significant correlations-- [$r(16) = 0.78$, $p = 0.0003$]. No significant correlations were found between the SSTP and the SSTE or between the speaking and the reading span tests in either language.

Table II - Correlations among Measures of Working Memory Capacity

	SSTE strict	SSTE lenient	RSTE	RSTP
SSTP strict	0.20	0.16	0.16	0.09
SSTP lenient	0.11	0.27	0.36	0.27
RSTP	0.13	0.17	0.78*	----
RSTE	0.33	0.35	-----	0.78*

* $p < 0.01$

The speaking span (Daneman and Green, 1986) and the reading span (Daneman and Carpenter, 1980) tests are complex measures of working memory which require that the individual carry out a processing task while trying to maintain the to-be-remembered stimulus, thus taxing both the processing and storage functions of the system. As already observed in 2.5.1, individual differences in working memory capacity have been accounted for in terms of the task-specific view, the processing efficiency view and the activation view.

The task specific view sustains that individuals' working memory capacity is functional and varies according to the individual's efficiency in the specific processes demanded by the complex cognitive task in which performance is being predicted. It seems reasonable to argue that the results of the span tests carried out in the present study reflect the functional capacity of working memory in relation to the processing requirements made by the background task. Obviously, the background tasks of the speaking and reading span tests involve qualitatively different processes, the former demanding processing efficiency in language production, and the latter in language comprehension. Furthermore, the lack of a correlation between the SSTP and the SSTE might indicate that speaking in L1 and L2 require somewhat different processing, thus leading to a variation in subjects' working memory capacity in language production, as illustrated by Figures 1 and 2. In fact, the bilingual models of speech production proposed in the L2 literature (e.g. de Bot, 1992; Faerch and Kasper, 1983) differ in some aspects from a unilingual model like Levelt's (1989).

Figure 1-Subjects' performance on the SSTP and SSTE (strict scores)

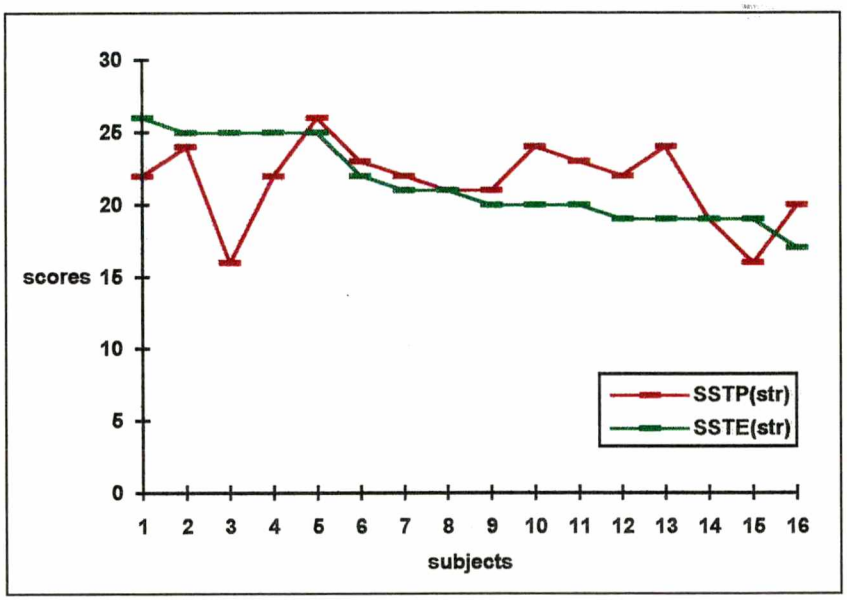


Figure 2-Subjects' performance on the SSTP and SSTE (lenient scores)

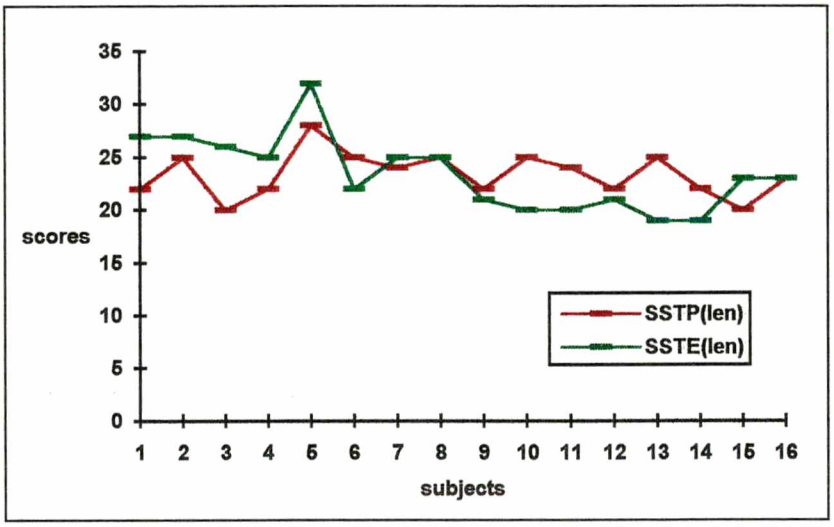
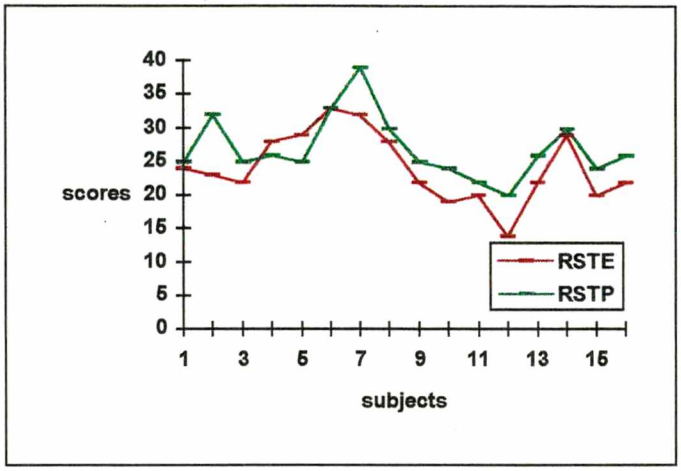


Figure 3-Subjects' performance on the RSTP and RSTE



Unlike language production, models of reading generally assume that there are no qualitative differences in reading in L1 and L2, which means that, in principle, the processes are the same. The significant correlation found between the RSTP and the RSTE corroborate the similar correlation obtained by Harrington and Sawyer (1993). Figure 3 illustrates, subject by subject, this high positive correlation, and shows that performance on the RSTP was better.

The idea that language production in L1 is qualitatively different from that in L2 is also corroborated by Krashen's (1982 and elsewhere) well-known acquisition/learning distinction.[10] While speaking in our L1 is a product of the acquisition process, speaking in a L2 is, to a great extent, an outcome of learning, a quite different process. Although the acquisition/learning distinction has been severely criticised, it seems to be in line with the procedural/declarative dichotomy sustained by neuropsychologists (see 2.2.3). The type of knowledge that results from the learning processes would be declarative, a conscious explicit knowledge. It seems reasonable to speculate that, due to the characteristics of L2 learning processes, speaking in

[10] Except where explicitly mentioned that it is Krashen's terminology that is being adopted, as is the case in section 4.1, the terms acquisition/learning have been used interchangeably in the present study.

the L2 for the subjects who took part in the present study, is at least partially a learned, rather than acquired, skill.

This distinction also seems useful to explain the significant correlation between the RSTP and the RSTE. Reading, unlike speaking, is a product of learning, be it in L1 or L2. One reason why no researcher has seriously proposed a bilingual model of reading is that individuals seem to apply their L1 reading processes even when the task is in L2.

4.2 Working Memory and Speech Generation

The results of the correlation between working memory capacity, as measured by the Speaking Span Tests (SST), in Portuguese (SSTP) and English (SSTE), and the Speech Generation Task, in which fluency was measured in terms of number of words produced, stand as the most important findings of the present study. As hypothesised, the SST correlated significantly with this L2 fluency task, but only the English version of the SST (see Table III). From the scores obtained, the SSTE strict correlated better with L2 fluency in the SGT, although the expectation was that the SSTE lenient would correlate better with fluency in this task [$r(16) = 0.64$, $p = 0.0073$, for the SSTE strict and the SGT; and $r(16) = 0.61$, $p = 0.0114$ for the SSTE lenient and the SGT].

Table III - Correlations among the Speaking Span Tests and the Speech Generation Task

	SSTP strict	SSTP lenient	SSTE strict	SSTE lenient
SGT	-0.08	-0.19	0.64*	0.61**

*$p < 0.01$

**$p < 0.05$

According to Daneman (1991) the SGT was included as a global measure of oral fluency because, to be performed, it requires skilful coordination of the processes involved in

the planning and execution of fluent speech. This coordination of the speech production processes is assumed to be carried out in working memory. As Daneman (ibid.) argues, the larger an individual's working memory capacity, as measured by the SST, the more fluent his speech will be, since his coordination of the speech production processes will also be more efficient. The significant correlation found between the SSTE strict and the SGT corroborates the results of Daneman's study, in which she found a significant correlation between individuals' working memory capacity and L1 oral fluency. However, as already noted, in Daneman's study SST lenient was a more powerful predictor of fluency in the SGT than SST strict.

In the theory of working memory adopted within the psychometric correlational approach, and thus in the present study, working memory is conceptualised as a single central system (Daneman 1991; Daneman and Green, 1986) in charge of the processing and temporary storage of information during complex cognitive tasks. Researchers in the psychometric correlational approach are primarily concerned with what Baddeley (1990 and elsewhere) calls the *central executive* and assume no other processing components within this system. Thus, in relating the processes of speech production as Levelt conceptualises them (see chapter 2) to this theory of working memory, it seems reasonable to suggest that the whole process takes place within this single central system, with no particular peripheral components being responsible for specific processes.

Daneman and Carpenter (1980,1983) proposed that the two functions of working memory, i.e., the storage and processing functions, compete for the limited capacity of the system, which acts as an arena for the execution of processes and for the storage of the intermediate products of these processes. Hence, when the individual is engaged in a complex task such as speaking, the capacity of the system is being shared by both conceptual and linguistic processing demands as well as by storage demands. For each of the processes of speech production there is an intermediate outcome that must be temporarily stored.

Working memory is in charge of all the mental processes involved in speaking--from intention to the construction of internal speech. The system resources are shared between the execution of processes--establishment of a communicative intention, conceptualisation of the message, formulation of the message through grammatical and phonological encoding--and the storage of the products of these processes--the preverbal message (or conceptual structure), the surface structure (result of grammatical encoding), the phonetic plan of the message (or internal speech). The two speech production processes which are assumed to make the greatest demands on working memory are the establishment of a communicative intention and the conceptualisation of the message, for these two processes, which can hardly be separated, require that the speaker consider aspects of the context in which he is involved as being determinant of the kind of talk he/she will produce. Another extremely demanding process is the monitoring of one's own speech, whether as a phonetic plan or as overt speech (Levelt, 1989).

In addition to these higher-level conceptual processes, there are specific linguistic processes, which also compete for working memory processing and storage capacity. These are assumed to be highly automatic in L1, and for this reason, do not make great demands on the system and thus occur in parallel. Fluent speech requires skilful coordination of all these processing and storage requirements. Thus, Daneman (1991) obtained a significant correlation between individuals' working memory capacity and the fluency with which they can speak. The reasoning underlying this finding is that individuals with a larger working memory capacity have more efficient processing skills in the task in question, i.e., fluent speech, thus leaving more of their working memory capacity for the storage of intermediate products of this processing and subsequent integration of information processed. Daneman and Carpenter (1983), Daneman and Green (1986) and Daneman (1991) have argued that working memory capacity is task-specific.

Recent research (e.g. Engle et al., 1992; Cantor and Engle, 1993) has disputed this view, however, and cognitive psychologists have yet to show with precision whether the nature

of working memory capacity is due to differences in processing efficiency of a particular task, in processing efficiency of related tasks, or whether it is a general capacity. The results of the present study tend to corroborate the task-specific view.

As illustrated in Table IV and supported by the lack of significant correlation obtained (see Table III), each subject's working memory capacity measures varied from one test to another. It seems reasonable to suggest that, at least for speaking, the factor determining different results in two similar tests was the language--speaking different languages imposes different processing and storage demands on the system. The assumption that speaking in different languages involves somewhat different processing and storage requirements is supported by the literature on fluent L2 speech production (see de Bot, 1992, e.g.).

Table IV - Subjects' Performance on the Speaking Span Tests (strict and lenient scores)[11]

SUBJECTS	SSTP strict	SSTP lenient	SSTE strict	SSTE lenient
1	22	22	26	27
2	24	25	25	27
3	16	20	25	26
4	22	22	25	25
5	26	28	25	32
6	23	25	22	22
7	22	24	21	25
8	21	25	21	25
9	21	22	20	21
10	24	25	20	20
11	23	24	20	20
12	22	22	19	21
13	24	25	19	19
14	19	22	19	19
15	16	20	19	23
16	20	23	17	23

It can be assumed that Levelt's model was proposed primarily for the unilingual speaker since the author makes only modest references to bilinguals. Nevertheless, in view of the

[11]Subjects' lenient scores were entered by adding the words they recalled in their exact form of presentation to the words they recalled in a modified form. Thus, for instance, if a subject's strict and lenient scores were 16 and 20, respectively, this means that he/she recalled 16 words in their exact form of presentation and 4 in a modified form. When a subject's strict and lenient scores match, this means that he/she recalled all words in their exact form of presentation.

tremendous explanatory power of the model, de Bot (1992) has proposed an adaptation of the model for the bilingual speaker, which is useful in explaining how L2 speech production might take place. In the case of the present research, it casts some light on how working memory capacity might be involved in this production.[12]

The first modification de Bot (ibid.) makes in Levelt's original model in order to adapt it to L2 speech production concerns the *Conceptualizer*, which Levelt assumes is completely language-specific. De Bot proposes, instead of considering the Conceptualizer to be completely language-specific, to consider macroplanning--establishing goals and subgoals--to be language-independent, and microplanning--giving structure to the content of goal and subgoals--to be language-specific. This modification seems reasonable, since it is in the microplanning stage that the speaker might be faced with conceptual decisions such as spatial and temporal reference, where the options are different for different languages. Thus, one of the main differences between speaking in L1 or L2 is that when speaking in the latter, if the individual has organised his thoughts according to the way concepts are expressed in L1, he might have problems in expressing a particular concept for which the L2 does not have the lexical items or whose lexical items the speaker can not access. A native speaker is not normally faced with this difficulty. Problems in the conceptualisation of the message in L2 will lead to problems in the formulator when the speaker gets involved in grammatical encoding, whose first step is accessing the specific lexical items to realise the message.

With regard to the formulator, de Bot's proposal is similar to Levelt's in including a separate component for each language. One of the crucial aspects of Levelt's model is the connection between meaning and syntactic information. For Levelt, the speaker first accesses meaning and, based on his/her lexical choices, applies syntactic procedures which are defined by the grammatical specifications of the lexical item in the lemma. Such an assumption poses a

[12]The present researcher is fully aware of the many different ways in which the term 'bilingual' has been defined and used in the literature. For the purpose of this study 'bilingual' means the speaker of a L2 independent of the context of acquisition and use of this L2 and level of proficiency.

relevant question within L2 studies related to the form in which our L2 mental lexicon is organised.

Based on neurolinguistic research, Paradis (1985) claims that bilinguals have one conceptual store and two distinct semantic stores which are differentially connected to the conceptual store. This store, which corresponds to our experiential and conceptual information, contains mental representations of things, events, properties and qualities of objects, and our knowledge of the world. The lexical items representing these concepts are stored separately for each language. Many theoreticians (Grosjean, 1982; Poulisse, 1993; de Bot, Cox, Ralston, Schaufeli, and Weltens, 1995) seem to side with the view that bilinguals have one conceptual store and separate lexical stores for each language.

Having separate lexical stores implies having separate formulators as well. As explained in 2.8, it is in the formulator that both grammatical and phonological encoding take place. De Bot proposes that the bilingual speaker might have separate storages for those language-specific sounds. The articulator, in turn, is assumed to be one and the same for both languages.

The point in giving an outline of how speech production in L1 and L2 occurs is that speaking seems to differ in terms of processing when languages differ. If speaking in different languages entails different processing, then it seems reasonable to assume that an individual's working memory capacity will vary according to the language being spoken. As Turner and Engle (1989) point out, Daneman and colleagues argue that the working memory capacity span measure--the span test--is dependent on the background task carried out while the span is being measured. This background task must include the processing of the task whose performance the span measure will predict. In other words, if the span measure predicts performance in speaking in English as a L2, the background task (the processing part of the test) must be an activity involving speaking in English. Thus, in principle there seems to be no reason why individuals' working memory capacity as measured by the SSTP (strict or lenient)

should be related to their fluency in English, since this test is taxing working memory storage capacity under Portuguese language production processing constraints, a process different from the production of language in English.

As stated above, it was hypothesised, based on Daneman's (1991) L1 findings, that the lenient score of the SST would correlate better with fluency in the SGT since this task allowed subjects to produce speech in a creative, semantically rich way. This prediciton was not born out for the L2. As Table III shows (p.71), the magnitude of the correlation for the SSTE strict was higher than that for the SSTE lenient.

It is not easy to explain these results in face of the their complexity and the lack of literature addressing the topic. However, some speculation might be allowed. Daneman's finding that the lenient score was a better predictor of L1 fluency seems to reflect the assumption that when presented with the to-be-remembered word, subjects are more inclined to think of the meaning of this word and of the semantic context in which this word may appear in a sentence than to think of the form of this word. Thus, it is possible that when performing the SST in their native language, subjects are more concerned with making a sentence in which content is the most important aspect and, to conform to this, the word might be slightly modified so that meaning can be better expressed. On the other hand, in the L2, especially if it was learned in the classroom, where they are likely to have been trained in manipulating language, subjects may be inclined to think first of the form in which the word was presented--which restricts its grammatical environment--and then of a possible sentence in which that word could appear. While thinking of the form in which the word was presented it is possible that subjects become engaged in some type of rehearsal, which would enable them to keep an exact representation of that word in working memory.

In summary, the significant correlations found between the SSTE and the SGT were explained in terms of the task-specific view. In the case of the present study, some individuals have more efficient processing skills for L2 production than others, thus leaving a greater part

of their working memory capacity for storage. Their L2 speech production processing efficiency is evident in their performance on the SGT--they were more able to coordinate the planning and execution processes involved in L2 production, which resulted in L2 speech characterised as smooth, continuous, with few perceptible pauses and hesitations, and adequate to the context, as shown by the measure of fluency--number of words produced in the allotted time. Subjects with inefficient processes allocate more of their available capacity to processing, thus leaving less for storage of the to-be-remembered words in their exact form of presentation.

One possible reason these subjects have efficient processing skills in the L2 might be the degree of automaticity of their L2 production processes. In his proposed blueprint for the speech production process (see 2.8), Levelt (1989) assumes that most of the processes involved in speech production take place in parallel incremental fashion, which requires that certain processes be automatic. It is well accepted in the cognitive literature that, because humans are limited-capacity processors, some aspects of the cognitive tasks they are involved in have to be highly automatized so that they can attend to those more complex aspects of the task (McLaughlin, 1987, 1990). The limited capacity of our working memory requires that only some aspects of the task we are engaged in be attended to at a time. These aspects are carried out by means of controlled processes.

The dichotomy between controlled and automatic processes--a classical one within cognitive psychology--is fundamental to the understanding of human cognitive behaviour. Shiffrin and Dumais (1981) state that all complex skills involve a mixture of controlled and automatic processes. Automatic processes do not demand processing resources, thus freeing the cognitive system to the more complex, higher-level processing of the task. Because they do not share cognitive resources, automatic processes are highly efficient and can be carried out in parallel. Controlled processes, on the other hand, are assumed to make great demands on the capacity of the system.

Levelt proposes that the aspects of speaking that require the most attention are the establishment of a communicative intention and the conceptualisation of the message. In other words, when we speak, our attentional resources are focusing on what we want to say. Everytime we speak we first have to conceive a message, and it is unlikely that we have stored in our long-term memory a package of intentions. Thus speaking involves an activity of genesis: we create a communicative intention and to realise this intention we have to find an effective means of expression, bearing in mind that we have to be coherent, that we have to develop a chain of thought, that we have to give relevant information, and that the context requires certain social procedures which affect the whole message construction. Another aspect that requires our attentional resource is monitoring, which happens only if the speaker is aware of what he/she is saying and how he/she is saying it.

Levelt is careful to say, however, that even within conceptualisation some aspects are automatized. The adult speaker has such an extensive experience with speaking that many conversational skills are automatized; i.e. packages of ready-made messages or formulaic language are available. The other components of the model proposed by Levelt are assumed to require mostly automatic processing. Formulating the message and articulating it demand very few, if any, controlled processes. This seems to be a plausible statement if we consider that the number of speech errors the average speaker makes is nothing compared to the amount of processing he/she carries out everytime he/she speaks.

Researchers (e.g. Gatbonton and Segalowitz,1988; Crookes, 1990; Schmidt, 1992 and 1994; de Bot, 1992; McLaughlin, 1987 and 1990, Paradis, 1985 and 1994, among others) agree that L2 fluency, as fluency in L1, requires a great degree of automaticity, especially in the grammatical and phonological aspects. Such automaticity is necessary in order to free the attentional resources to focus on those more demanding aspects of the task, which Levelt (1989) considers to be the establishment of a communicative intention and the conceptualisation of the message. De Bot (1992) poses that it is in the formulator, where the grammatical and phonological encoding take place, that L2 speakers might face the greatest

difficulties, ranging from access of the right lexical items to the application of syntactic and morphophonological rules. A consequence of lack of automaticity in L2 speech production is slower speech rate and probably less creative speech, as they cannot pay as much attention to conceptualization.

One might argue that the point being raised here is that it is degree of proficiency, and not necessarily system capacity problems, that is causing individuals' less fluent production. Indeed, one of the most important questions the research within the psychometric correlational approach has not yet solved is whether working memory capacity is dependent on the degree of proficiency the individual has in the task in which this capacity is predicting performance. This problem is even more serious when the complex cognitive task is performed in a L2. Despite all the effort made to diminish differences in subjects' level of proficiency in this study, it is not possible to deny the fact that degree of proficiency is an intervening variable in the results of the present study.

It is necessary to mention at this point that while the task-specific view as suggested by Daneman and colleagues (1980 and elsewhere) is a plausible way of explaining the results of the correlations obtained between the SSTE and the SGT, it does not allow us to speculate on the origin of the efficiency of individuals with a larger working memory capacity, since the background task of the span test is dependent on the main complex task, making apparent a problem of circularity.

According to the task-specific view, individuals have a larger or smaller working memory capacity due to the degree of their task-specific processing efficiency. However, following this reasoning it is impossible to know what has come first--capacity or processing efficiency. If capacity evolves from the individual's efficiency in the task, then it is a function of proficiency, and thus capable of being developed. As pointed out in 2.5.1, Cantor et al (1992) have proposed a General Capacity Model of working memory in which they argue for a single unitary resource, independent of the task being performed. However, their hypothesis

has been tested only within language comprehension. Furthermore, there have been no longitudinal studies, to my knowledge, to verify whether working memory capacity increases as a function of proficiency or whether it is a general capacity constant across different complex tasks. The significant correlation found between working memory capacity as measured by the SSTE and the SGT validates the speaking span test as an instrument to assess working memory during speech production and corroborates the findings of research in L2 fluency at the same time. As seen in chapter 2, Lennon (1990), Riggenbach (1991) and Ejzenberg (1995) all reported finding speech rate as measured by words or morphemes produced per minute to be a significant distinctive variable between more (+) and less (-) fluent nonnative speakers. In the present study the main measure of L2 fluency was the number of words produced in the time allotted --1m30s. As observed, more fluent speakers produced more words than less fluent speakers.

As explained in 3.3.3 subjects' oral protocols were submitted to two independent judges to rate their fluency in terms of richness and originality of content on a 5-point scale (1 for repetitious, semantically empty speech and 5 for creative, semantically rich speech). The judges' evaluation was used to check whether working memory capacity would correlate with subjective measures of fluency. Table V shows, for each subject, number of words produced in the SGT and the subjective measures .

Table V - Subjects' performance on the SGT and subjective rating of fluency

Subject	SGT	Judge 1	Judge 2	Average
1	223	5	5	5
2	195	5	5	5
3	225	4	4	4
4	203	5	5	5
5	180	4	3.5	3.75
6	150	5	4.5	4.75
7	170	3	3	3
8	152	4	4.5	4.25
9	128	3	3	3
10	155	3	3	3
11	100	4	4	4
12	194	4	4.5	4.25
13	121	3	3	3

14	149	4	4	4
15	124	3	3	3
16	184	5	4.5	4.75

Since these measures are subjective, the average rating of the two judges was used to enter subjects' results. Working memory capacity, as measured by the SSTE, did not reach significant correlations with the SGT as measured by subjective ratings [r (16) = 0.42, p= 0.1018, for the SSTE strict and the subjective measures, and r (16) = 0.35, p = 0.1895, for the SSTE lenient and the subjective measures]. However, when the results of subject 16 (see Table IV) are taken out, the correlation between the SSTE (strict) and the subjective measures of the two judges reaches significance--[r (15) = 0.60, p = 0.0173]. This subject performed poorly in the SSTE but had good performance on the SGT, in both the word count and subjective measures.[13] Again, contrary to what was hypothesised, the better predictor of fluency was the strict score. There is no significant correlation between the SSTE lenient and subjective measures of L2 fluency.

Another interesting finding of this study is the significant correlation found between number of words produced in the SGT--the main measure of L2 fluency--and the subjective ratings r (16) = 0.54, p = 0.0305]. This result might indicate that number of words produced--which reflects the contrast between sound and silence--seems to be taken into consideration when non-trained listeners evaluate L2 fluency on the basis of intuition. Thus, once again, number of words stands as a significant variable in the evaluation of nonnative fluency.

4.3 Working Memory and Fluency in L2 Oral Reading

Following Daneman (1991), the oral reading task (ORT) was included in this study primarily in order to assess fluency in articulation of words, a process necessary for language

[13]It is out of the scope of this study to speculate on the reasons why subject 16 had poor performance on the SSTE. In principle, it could have been for a number of reasons, from anxiety due to the "test" characteristic of the experiment to tiredness and personal memory problems.

production. The objective of the task was not to evaluate L2 reading comprehension. Nevertheless, it is likely that an individual, when engaged in an oral reading task, is also carrying out reading comprehension processes of the content of the reading passage. For this reason an index of working memory capacity during language comprehension was also included, that is, the Reading Span Test (RST), which was applied both in Portuguese (RSTP) and in English (RSTE).

It was hypothesised that individuals with a larger working memory capacity would be more fluent in the ORT, thus taking less time to read the whole passage. The prediction was that both the reading and speaking spans, in both languages, would be related to fluency in L2 oral reading, as measured by the time (in milliseconds) each individual took to read the passage, but that the measures of working memory during language production--the SSTP and the SSTE--would be better predictors of fluency in this task, since reading aloud requires the involvement of the speech production processes. It was also expected that the RST would not correlate with the non-reading-related tasks.

The hypothesis was not confirmed. As already noted, the SST in Portuguese did not correlate with any L2 fluency task. The SST in English correlated significantly only with the SGT. Individuals' working memory capacity as measured by the SSTE did not correlate with fluency as measured by the ORT. Nevertheless, individuals' working memory capacity as measured by the RSTE and the RSTP correlated significantly with the ORT [$r(16) = -0.51$, $p = 0.0455$, for the RSTE and ORT, and $r(16) = -0.55$, $p = 0.0263$, for the RSTP and the ORT].[14]

These results were unexpected, and it is outside of the scope of the present research to speculate in detail on the reasons why the reading span and not the speaking span correlated with the ORT, since this study is concerned with L2 oral fluency. However, a few words seem in order.

[14]Shorter reading times in the ORT mean more fluent oral reading, thus the negative correlations.

As mentioned in Chapter 2, the reading span has been extensively used by researchers as an index to measure working memory capacity during language comprehension. There has been a massive amount of research accumulating in the psychometric correlational approach providing evidence that this test is a good predictor of performance on reading comprehension tasks. However, in these studies the results of subjects' performance on the RST are correlated with measures of specific subskills of reading comprehension, such as making inferences (Mason and Miller, 1983), perceiving inconsistencies in sentences with homonyms (Daneman and Carpenter, 1983), using contextual cues to infer the meaning of new words in a text (Daneman and Green, 1986), to mention only a few.

In the present study, no measures of reading comprehension were applied, but it seems reasonable to suggest that these particular subjects were applying comprehension processes to which the RST was sensitive. If that is true, then it seems also reasonable to suggest that the speed of their oral reading was constrained by reading comprehension processes. In the case of the present results, it seems that subjects were attempting to comprehend in order to read aloud. In fact, it is necessary to have some comprehension of the passage in order to make appropriate pauses and use appropriate intonation while reading aloud. The only reason I see for these subjects to have had their reading time constrained by their reading comprehension processes to such a degree that the SSTE was not sensitive to their L2 oral fluency is the fact that the reading passage chosen for the experiment was not an appropriate one (see Appendix F, for passage).

As explained in Chapter 3, it was intended in the present research to keep as close as possible to Daneman's (1991) methodology, making adaptations only where judged extremely necessary, either because the focus was on L2 or because of research conditions. Thus, in order to avoid unnecessary changes, an attempt was made to maintain the same text Daneman used in her experiments, based on the information she gives. Although she does not clearly refer to the page from which the passage was taken, she does say that it was from *The Great*

Gatsby and makes reference to a line of the passage. Searching for this line in the book, it was possible to find the passage which contained it and thus include it in this study. However, the passage is decontextualized in the sense that it was taken from the middle of a chapter, it does not have the pattern of a common reading passage, i.e, beginning, middle and end, and the vocabulary is characteristic of literature. The strangeness of the passage might have activated higher-level reading comprehension processes in subjects which could be captured by the RST.

An interesting aspect of the results of the correlation between working memory capacity and the ORT was that the RST both in Portuguese and English correlated significantly with this task. These results are in line with previous findings of significant correlations between working memory capacity for reading in L1 and for reading in L2 (Harrington and Sawyer, 1993). As is well-known, models of reading generally assume that there are no qualitative differences in reading in L1 and L2. That is not true for language production, since researchers have argued for bilingual models of speech production, emphasising that the processes are qualitatively different.

4.4 Working Memory Capacity and Spoonerisms

Finally, the last set of experiments of the present study consisted of correlating working memory capacity with speech errors. Following Daneman (1991), the Oral Slip Task was used in this study to elicit spoonerisms in an artificial context. A spoonerism is a type of speech error which consists of the exchange of phonemes in adjacent or near-adjacent syllables or words (Motley, Baars, and Camden, 1983). The OST assesses fluency in the articulation of individual words. The hypothesis was that individuals with a larger working memory capacity, as measured by the SST, would be less prone to making spoonerisms in the L2.

No significant correlations were found between individuals' working memory capacity and L2 speech errors in either form of the SST. These results will be explained in terms of a methodological failure.

The OST utilised by Daneman (1991) was an adaptation of a technique provided by Baars et al (1975) to elicit speech errors in the laboratory, the SLIP (Spoonerisms of Laboratory Induced Predisposition) paradigm. Baars and colleagues have extensively used the SLIP technique to evaluate frequency and type of spoonerisms, and the consistency of their findings has led them to classify the SLIP technique as "robust" (Motley, Baars, and Camdem, 1983). However, Sinsabaugh and Fox (1986) point out that in reviewing relevant literature on spoonerisms, they found no published replication of the SLIP paradigm, with the exception of the one produced by Baars and colleagues themselves. Sinsabaugh and Fox (ibid.) utilised the Baars et al paradigm in an attempt to elicit spoonerisms in the laboratory and found that the kinds of error that occur are resultant of memory confusions rather than the elicitation of real spoonerisms.

The design of the OST task used in the present study is basically the same as that used by Daneman (1991) and by Sinsabaugh and Fox (1986), which in turn are similar to the original SLIP paradigm. The differences between the OST of the present study and the others is that the word pairs of the test are in the L2 and the total number of word-pairs included was smaller. The results of the present study are in line with the L1 results obtained by Sinsabaugh and Fox (1986), who report that spoonerisms were only a small fraction of the errors their subjects made. Much more common were errors involving no spoken responses, responses that were phonetically unrelated to any beeped word pairs, and responses that were phonetically unrelated to the target-word pairs, among others. In the present study the most common type of error made was no spoken response.

However, even when analysing the spoonerisms subjects made and entering their results in the computer for statistical computations, another problem arises. There is no adequate way of making a distinction between spoonerisms and other types of errors. For example, if only spoonerism errors are counted, a subject who spoke aloud all beeped word pairs and made, say, one spoonerism error out of eight, will obtain a lower score than a subject

who made no spoonerism errors but responded to only a few beeped word pairs. On the other hand, if all errors are counted, the test is no longer a test of spoonerisms, but of something entirely different.

Interestingly, when all types of errors, including spoonerisms, other speech errors, and no spoken responses, are indistinctly entered for statistical computation, a significant correlation between the SSTE strict and the OST is obtained [r (16) = -0.58, p= 0.0182]. That is, individuals with a larger working memory capacity, as measured by the SSTE strict perform better on the OST. It is not possible to say from these results, though, that these individuals are less prone to making spoonerisms. Indeed, individuals with larger working memory spans tended to respond to all beeped word pairs, without a miss, in addition to producing the word pairs correctly. Individuals with smaller spans, although often making no spoonerism errors either, tended to give no spoken responses for some of the beeped pairs or give other words as responses. Thus, it seems that working memory capacity is playing a role in the performance of the task--which may somehow measure English articulation ability--although it is not possible to comment on the role of this system in the production of spoonerisms, due to the methodological problem described.

CHAPTER 5

FINAL REMARKS

5.1 Concluding Statements

The purpose of the present study was to verify whether there was a correlation between individuals' working memory capacity and their fluency in English as a L2. In order to investigate this issue, a set of seven experiments was carried out, four aiming at assessing working memory capacity--a Speaking Span Test in Portuguese, a Speaking Span Test in English, a Reading Span Test in Portuguese, and a Reading Span Test in English--and three aiming at assessing L2 fluency--a Speech Generation Task, an Oral Reading Task, and an Oral Slip Task.

Following Daneman (1991), on which the present study was theoretically and methodologically based, the following set of hypotheses was considered: (1) Individuals with a larger working memory capacity, as measured by the Speaking Span Test in Portuguese and English, would be more fluent at generating speech, more fluent at reading aloud, and less prone to making spoonerisms in the L2; (2) Speaking Span strict and Speaking Span lenient, are sensitive to different aspects of L2 oral fluency: the former would correlate better with fluency in articulating words, as assessed by the Oral Reading Task and the Oral Slip Task, and the latter with fluency in producing smooth, continuous, coherent and creative speech, as assessed by the Speech Generation Task, and (3) the Reading Span Test, in Portuguese and English, like the Speaking Span Test, would correlate with L2 oral reading, but would not correlate with the other two non-reading related tasks.

Since the span tests were applied in both Portuguese and English, it was possible to pursue two secondary questions in this study: (1) whether working memory capacity, as measured by the span tests, would be constant across the two languages, and (2) whether

working memory capacity, as measured by the Speaking Span, would correlate with subjective ratings of fluency.

The results obtained in the present study were complex and unsystematic. Hypothesis 1 was only partially confirmed. Results of the experiments demonstrated that individuals with a larger working memory capacity, as measured by the Speaking Span Test in English only, were more fluent at generating speech in the L2. Contrary to what was expected, no significant correlation was found between the Speaking Span Test, in Portuguese or English, and the L2 Oral Reading Task. As regards the Oral Slip Task, subjects' results were affected by a methodological problem in entering results for statistical computations, the impossibility of adequately distinguishing between spoonerism errors and other kinds of error (non responses or responses other than the expected). However, when all errors were entered indistinguishably, a significant negative correlation was obtained between working memory capacity, as measured by the Speaking Span Test in English only, and number of errors in this task. In summary, individuals' working memory capacity as measured by the Speaking Span Test in Portuguese did not correlate with individuals' L2 fluency, contrary to what was hypothesised. Their working memory capacity, as measured by the Speaking Span Test in English, was significantly correlated with the Speech Generation Task and with the Oral Slip Task when subjects' overall performance on the task is considered.

These results, i.e., the fact that working memory capacity during language production , as measured by the span task in English and not in Portuguese, reached a significant correlation only with fluent L2 speech generation, were explained in terms of the task-specific view of working memory capacity (Daneman and Carpenter, 1980 and 1983; Daneman and Green, 1986, Daneman, 1991). This view poses that working memory capacity is functional and varies with the processing characteristics of the task being performed--individual differences in working memory capacity are driven by differences among individuals in their processing skills of the task in question. Speaking in Portuguese, subjects' native language, and in English, the L2 in focus, require somewhat different processing activities, being in fact, two different tasks.

Therefore, there is no reason for subjects' working memory capacity, as measured by the Speaking Span Test in Portuguese, to correlate with their fluency in L2 since this capacity is functional to Portuguese language production. The task-specific view is corroborated by the fact that individuals' working memory capacity varied across the two languages, answering thus the first secondary question of this study.

It was expected that individuals' working memory capacity, as measured by the Speaking Span Test, would correlate with their fluency in L2 oral reading. Again, results did not confirm the hypothesis. Neither version of the Speaking Span Test correlated significantly with L2 oral reading fluency.

With respect to hypothesis 2, contrary to what was expected, it was the strict score of the Speaking Span Test in English, and not the lenient one, which correlated better with the L2 fluency task (the Speech Generation Task). The same is true for the Oral Slip task, when all subjects errors are considered.

The results mentioned above with regard to the Speaking Span Tests and the Oral Reading Task, in addition to the fact that there was a significant correlation between individuals' working memory capacity for language comprehension and the L2 oral reading task partially confirmed hypothesis 3. Subjects' working memory capacity, as measured by the Reading Span Test in Portuguese and English, correlated significantly with fluency in oral reading, measured in terms of the time each subject took to read the passage (in seconds). These results were explained by arguing that subjects might have applied higher-level reading comprehension processes for which the Reading Span Test was sensitive. Such processes might have constrained the time subjects took to read the passage. The fact that both versions of the Reading Span Test reached a significant correlation with L2 oral reading corroborate previous findings by Harrington and Sawyer (1993) of correlations between working memory capacity and L2 reading comprehension.

As already observed, the Oral Slip Task suffered a methodological flaw in terms of the way subjects' results could be entered for statistical computations since it was impossible to distinguish between spoonerism errors, for which the task was intended, and other kinds of error. Previous criticism of the Oral Slip Task as designed by Motley, Baars, and Camdem (1983) has been already made in relation to the fact that this task, although aimed at eliciting spoonerisms in the laboratory, does not really reach its objectives, with spoonerisms being only a fraction of the types of errors subjects make during performance. Nevertheless, when subjects' errors of all types were entered for statistical computations, a significant correlation was obtained between working memory capacity, as assessed by the Speaking Span Test in English, and the Oral Slip Task. Individuals with a larger working memory capacity not only did not make spoonerism errors, but also managed to respond to all beeped word pairs correctly, which indicates that these individuals were able to maintain in their working memory a mental representation of the word pairs in their exact form of presentation and to articulate them correctly.

In relation to the last secondary question the present study pursued, working memory capacity did not reach a significant correlation with subjective measures of fluency, in this case, richness of content. However, when the results of subject 16 are taken out, the correlation reaches significance, which might indicate that it is possible, with future research, to investigate working memory capacity and more global and subjective measures of L2 fluency.

5.2 Limitations of the Study and Suggestions for Further Research

The present study is, to my knowledge, the first one to investigate the relationship between working memory capacity and fluent L2 speech production. It was theoretically and methodologically based on a previous study carried out by Daneman (1991), which aimed at verifying the extent to which the Speaking Span Test, an instrument which had been proposed by Daneman and Green (1986) as a measure of working memory capacity during L1

production, could predict L1 fluency. Being tentative and exploratory in nature, a number of difficulties were encountered throughout the research in both the theoretical and practical aspects. Next I present the limitations of this study and make suggestions for future research.

(1) Assessment of fluency (a): In the present study fluency was assessed by picture description, a task aimed at engaging subjects in the generation of speech in a more realistic situation of actual speech production. However, as Ejzenberg (1995) has suggested, picture description is a highly pre-structured task in the sense that the speaker has available the necessary cues for him/her to produce his speech and knows that the listener can predict much of what is going to be said. It would be interesting to verify the correlation between working memory capacity and L2 fluency as assessed by the construction of narratives, which, as Goldman-Eisler (1968) has suggested, is a more cognitively demanding task.

(2) Assessment of fluency (b): One important aspect in the assessment of fluency is the communicative aspect of the task. In the case of the present study, which was an experimental one, picture description suffered a lack of communicative purpose, since the listener (the experimenter) already knew the information which would be provided. It is possible that subjects avoided describing or commenting on the picture in more detail simply because they knew the listener did not need this kind of information, hence affecting the number of words spoken. It would be interesting to verify the correlation between working memory capacity and L2 fluency in more interactive tasks, such as dialogues. In such tasks it is possible to involve the subject in topics that are relevant to him/her, thus providing a communicative situation where the intention to speak is closer to realistic contexts.

(3) Assessment of fluency (c): As Riggenbach (1991) and Ejzenberg (1995) have suggested, L2 fluency seems to be sensitive to context. It would be interesting to verify the correlation between working memory capacity and individuals' L2 fluency as assessed in different contexts, such as in a relaxing conversational setting where only peers are involved as opposed to a more academic one in which the conversation is between peers and a professor. By

gathering data from the same speakers producing L2 speech in different conversational contexts, it would be possible to verify whether individuals with larger working memory capacities maintain their level of L2 fluency across tasks.

(4) Measures of fluency (a): In the present study fluency was measured only by number of words produced in the time allotted. Further research might investigate the correlation between working memory capacity and L2 fluency as measured by other variables such as those of hesitation phenomena--filled pauses and unfilled pauses, filled and unfilled pauses per T-unit, restarts, and repetitions for purposes other than rhetoric.

(5) Measure of fluency (b): The above mentioned measures of fluency are all considered to be quantitative ones. Although these variables seem to be easily perceived and taken into consideration in the judgement of L2 fluency, one important aspect of L2 fluency seems to be the quality of the speech being produced as regards the information being given. Further research might provide reliable instruments to measure L2 fluency by means of more qualitative variables.

(6) Fluency in L2 Oral Reading: The results of the present study showed that the Speaking Span Test did not correlate with L2 fluency in oral reading. It would be interesting to carry out these two experiments again, with a few necessary modifications to investigate the relationship between working memory capacity and L2 oral reading. As already observed, the passage subjects were required to read aloud was inappropriately chosen, and because of its degree of difficulty subjects' reading time might have been constrained by higher-lever reading processes. Further research might show that, in fact, as Daneman (1991) argues, when reading aloud subjects are engaged in a process of speech production rather than one of reading comprehension.

(7) Fluency and proficiency: Ejzenberg (1995) argues that L2 oral fluency is one of the most powerful indicators of L2 proficiency. She has shown that there seems to be a linear

relationship between L2 fluency and proficiency level, which indicates that the higher the individual's level of proficiency, the greater his/her fluency. It would be interesting to verify whether those individuals with a larger working memory capacity, who are more fluent L2 speakers, are also more proficient overall in the L2. This kind of research would cast light on the ways L2 proficiency might be assessed, on the relationship between fluency and proficiency, and on the relationship between working memory capacity and level of proficiency.

(8) Working memory capacity and proficiency: As has been noticed, one problem the psychometric correlational approach seems to be avoiding is the one related to the degree of proficiency subjects have in the cognitive task being performed. It is not clear yet whether working memory capacity is a function of proficiency in the task being predicted. Further research examining L2 can verify this aspect more carefully by assessing individuals' working memory capacity during various moments of their L2 acquisitional process and then observing whether this capacity is held constant.

(9) Time pressure - In the present study time pressure was present in all experiments. In the speaking span tests and in the Oral Slip Task, stimuli presentation and interval were absolutely controlled; in the Oral Reading Task, fluency was assessed by the time each subject took to read the whole passage, and in the Speech Generation Task subjects had to organise their speech to be made in 1m30s sharp. With regard to the latter task, it was only at the end of the present study that it occurred to me that speech rate might be increased if the individual is under time constraints. Thus, in further research it might be more appropriate to investigate L2 fluency as measured by number of words produced without the intervening time pressure variable.

(10) Context of data collection: one important aspect of the present study is that data collection took place in a context far from being natural--a small room, with a few chairs, a tape recorder, and a computer, the experimenter and the subject, only--much in the way most

cognitive psychology research is done. It seems to be a challenge for researchers in this area to provide more naturalistic ways of gathering data without the negative influence of a laboratory, which makes the whole process of data collection seem to be that of a test in which individuals are being evaluated.

5.3 Why no Pedagogical Implications

It seems to be a shame for one to decide to dive down into the world of human cognition and come back to the surface without any answers to many of our everyday questions. From the very beginning I did not intend to provide pedagogical implications from the results of the present study, if not for other reasons, just because this study was too exploratory. Researchers investigating the role of working memory have shown that this limited capacity system is involved in the performance of cognitive tasks, language comprehension and reasoning (e.g. Baddeley, 1990) being the types of task most investigated. Daneman and Green (1986) showed that working memory was involved in lexical access during L1 production. Daneman (1991) expanded this study and showed that working memory was involved in the generation of L1 fluent speech production.

The present study adapted Daneman's (1991) methodology to verify whether working memory correlated with L2 fluency and the set of hypotheses made were only partially confirmed. Therefore, it is important to point out that the results of the present study are valid only for the 16 subjects who participated in it, under the conditions in which the data were collected.

It is clear that all we can do in the cognitive sciences is to build metaphors of the way the human cognitive system behaves. The working memory system is a beautiful and powerful metaphor for the way human beings coordinate the processing and maintenance of information during mental activity, and research in this area seems to be promising. Nevertheless, the level of sophistication of the instruments used to assess working memory capacity and performance

on complex cognitive tasks does not allow researchers to make any kind of generalisation--let alone suggestions for classroom practice--since these researchers, careful to the level of obsession with the method, have to decrease, as much as they can, the number of variables they are observing. Thus, it happens that when the subject steps into the laboratory, he/she is only a subject, with no history behind him/her.

This does not make this kind of research invalid, though. Experiments in the laboratory to study human cognition are artificial and lack *ecological validity*, as Neisser (1978) claimed, but at this moment in the development of cognitive science, they seem to be the most appropriate way to investigate this issue. With future research and effort it will be possible to build connections with the real world, everyday life and, hopefully, classroom practice .

Appendix A

Measure of working memory during language production
Speaking Span Test in Portuguese (SSTP)

(2)
direcao
materia
(2)
memoria
assalto
(3)
cerveja
exilado
arvores
(3)
galinha
decreto
estacao
(4)
natacao
cadeira
palhaco
estrela
(4)
bondade
teatral
suborno
caminho

(5)
besouro
policia
camisas
amizade
revista
(5)
beliche
viveiro
caderno
laranja
bordado
(6)
padaria
violino
leitura
tesouro
futebol
cozinha
(6)
estadio
grafica
perfume
aquario
redacao
lampada

Appendix B

Measure of working memory during language comprehension
Reading Span Test in Portuguese (RSTP)

(2)
A Paris Video Filmes esta lancando a nova versao de uma das mais belas historias femininas. (from *Corpo a Corpo,* July, 1994, no. 67 --16 words).

As pesquisas tem mostrado que o povo brasileiro esta insatisfeito com o governo. (from *Diario Caterinense*, September, 1994 --13 words).

(2)
Os adolescentes tentados a paquerar correm o risco de ir parar na cadeia nos Emirados Arabes Unidos. (from *Diario Catarinense*, September, 1994 --17 words)

O limao pode ser consumido in natura ou em forma de chas, adocado com mel. (from *Corpo a Corpo,* September, 1994, no. 69 -- 15 words)

(3)
Todos sabemos que o fumo e a bebida alcoolica sao extremamente prejudiciais a saude. (from *Boa Forma*, September, 1994, no. 9 --14 words)

A acne aparece quando os poros estao obstruidos pelo excesso de uma substancia chamada queratina. (from *Claudia*, July, 1994, no. 7 -- 15 words)

Uma casa moderna nao deixa a ecologia restrita apenas as plantinhas penduradas na varanda. (from *Claudia*, July 1994, no. 7 --14 words)

(3)
A Trilha Ecologia da Fundacao Indaialense de Cultura e uma oportunidade de lazer e entretenimento. (from *Diario Catarinense*, September, 1994 --15 words)

E preciso tomar muito cuidado ao comprar carne vermelha em acougues e supermercados. (from *Corpo a Corpo*, July, 1994, no.67 --13 words)

Quem tem tendencia ao inchaco precisa de produtos que melhorem a circulacao periferica e descongestionem os vasos. (from *Corpo a Corpo*, July, 1994, no. 67 --17 words)

(4)
O linho foi usado pela primeira vez na mumificacao de faraos egipcios ha cinco mil anos. (from *Manequim*, September, 1994, no. 89 --16 words)

Depois dos olhos, as sobrancelhas sao os mais importantes instrumentos de expressao. (from *Corpo a Corpo*, July, 1994, no. 67 --12 words)

Dizem que os japoneses sao inteligentes por consumirem grande quantidade de frutos do mar. (from *Boa Forma*, July, 1994, no. --14 words)

Ao escolher roupas para comprar, prefira aquelas mais faceis de lavar e passar. (from *Manequim*, September, 1994, no. 9 --13 words)

(4)
Os dias quentes da primavera ja tem animado o setor hoteleiro catarinense. (from *Diario Catarinense*, September, 1994 -- 12 words)

As mulheres de cabelos pretos nao devem fazer reflexo, embora eles tenham voltado a moda. (from *Claudia*, July, 1994, no. 7 --15 words)

'Quatro Casamentos e Um Funeral' e uma comedia inglesa moderna sobre a vida a dois. (from *Diario Catarinense*, September, 1994 -- 15 words)

A situacao dos hospitais publicos brasileiros e tao precaria que virou tema de congresso. (from *Diario Catarinense*, Spetember, 1994 --14 words)

(5)
Para que o Plano de certo e preciso conter o consumo que gera alta de precos. (from *Diario Catarinense*, September, 1994 -- 16 words)

Pular corda emagrece e melhora nossa capacidade cardiovascular bem como nossa coordenacao motora. (from *Boa Forma*, July, 1994, no. --13 words)

Atualmente e muito importante saber falar e escrever bem em uma lingua estrangeira. (from *Diario Catarinense*, September, 1994 --13 words)

A tristeza no rosto daquele homem era nao saber como alimentar sua familia. (from *Diario Catarinense*, September, 1994 --13 words)

Uma infinidade de filmes espalhados pelos quatro cantos do planeta compoem a historia do cinema. (from *Diario Catarinense*, September, 1994 -- 15 words)

(5)
Mania entre os jovens de todas as idades, os patins prometem invadir pistas e ruas nestas ferias. (from *Claudia*, July, 1994, no. 7 -- 17 words)

Para evitar que o filho se torne um obstaculo o ideal e planejar a maternidade. (from *Claudia*, July 1994, no. 7)

Na nossa burocratizada vida, papeis e mais papeis entopem gavetas e congestionam prateleiras. (from *Claudia*, September, 1994, no. 9 -- 13 words)

Assim como uma lingua estrangeira, conhecimento sobre programas de computador tambem e necessario no mundo de hoje. (from *Diario Catarinense*, September, 1994)

Termina esta semana a campanha do Detran 'Cinto de seguranca, uma opcao inteligente'. (from *Diario Catarinense,* September, 1994 --13 words)

(6)
Com o verao chegando, muita gente ja comeca a se preocupar com sua forma fisica. (from *Boa Forma,* July, 1994, no. -- 15 words)

Ir ate Nova Iorque e aproveitar para fazer compras pode ser mais barato que no Brasil. (from *Diario Catarinense,* September, 1994 --16 words)

Presente em todas as festividades comunitarias a banda da Policia Militar corre o risco de desaparecer. (from *Diario Catarinense*, July, 1994 -- 16 words)

A geleia real e uma substancia cremosa, leitosa, acentuadamente acida produzida por abelhas. (from *Boa Forma*, September, 1994, no. --13 words)

Os avancos tecnologicos dos ultimos anos na area eletronica iniciaram uma revolucao na comunicacao. (from *Diario Catarinense*, September, 1994 --13 words)

A seca ja dura mais de trinta dias e esta fazendo o preco dos alimentos subir. (from *Diario Catarinense*, July, 1994 --16 words)

(6)
No mundo de hoje e fundamental estar em dia com os acontecimento internacionais. (from *Claudia,* Julho, 1994, no. 7 --13 words)

Um bom programa para hoje depois do expediente e ir ao cinema com alguns amigos. (from *Diario Catarinense,* September, 1994 --15 words)

Impressiona como vem sendo publicados no mundo inteiro e em grande numero livros sobre misticismo. (*Diario Catarinense,* July, 1994 --15 words)

A vida de quem trabalha fora, estuda e ainda cuida da familia nao e facil. (from *Claudia,* July, 1994, no. 7 --15 words)

Reitores de varias universidades brasileiras estao reunidos para repensar o ensino de terceiro grau. (from *Diario Catarinense*, September, 1994 --14 words)

Betinho e um heroi nacional, pois mesmo doente organizou uma grande campanha em prol dos famintos. (from *Claudia*, Julho, 1994, no. 7 --16 words)

WORDS TO BE RETAINED:

(2)
femininas
governo
(2)
unidos
mel

(3)
saude
queratina
varanda
(3)
entretenimento
supermercados
vasos
(4)
anos
expressao
mar
passar

(4)
catarinense
moda
dois
congresso

(5)subir
precos
motora
estrangeira
familia
cinema

(5)
ferias
maternidade
prateleiras
hoje
inteligente

(6)
fisica
Brasil
desaparecer
abelhas
comunicacao
subir

(6)
internacionais
amigos
misticismo
facil
grau
famintos

Appendix C

Measure of working memory span during language production
Speaking Span Test in English (SSTE)

(2)
cake
hand
(2)
week
rain
(3)
duck
pen
gas
(3)
club
spring
knife
(4)
arm
sky
deer
ball
(4)
desk
road
glass
brain
(5)
sun
mouth
key
bag
file
(5)
bank
shirt
egg
date
hair

(6)
clock
wave
tool
coat
map
year

(6)
cow
pair
drum
sea
bus
west

Appendix D

Measure of working memory during language comprehension
Reading Span Test in English (RSTE)

(2)
His younger brother played guitar in a rock and roll band.
The boat engine would not run because it was out of oil.

(2)
At the very top of the tall tree sat a small bird.
They knew it was impolite to eat spaghetti with a spoon.

(3)
The people in northern Europe always like to travel by train.
He looked across the room and saw a person holding a gun.
Popular foods in the summer are watermelon and sweet corn.

(3)
The young woman and her boyfriend thought they saw a dog.
Suddenly the taxi opened its door in front of the church.
All that remained in the lunch box was one salted nut.
*Car go break stars don't see the house.

(4)
The skiing was so wonderful that he did not mind the snow.
The saw that he brought was not strong enough for the lock.
*The girl can't looked at table.
He overslept and missed all of the morning economics class.
He wanted to leave his bags and jacket in the hotel room.

(4)
They decided to take an afternoon break by the large rock.
There were so may people that I couldn't find a seat.
She opened the bottom drawer and pulled out her favourite blouse.
I saw a child and her father near the river playing baseball.

(5)
She leaned over the candle and her hair caught on fire.
* he woman good dishes are dinner.
The birthday party began in the morning and lasted all day.
The last thing he did was to take a nice hot bath.
At night the prisoners escaped through a hole in the wall.

The first driver out in the morning always picks up the mail.

(5)
*Computers cry lovely television set.
There was nothing left to do except leave and lock the door.
He quickly drank some of the coffee and then washed the mug.
She soon realised that the man forgot to tell her the room number.
The first thing he does every morning is swim in the river that crosses his farm.
The letter said to come to the market to claim the prize.

(6)
*Carry read paper yellow the water is.
He played baseball all day at the park and got a sore finger.
She took a deep breath and reached into the rusty box.
The only thing left in the kitchen cupboard was a broken cup.
It was a very simple meal of salted fish and boiled rice.
*It was a sunny green yesterday fall school
The letter was lost because it did not have a postage stamp.
In order to attend the dinner she needed to buy a dress.

(6)
The hunting knife was so sharp that it cut his right wrist.
*Let's studying together will magazines and ice-cream.
The season that people often associate with happiness is the summer.
The clerk in the department store put the presents on a chair.
*The zoo were near the clock and the boys in the garden.
The state of Wisconsin is famous for its butter and cheese.
The woman screamed and slapped the old man in the face.
All morning the two children sat and talked under a tree.

WORDS TO BE RETAINED:

(2)
band
oil
(2)
bird
spoon
(3)
train
gun
corn
(3)
dog
church
nut
(4)
snow
lock
class
room
(4)
rock
seat
blouse
baseball
(5)
fire
day
bath
wall
mail
(5)
door
mug
number
farm
prize
(6)
finger
box
cup
rice
stamp
dress
(6)
wrist
summer
chair
cheese
face
tree

Appendix F

Reading Passage

She turned her head as there was a light dignified knocking at the front door. I went out and opened it. Gatsby, pale as death, with his hands plunged like weights in his coat pockets, was standing in a puddle of water glaring tragically into my eyes.

With his hands still in his coat pockets he stalked by me into the hall, turned sharply as if he were on a wire, and disappeared into the living-room. It wasn't a bit funny. Aware of the loud beating of my own heart I pulled the door to against the increasing rain.

For half a minute there wasn't a sound. Then from the living-room I heard a sort of choking murmur and part of a laugh, followed by Daisy's voice on a clear artificial note: "I certainly am awfully glad to see you again:.

A pause; it endured horribly. I had nothing to do in the hall, so I went into the room.

Gatsby, his hands still in his pockets, was reclining against the mantelpiece in a strained counterfeit of perfect ease, even of boredom. His head leaned back so far that it rested against the face of a defunct mantelpiece clock, and from this position his distraught eyes stared down at Daisy, who was sitting, frightened but graceful, on the edge of a stiff chair.

"We've met before", muttered Gatsby. his eyes glanced momentarily at me, and his lips parted with an abortive attempt at a laugh. Luckily the clock took this moment to tilt dangerously at the pressure of his head., whereupon he turned and caught it with trembling fingers and set it back in place. Then he sat down, rigidly, his elbow on the arm of the sofa and his chin in his hand.

"I'm sorry about the clock", he said.

My own face had now assumed a deep tropical burn. I couldn't muster up a single commonplace out of the thousand in my head.

(*The Great Gatsby*, p.86-87)

Appendix G

Oral Sip Task

deaf beetle
dead beet
daddy beat
bad deed
< beep >

white bag
living room
< beep >

silver port
silly poem
sip pole
pick soap
< beep >

farm hall
black door
caught bat
beauty parlour
< beep >

sea ships
seek sheeps
see shears
she sees
< beep >

sunny day
wind mill
black boxes
boggy marsh
< beep >

massy bread
messy bed
met Beth
bath mat
< beep >

kitchen sink
cute baby

taught course
fast horse
< beep >

dummy guard
dunce guile
dumpy guide
gum dies
< beep >

left hand
clear cut
squeaky floor
sore throat
< beep >

thin rain
key chain
< beep >

back route
bad rule
beg roof
red book
< beep >

Cassius Clay
splicing book
< beep >

slumber party
reading list
wine racks
< beep >

make pans
made pants
maiden plan
paid men
< beep >

bed bugs
taxi cab
big games
mice saw
< beep >

hot drink
big tube
< beep >

kinky doc
queen's dog
keen dot
deed cop
< beep >

need love
bad name
fun time
shot gun
< beep >

bake pie
wise man
pants fit
nine cups
< beep >

get food
tease girls
keep tabs
five bars
< beep >

good boy
pink toy
< beep >
right sauce
type boss
tied moth
might toss
< beep >

nice time
sad boy
big ball
they fall
take pill
< beep >

Appendix H

Instructions to subjects (samples)

I. Speaking Span Test in Portuguese

Todos os experimentos que você vai fazer hoje são relacionados a memória de curto prazo, aquela que a gente usa quando precisa , por exemplo, procurar um número de telefone no catálogo, manter esse número na cabeça e fazer a ligação. Serão quatro experimentos, dois em português e dois em inglês. Este primeiro é todo em português.

Você vai ver na tela do computador conjuntos de palavras e ler estas palavras silenciosamente. Para cada palavra você deve fazer uma oração. O menor conjunto é de duas palavras e o maior de seis. Há dois conjuntos para cada número de palavras e eles são apresentados em ordem crescente. Ou seja, primeiro você vê os dois conjuntos de duas palavras, depois os dois conjuntos de três palavras, e assim por diante até chegar aos dois conjuntos de seis palavras.

As palavras foram aleatoriamente escolhidas e não têm qualquer ligação entre si. Por exemplo, em um conjunto de três palavras você pode ter "piscina", "mercado", e "nevasca". Cada palavra do conjunto que está sendo apresentado aparece sozinha na tela, por um segundo. Após dez milissegundos a próxima palavra do conjunto aparece, e assim por diante, até todas as palavras do conjunto terem sido apresentadas.

As palavras vêm acompanhadas de um beep. Ao acabar um conjunto você vai ver a tela branca, o que indica que você deve começar a fazer as orações, oralmente e em português, uma oração para cada palavra, na ordem e na forma em que elas foram apresentadas. Por exemplo, você vai ver "piscina" por um segundo, depois "mercado" também por um segundo e, então, "nevasca". Para cada palavra o beep toca. Quando

aparecer a tela branca, você me dá as orações: "A piscina estava com a água suja; "O mercado de automóveis oferece boas oportunidades de negócios"; "Os montanhistas tiveram que enfrentar uma nevasca no caminho". Então passaremos para o próximo conjunto de três palavras e assim por diante até terminar o experimento. As orações podem ser curtas ou longas, simples ou complexas, você escolhe. Mas elas devem ser todas gramaticais, tanto sintaticamento quanto semanticamente. Você tem que prestar atenção às palavras quando estão sendo apresentadas porque elas ficam na tela só por um segundo.

II. Reading Span Test in Portuguese

Neste experimento quem vai te dar as orações sou eu e você vai tentar lembrar da última palavra de cada oração. O experimento é todo em português.

Você vai ver conjuntos de orações: o menor conjunto contem duas orações e o maior, seis. Há dois conjuntos para cada número de orações, também apresentados em ordem crescente. Ou seja, primeiro você vê os dois conjuntos de duas orações, depois os dois conjuntos de três orações e assim por diante até os dois conjuntos de seis orações.

Você vai ver uma oração por vez na tela do computador e vai ler esta oração em voz alta, tentando compreendê-la. Quando você acabar de ler a oração eu vou apresentar a próxima e você vai fazer a mesma coisa. Quando a tela branca aparecer é sinal de que aquele conjunto acabou e você deve, então, me dizer a última palavra de cada oração, na ordem e forma em que elas foram apresentadas. Por exemplo, em um conjunto de duas orações você vai ler em voz alta "A água que evapora dos oceanos não é salgada" e depois "Esta tarde irei ao hospital visitar minha tia'. Quando a tela branca aparecer você deve me dar "salgada"e "tia".

III. Speaking Span Test in English

Este experimento é igual ao primeiro que você fez mas vai ser em inglês. Você vai ver na tela conjuntos de palavras e vai ler cada palavra silencionsamente. Para cada palavra você deve fazer uma oração em inglês.

Como no experimento em português, o menor conjunto é de duas palavras e o maior, de seis. Há dois conjuntos para cada número de palavras, também apresentados em ordem crescente. Ou seja: primeiro você tem os dois conjuntos de duas palavras, depois os de três palavras, os de quatro, e assim por diante.

As palavras nao têm ligação entre si, são apresentadas individualmente na tela, uma palavra por vez, por um segundo. O intervalo entre elas é de dez millissegundos e são acompanhadas de um beep. Quando a tela branca aparecer é sinal de que aquele conjunto acabou e você deve, então, fazer uma oração para cada palavra, na ordem e na forma em que foram apresentadas. Por exemplo, num conjunto de três palavras, você pode ter "school"", "throat", "lawyer", cada uma apresentada por um segundo. Quando surgir a tela branca, você faz oralmente as orações: "The school I used to go to was very good", "I've got a sore throat", "To be a lawyer you need to have good language skills'. Então passaremos para o próximo conjunto de três e assim por diante até terminar o experimento. As orações podem ser curtas ou longas, simples ou complexas, mas devem ser gramaticais tanto sintaticamente quanto semanticamente. Preste atenção às palavras quando estiverem sendo apresentadas porque elas ficam no vídeo por um segundo apenas.

IV. Reading Span Test in English

Neste experimento eu dou as orações em inglês e você vai tentar lembrar da última palavra de cada oração, na ordem em que foram apresentadas. É parecido com o que você fez em português.

As orações são apresentadas em conjuntos, o menor é duas orações e o maior, de seis. Há dois conjuntos para cada número de orações e, como nos outros experimentos, são apresentados em ordem crescente: primeiro os dois conjuntos de duas orações, depois os de três, os de quatro, e assim por diante. Você vai ler as orações em voz alta, tentanto compreendê-las. Quando terminar de ler uma oração, eu apresento a outra. A tela branca indica que um conjunto acabou e que você deve começar a dizer a última palavra de cada umas das orações, na ordem e forma em que foram apresentadas. Neste experimento aparecem, aleatoriamente, algumas orações que estão completamente erradas sintatica e semanticamente. Ao ler uma dessas orações você deve me dizer que ela está incorreta e deve ignorá-la no momento em que começar a reportar a última palavra de cada oração. Estas orações são explicitamente incorretas e elas podem aparecer em qualquer conjunto. Por exemplo, em um conjunto de duas orações, você poder ter primeiro "The girls were studying for a difficult exam" e depois "I enjoy watching thrillers". Entre estas duas pode aparecer uma sentença incorreta como "Flowers will motorbike never ", que você deve me dizer que é incorreta e ignorar.

V. Speech Generation Task

Todos os experimentos hoje serão em inglês e o objetivo é medir sua fluência. Neste primeiro experimento você vai descrever uma figura e tecer comentários sobre o que você está vendo. Dê o máximo de informação que você puder tanto na descrição quanto nos comentários. Fale o mais fluentemente que puder. Você tem um minuto e trinta segundos para descrever e comentar sobre a figura, em inglês.

VI. Oral Reading Task

Neste experimento você vai ler um texto em inglês, em voz alta. O texto foi retirado do "The Great Gatsby". Você deve tentar ler o mais rápido que puder, mas de uma maneira

clara, com boa dicção e sem pular palavras. A ênfase é na velocidade de leitura em voz alta. Seu tempo de leitura será marcado.

VII. Oral Slip Task

Neste experimento você vai ver pares de palavras na tela do computador e vai ler cada par silenciosamente, prestando o máximo de atenção que puder. Aparece um par por vez, por 1 segundo. O intervalo de tempo entre um par e outro é de apenas 100 milissegundos. Quando soar o beep, imediatamente você deve falar em voz alta o par que precedeu este beep e que já não está mais visível na tela. Quando o beep parar de soar o próximo par já estará aparecendo. Você deve falar o par que antecede o beep. Por exemplo, você pode ter um par como "beautiful car", em seguida "wobbly chair" e depois "cloudy sky" e um beep. Você deve dizer "cloudy sky" sem parar de prestar atenção à tela, pois o próximo par já estará sendo apresentado.

Appendix I

Instructions to independent judges

Here you have the picture used as stimuli for the assessement of L2 fluency subjects' tape-recorded protocols. They were required to describe the picture and to make comments about it, giving as much information as possible. They had 1m30s to perform the task and my measure of fluency was number of words produced. I would like you to judge their fluency in terms of **richness of content**, on a scale of **1**(repetitious, semantically empty speech) to **5** (creative, semantically rich).

Subject 1

Subject 2

Subject 3

Subject 4

Subject 5

Subject 6

Subject 7

Subject 8

Subejct 9

Subject 10

Subject 11

Subject 12

Subject 13

Subject 14

Subject 15

Subject 16

Appendix J

Subject's responses

I. Speaking Span Test in Portuguese

Subject 1
A direção da escola é boa.
Eu não gosto dessa matéria.

A memória é meu fraco.
Ontem eu fiquei sabendo de um assalto.

Não gosto de cerveja.
Conheci um exilado ontem.

Gosto de comer galinha.
O presidente assinou um decreto.

O palhaço é uma estrela do circo.
Eu vi uma estrela que caiu ontem.

A bondade é uma virtude.
O caminho pra universidade é difícil.

O besouro é um inseto.
A amizade é uma virtude.
Eu gosto da revista Newsweek.

Um beliche tem duas camas.
O bordado é uma arte.

Compro pão na padaria.
Não gosto de futebol.
Também não gosto de cozinha.

Nunca fui a um estádio.
Não gosto de perfume forte.

Strict score:22
Lenient score: 22

Subject 2

Não sei qual é a direção certa.
Essa matéria é muito difícil.

Minha memória tá falhando.
Foi um assalto horrível.

Eu não gosto de cerveja.
Ele é um exilado.
As árvores precisam ser cortadas.

Eu prefiro sopa de galinha.
Essa é a estação que eu mais gosto.

Eu estou precisando de algumas aulas de natação.
Me dê essa cadeira.
O palhaço é muito engraçado.

Ele foi vítima de um suborno.
Esse caminho é muito estreito.

Tem um besouro na minha sopa.
A polícia chegou tarde.
A camisa está lá no armário
Nossa amizade deve ser continuada.

O beliche foi quebrado.
O viveiro está sujo.

Você já foi na padaria?
Eu não gosto muito do jogo de futebol.
Minha cozinha tá muito suja.

A redação não está boa.
A lâmpada está queimada.

Strict stocre: 24
Lenient: 25

Subject 3

A direção da escola é bastante competente.
As matérias aqui do curso de pós-graduação são muito difíceis.

Eu tenho uma péssima memória.
Assaltos são muito comuns aqui no centro de Florianópolis.

Brasileiro gosta muito de cerveja.
Na década de sessenta houve muitos exilados.

Eu tenho um tio que não pode nem ouvir falar de galinha.

Eu pratico natação três vezes por semana.
Existem cinco cadeiras aqui nessa sala.
No circo a gente sempre encontra um palhaço.

Bondade é uma coisa que é muito deficil de encontrar hoje em dia.
Teatral é a minha aula de inglês.

A polícia catarinense é bastante competente.
A amizade é a coisa mai preciosa que uma pessoa pode ter.

Laranja eu adoro comer.
Bordado eu não sei fazer porque eu não sou nem um pouquinho prendada.

Lá perto de casa tem uma padaria.
Eu adoraria tocar violino mas infelizmente não consigo.
Brasileiro gosta bastante de futebol.

Meu sobrinho adora peixes então vive pedindo um aquário pro meu irmão.

Strict score: 16
Lenient score: 20

Subject 4

A direção do meu carro é hidráulica.
A matéria que eu mais gosto até agora é a do Malcolm.

Minha memória está terrível.
Nunca sofri um assalto.

Odeio cerveja.
O FHC já foi exilado.

A galinha dá ovos.
Está pra sair um decreto do presidente.
O verão é uma estação do ano.

Nunca fiz natação.
Estou sentada numa cadeira.
No circo existe palhaço.

A minha avó vive praticando a bondade.
Vi uma peça teatral semana passada.

Acho bonitinho o besouro.

Nunca dormi num beliche.
Tô fazendo um bordado em ponto de cruz.

Eu vou compar pão na padaria.
Existe um tesouro no fundo do mar.

Não gosto de ir ao estádio
Posso imprimir um livro numa gráfica.
A lâmpada está acesa.

Strict score: 22
Lenient score: 22

Subject 5

A direção da escola é boa.
A matéria é difícil.

Memória é o que a Mailce está pesquisando.
Assalto é uma coisa comum no Brasil.

Nao gosto de cerveja.
O exilado foi preso.

Galinha bota ovo.
Os decretos são feitos autoritariamente.

Natação é saudável.
A cadeira é dura.
Palhaço trabalha em circo.
A estrela está no céu.

Bondade lembra caridade.

O besouro me lembra o Vitor.
A polícia é perigosa.
Eu tenho boas amizades

O beliche fica no quarto.
O viveiro é casa de aves.
O caderno é de levar para a escola.
A cenoura é laranja.

A padaria é na esquina.
Violino me lembra música clássica.
Leitura me lembra que eu gosto muito de ler.
O futebol é um esporte brasileiro.
Na cozinha tem um fogão.

A gráfica faz cadernos.
O perfume se compra em perfumaria.
No aquário tem peixes.

Strict score:26
Lenient score: 28

Subject 6

Essa rua segue numa direção só.
A matéria faz parte da teoria da relatividade de Einstein.

A minha memória é fraca.
Eu presenciei um assalto semana passada.

A cerveja que eu prefiro é aquela.
Fernando Henrique Cardoso foi exilado no Chile.
As árvores estão floridas.

A galinha põe ovos.
O presidente lançou mais um decreto.

Meu filho está na natação.
Estou sentado na cadeira.
Aquele palhaço não é engraçado
Essa noite não tem estrelas.

A bondade é um valor importante.
Aquela atitude foi muito teatral.
Ele errou o caminho.

O besouro é um poleóptero.
Minha camisa está rasgada.

O beliche está no quarto à direita.
Os animais estão no viveiro.
A laranja está verde.

O pão é feito na padaria.
Naquela ilha tem um tesouro escondido.

Comprei um perfume ontem.
O aquário tem peixes dourados.

Strict score: 23
Lenient score: 25

Subject 7

Eu não sei que direção tomar.
Essa matéria é muito difícil para mim.

A minha memória está pior.
Eu nunca presenciei um assalto.

Adoro cerveja.
Caetano foi exilado do Brasil.

Eu gosto de galinha.
Eu não sei qual é o último decreto do governo.
A estação agora é outono.

Eu queria começar natação mas não tenho tempo.
A cadeira está quebrada.
Ontem eu não vi nenhuma estrela.

Às vezes sou um pouco teatral.
O suborno é uma das palavras que mais se conhece nesse país.

Besouro não é uma palavra comum.
A camisa tem que ser lavada.
Eu não tenho feito novas amizades ultimamente.

Eu tenho um beliche lá em casa.
Tem um viveiro na casa da minha vizinha.
Um dos meus passatempos é fazer bordado.

Descobri que tenho um amigo que toca violino.
Agora finalmente descobriram o tesouro.

Eu comprei um aquário pra mim.
Queimou uma lâmpada da frente da casa ontem.

Strict score: 22
Lenient score: 24

Subject 8

Ele foi naquela direção.
Essa matéria é muito difícil.

Minha memória está péssima.
O preço desse carro é um assalto.

Meu namorado gosta de cerveja.
João foi exilado.
Não tem nenhuma árvore nessa rua?

Essa sopa é de galinha.
Ele perdeu o emprego por causa de um decreto.
Meu primo mora perto da estação.

Você gosta de natação?
Estou sentada numa cadeira
Quantos palhaços tem esse circo?
O sol é uma estrela.

Eu aprecio sua bondade.
O funcionário recebeu suborno.

Eu não gosto de besouros.
Esse prédio é um departamento de polícia.

Quando eu era criança eu dormia num beliche.
Os pássaros estavam num viveiro.
Minha tia faz bordados.

A Maria mora perto da padaria.
Eu vi um filme chamado O tesouro da Serra Madre.

Eu nunca fui a um estádio
Na minha rua tem uma gráfica.

Strict score: 21
Lenient score: 25

Subject 9

Não sei que direção dar a minha vida.
Matéria é tudo que ocupa lugar no espaço.

Minha memória é um problema não é?
Tenho muito medo de assalto porque já fui assaltada uma vez.

Gosto muito de cerveja.
Brizola foi exilado durante o período militar.

Menino de cidade grande não vê galinha.
Não uso a palavra decreto no meu dia-a-dia.

Cibele faz natação.
Estou sentada numa cadeira.
Os meninos gostam muito de palhaço.

Bondade verdadeira é muito difícil de alguém ter.
O meu profesor de literatura é muito teatral.

Acho a amizade uma coisa importante.
Leio muitas revistas.

Meus meninos dormem num beliche.
Eles adoram laranja.
Gosto muito de bordado.

Compro pão na padaria.
Assisti um filme outro dia em que o menino tocava violino muito bem.
Criança gosta de inventar mapa do tesouro.

Meu irmão trabalha numa gráfica.

Strict score: 21
Lenient score: 22

Subject 10

A direção da escola podia melhorar.
Não tem uma matéria que eu ache interessante.

Eu acho que eu tenho uma memória não muito boa.
Assalto é uma coisa que todo mundo evita.

A cerveja é uma bebida que eu gosto muito.
O CaetanoVeloso foi uma vez exilado.
As árvores estão bastante verdes.

Galinha é meu bicho preferido.
Não entendo de decreto.
A estação que a gente tá agora é outono.

Odeio natação.
A cadeira tem que ser vermelha.

A bondade é uma coisa muito legal.
Acho que às vezes eu sou um monte teatral.
O suborno é muito ruim.

O besouro é um bicho da sorte.
Quando eu vejo um policial eu acho que é mau agouro.

Beliche é uma cama em cima da outra.
Viveiro é bom pra se criar galinha.
Bordado é uma coisa que eu não sei fazer.

O violino eu acho maravilhoso.
Tesouro é uma coisa que todo mundo procura.
Futebol é um esporte que eu odeio.

Um dia gostaria de ter uma gráfica.
O perfume que eu uso é Poison.

Strict score: 24
Lenient: 25

Subject 11

A direção do carro tá pra direita.
A matéria é muito dificil..

A minha memória é péssima.
Ontem eu sofri um assalto.

A cerveja está cara.
O homem foi exilado.
As árvores são bonitas.

A galinha é a mãe dos pintos.
O decreto foi aprovado.
A estação é outono.

A natação é meu esporte preferido.
A cadeira é de madeira.
O palhaço é engraçado.

A bondade é uma boa qualidade.
O caminho é esse.

O besouro é preto.
A amizade é um sentimento muito bonito.
A revista que eu mais gosto é Veja.

Lá em casa tem dois beliches.

A padaria estava fechada.
O violino é o instrumento que eu mais gosto.
O futebol é o esporte do momento.

O estádio está lotado.
O perfume que eu mais gosto é do Boticário.

Strict score: 23
Lenient score: 24

Subject 12

A direção da escola foi demitida.
A matéria que eu estudei ontem era muito complicada.

A minha memória não tá boa.
Ocorreu um assalto aqui na universidade.

A cerveja tava gelada.
O exilado sofreu torturas.

Acho galinha um animal detestável.
A estação de ônibus tava lotada.

Eu não pratico natação.
A perna da cadeira tá quebrada.
A estrela brilha no céu.

O caminho pra minha casa é perigoso.

A amizade é uma coisa difícil de ser conquistada.
Eu gosto da revista Veja.

O caderno estava todo riscado.
A minha mãe faz um bordado bonito.

Eu não gosto de ir à padaria.
Os piratas decobriram um tesouro.
Meu irmão joga futebol.
A minha cozinha tá suja.

Geralmente os alunos acham redação uma coisa difícil.
Troquei a lâmpada do meu quarto ontem.

Strict score:22
Lenient score: 22

Subject 13

A direção determinou que o andamento da obra seja mais rápido.
A matéria que estamos estudando é muito interessante.

Minha memória tá meio fraca.
Apareceu a reportagem de um assalto ontem.

A cerveja está hipergelada.
O cantor ficou exilado muito tempo no exterior.
As árvores do jardim precisam ser cortadas.

Gosto de galinha com arroz.
O decreto de lei foi anunciado ontem.

Ontem fui à aula de natação.
Tô sentada numa cadeira.
O palhaço é muito engraçado.
Gosto de estrelas.
Vou assistir uma peça teatral em Curitiba.
O suborno é um crime.
O caminho por aqui é mais curto.

O besouro faz barulho quando voa.
A polícia mantém o nível de segurança.

A laranja estava gostosa.
Uma amiga minha gosta muito de bordado.

O futebol é um esporte meio grosseiro.
A cozinha está limpa.

Estou pensando em comprar um aquário.
Sua redação precisa de uns retoques.
Precisamos trocar esta lâmpada.

Strict score: 24
Lenient score:25

Subject 14

Fui falar com a direção do colégio depois que senti o problema com os alunos.
A matéria mais difícil é a língua portuguesa.

Há muitos assaltos nas cidades tanto pequenas quanto grandes.

Eu gosto de tomar cervejas.
Eu vejo uma porção de árvores quando viajo para o interior.

A galinha faz cocoricó.
O decreto do presidente temos que boicotear.
Você só consegue pegar trem na estação.

Como eu gostaria de fazer natação todos os dias!
Eu tenho que sempre que sentar numa cadeira dura e desconfortável.
Às vezes eu me sinto um palhaço porqe eu tenho que fazer coisas mirabolantes.

A bondade é uma das virtudes que a gente pouco encontra nas pessoas.
A peça teatral que eu assisti era cômica.
O caminho mais curto entre dois pointos é uma linha reta.

Besouro sempre me incomoda nas noites de verão.
A polícia é uma das instituições que está com grande problemas.
Gosto de usar camisas claras e chiques.
Eu leio revistas assim que tenho oportunidade para tal.

Eu não gosto de dormir em beliche

Eu sempre compro pães na padaria da esquina.

O perfume que você está usando é delicioso.
A redação do jornal estava tumultuada.

Strict score: 19
Lenient score: 22

Subject 15

Ele foi em direção à sala de aula, mas não entrou.
Ele gosta muito da matéria português.

Estou fazendo um teste de memória.
João ficou muito preocupado com o assalto que aconteceu com a sua mãe.

Paulo não gosta de cerveja.
Ele foi exilado no passado.

Gosto de galinha ensopada.
O presidente assinou um decreto semana passada.
Minha estação preferida é verão.

Fiz natação por dois anos.
Gosto de olhar estrelas.

Não sou simpático a besouros.
Não gosto de camisetas velhas.
Comprei uma revista ontem.
Amizade é uma palavra importante no meu vocabulário.

Temos um beliche na casa de praia.
Gosto muito de laranja.
Minha avó fazia bordados muito bonitos.

Não estou fazendo o curso de leitura.

Meu irmão quebrou o aquário ontem.

Strict score: 16
Lenient score: 20

Subject 16

A direção dessa instituição é muito eficiente.
Sempre gostei muito das matérias de ciências exatas.

A memória é muito importante.
O assalto é um crime inafiançável.

Cerveja é a minha bebida preferida.
Os exilados da década de sessenta sofreram muito.
As árvores são maravilhosas.

Nunca gostei de carne de galinha.
A estação de trem em São Francisco do Sul me faz lembrar meu tempo de criança.

Natação é um dos meus esportes preferidos.
A estrela guia os caminhantes.

Bondade é uma das nossas boas qualidades.
O caminho até minha casa é longo.

O besouro é um inseto.
A camisa é uma espécie de roupa.

O beliche é uma espeçie de cama.
Viveiro é onde se cria aves domésticas.
O caderno é um instrumento importante para os alunos.

Tem uma padaria perto da minha casa.
Violino é um instrumento que eu não gosto.
Futebol é o meu esporte predileto.

O aquário foi feito para os peixes.
A lâmpada fornece luz.

Strict score: 20
Lenient score: 23

II. Reading Span Test in Portuguese

Subject 1

femininas
governo

unidos
mel

saúde
queratina
varanda

supermercados
vasos

expressão
mar
passar

catarinense
moda
dois
congresso

estrangeira
cinema

férias
inteligente

física
Brasil
subir

fácil
famintos

Score: 25

Subject 2

femininas
governo

unidos
mel

queratina
varanda

entretenimento
supermercados
vasos

anos
mar
passar

moda
congresso

preços
estrangeira
família
cinema

maternidade
hoje
inteligente

Brasil
desaparecer
abelhas
comunicação
subir

internacionais
amigos
misticismo
fácil
grau
famintos

Score: 32

Subject 3

femininas
governo

unidos
mel

saúde
queratina
varanda

entretenimento
supermercados
vasos

mar
passar

catarinense
dois
congresso

motora
estrangeira
cinema

férias
prateleiras
hoje

física
desaparecer
subir

famintos

Score :25

Subject 4

femininas
governo

unidos
mel

saúde
queratina
varanda

entretenimento
supermercados
vasos

expressão
mar
passar

moda
congresso

cinema

ferias
maternidade
hoje

fisica
Brasil
desaparecer
abelhas

fácil
grau
famintos

Score: 26

Subject 5

femininas
governo

unidos
mel

saúde
queratina
varanda

supermercados
vasos

expressão
mar
passar

moda
dois
congresso

preços
família
cinema

maternidade

física
Brasil
subir

internacionais
amigos
famintos

Score: 25

Subject 6

femininas
governo

unidos
mel

saúde
queratina
varanda

entretenimento
vasos

anos
expressão
mar
passar

catarinense
moda
dois
congresso

estrangeira
família
cinema

férias
maternidade
prateleiras
hoje

fisica
Brasil
desaparecer
abelhas
comunicação
subir

misticismo
fácil
famintos

Score: 33

Subject 7

femininas
governo

unidos
mel

saúde
queratina
varanda

entretenimento
supermercados
vasos

anos
expressão
mar
passar

catarinense
moda
dois
congresso

preços
motora
estrangeira
família
cinema

férias
maternidade
prateleiras
hoje
inteligente

física
Brasil
desaparecer
abelhas
comunicação
subir

amigos
misticismo
fácil
grau
famintos

Score: 39

Subject 8

femininas
governo

unidos
mel

saúde
queratina
varanda

entretenimento
vasos

anos
expressão
mar
passar

catarinense
moda
dois
congresso

preços
motora
estrangeira
cinema

férias
hoje
inteligente

física
Brasil
subir

misticismo
fácil
famintos

Score: 30

Subject 9

femininas
governo

unidos
mel

saúde
queratina
varanda

entretenimento
vasos

express ão
mar
passar

catarinense
dois
congresso

motora
família
cinema

férias
maternidade
inteligente

abelhas
comunicação
subir

famintos

Score:25

Subject 10

femininas
governo

unidos
mel

saúde
queratina
varanda

entretenimento

anos
passar

catarinense
moda
congresso

cinema

maternidade
hoje
inteligente

fisica
Brasil
desaparecer
subir

misticismo
grau
famintos

Score: 24

Subject 11

femininas
governo

unidos
mel

saúde
queratina
varanda

entretenimento
vasos

anos
passar

dois
congresso

preços
motora
cinema

férias
maternidade

Brasil
subir

fácil
famintos

Score: 22

Subject 12

femininas
governo

unidos
mel

queratina
varanda

vasos

passar

catarinense
congresso

estrangeira
cinema

férias
maternidade
hoje

fisica
Brasil
abelhas
subir

famintos

Score: 20

Subject 13

femininas
governo

unidos
mel

saúde
queratina
varanda

supermercados
vasos

anos
expressão
passar

dois
congresso

preços
família
cinema

férias
maternidade
hoje
inteligente

física
Brasil
subir

fácil
famintos

Score: 26

Subject 14

femininas
governo

unidos
mel

saúde
queratina
varanda

entretenimento
supermercados
vasos

anos
passar

dois
congresso

motora
estrangeira
cinema

férias
maternidade
hoje
inteligente

Brasil
desaparecer
abelhas
comunicação
subir

amigos
fácil
grau
famintos

Score: 30

Subject 15

femininas
governo

mel

queratina
varanda

supermercados
vasos

anos
mar

catarinense
moda
congresso

estrangeira
cinema

férias
maternidade
inteligente

física
Brasil
abelhas
subir

amigos
fácil
famintos

Score: 24

Subject 16

femininas
governo

unidos
mel

saúde
queratina
varanda

entretenimento
vasos

mar
passar

moda
dois
congresso

motora
estrangeria
cinema

férias
maternidade
hoje
inteligente

Brasil
abelhas
comunicação
subir

famintos

Score: 26

III. **Speaking Span Test in English**

Subject 1

I don't like cake.
I have a big hand.

Today is the first day of the week.
I don't like rain.

I have never eaten duck.
My pen is blue.
My car is out of gas.

I like to go the club.
Spring is the best season.

I look at the sky.
I don't like deer hunting.
My son has a ball.

I have a desk.
I broke a glass.
He has an interesting brain.

The sun is bright.
He has a big mouth.
I lost my key.
I have to organize my file.

I have to go to the bank.
I don't like eating egg.
My hair is brown.

I'm not good at reading maps.
I had an accident last year.

A cow is brown.
I'm waiting for the bus.
Lages is in the west of Santa Catarina.

Strict score: 26
Lenient: 27

Subject 2

I made a cake.
My hand is cold.

I went there this week.
The rain keeps falling on my head.

The duck is in the pond.
The pen is mine.
I need some gas.

I went to the club.
It's spring now.
The knife belongs to the cook.

My arm is not very long.
They killed the deer.
The ball is in the yard

My desk is empty
The glass was made for wine.

The sun is too hot for me.
The bag is empty.
The file is incorrect.

Could you buy some eggs?
My hair is awful today.

Read it clockwise
My coat was made in Taiwan.
I saw the map to come here.
This year hasn't been very good for me.

That cow is not mine.
The sea is blue.
Go west to get there.

Strict score: 25
Lenient score: 27

Subject 3

This cake is delicious.
My hand is burning.

This week I'm planning to work very hard.
I think tomorrow it may rain.

I have a duck in my farm.
I usually have a pen with me
My car has often to be taken to the gas station.

I usually go to the club at the weekends.
I love spring time.
I usually use a knife during the meal.

My arm is aching.
The sky is blue today.
I loved that film the Deer Hunter.

I have a desk in my bedroom.
I usually take the same road to my house.
My brain is always working.

The sun is shining today.
I should always keep my mouth closed.
I always have a bag with me.

I usually have to go to the bank.
I like very much egg.
My hair is too long.

I'm not very good at using tools.
I have a map of Santa Catarina in my house.

I usually take the bus to come to university.
My cousin lives in the west.

Strict score: 25
Lenient score: 26

Subject 4

I made a cake.
I washed my hand.

We're at the end of the week.
There's rain today.

I saw a duck.
I write with a pen .

I didn't go to the club this week.
I love the spring.
I use a knife to cut the bread.

I broke my arm.
The sky is grey today.
I played with a ball.

I'm sitting in a desk.
The teacher talked about brain damage today.

There's no sun today.
My mouth is dry.
I had to fill in a file.

I have to go to the bank.
I love egg.
I'll have my hair cut.

I could see the time in that clock.
I need this tool to open the window.
Where can I find a map?

It's been a long time I haven't seen a cow.
I'll go home by bus.

Strict score: 25
Lenient score: 25

Subject 5

The cake is in the oven.
My hand has five fingers.

There's no rain today.

There are ducks in the farm.
The pen is red.

I don't belong to any club.
I have many knives.

I have two arms.
The sky is blue.
The deer lives in the forest.

The tape is on the desk.
The road is wide.

The sun is yellow.
My mouth is for speaking.
The key is in the door.
I have a bag.
The file is in my bedroom.

The bank is open.
I'm wearing a shirt.
The egg has two parts.
I have a date.
My hair is short.

The clock is new.
The wave was big.
I have five tools.
I don't wear coats.
The map is on the wall.

I don't like cows.
I like working in pair.
I don't' play the drums.
The sea is blue.
I'm waiting for the bus.

Strict score: 25
Lenient score: 32

Subject 6

The cake is sweet.
My hand is dirty.

It will be next week.
The rain is falling heavily.

The duck is near the water.
My pen is brand-new.
The gas station is right over there.

It happened last spring.
I need a small knife.

The Deer Hunter is good film.
I like to play ball games.

It's on my desk.
This is the road to San Francisco.

The sun is hot.
My bag is empty.
Your paper is in the file.

The bank is closed.
She's got a beautiful hair.

The clock is right.
It happened last year.

The cow is eating grass.
The bus was late.

Strict score: 22
Lenient score: 22

Subject 7

I'm great at making cakes.
My hands are dry.

Last week I got a present.
Is it going to rain?

I don't really like a bird which is called duck.
I have two pink pens in my purse.

Spring is now coming.
I cut my finger with a knife.

My right arm is short.
The sky is blue today.
I gave him a ball.

Your desk is full.
I took a dusty road to go there.
My brain is not functioning well.

The sun is shining outside.
I have a file in my computer.

I fried an egg for lunch.
I had a date last night.
My hair looks good.

There's a clock in the wall.
Nice wave in your hair.
Last year I passed an examination.

Can you play the drums?
I took a bus to come to university.
Take west to go downtown.

Strict score: 21
Lenient score: 25

Subject 8

Can you bake a cake?
Give me your hand.

This has been a long week.
It rained a lot yesterday.

What a kind of a duck is this?
I'd like a red pen.

I'm a member of this club.
Spring is my favourite season.
Let go of this knife.

He hurt himself in the arm.
My father used to hunt deer.

This is my desk.

Open your mouth.
I lost my keys.
Where is my bag?
I have a big file.

I have an account at the Bamerindus bank.
Please don't give me any eggs.
She has long hair.

I like this clock.
Could you lend me your tool?
I bought this car last year.

Milk comes from cows.
You should take that bus.
I want to live in the west.

Strict score: 21
Lenient score: 25

Subject 9

I like chocolate cake.
Give me your hand.

I have many things to do this week.
I hope it is not going to rain.

Old McDonald had a farm and on his farm there was a duck.
My pen is blue.

I like to go to the club.
I like spring time.
Give me a knife.

Hold me in your arms.
The sky is blue.
My children like to play with the ball.

I have a desk in my room.
Today my brain is tired.

I like when the sun is shining.
Open your mouth.

I have to go to the bank.
I have to have my hair cut.

The clock is mine
This year I have to finish my dissertation

Everyday I take the bus.

Strict score: 20
Lenient score: 21

Subject 10

I love chocolate cake.
My hand is full of fingers.

The week has started.
The rain is falling.

(3)
I have a duck.
My pen is yellow.
My car needs some gas.

The club is closed.
I love spring.
The knife is sharp.

My arm is aching.
There's a deer over there.

The desk is brown.

There's sun today.
My key is on the table.
I have a wonderful bag.
The file is overloaded.

There's an egg in the fridge.

This year is gonna be a wonderful year.

The cow is grazing.

Strict score: 20
Lenient score: 20

Subject 11

I like cake.
My hand is wet.

Last week was very good.
The rain started right now.

The duck is beautiful.
I have a beautiful pen.

I went to the club.
We are in the spring.
My knife doesn't cut very well.

My arm is broken.
The sky is very beautiful.
I have a ball.

I like to study in my own desk.
There's a road in front of my house.

I lost my key.

I hate egg.

My clock doesn't work.
That's my best year.

I love when the sea is blue.
I come to the university by bus.

Strict score: 20
Lenient score: 20

Subject 12

I don't like cake.
My hand is dirty.

I need to study this week.
I think it's going to rain.

My brother has a duck.
I have a red pen.
I need to buy gas.

I love spring.
Knives are dangerous.

My arm is long.
The sky is blue.
I have a ball.

I bought a desk for my computer.
I think my brain doesn't work very well.

The sun is beautiful.
I need to find a file.

I don't like eggs.
I have a date today.
I need to cut my hair.

I intend to travel this year.
I hate to take a bus.

Strict score: 19
Lenient score: 21

Subject 13

I want to buy a cake.
Give me your hand.

Next week I'm going to travel.
There isn't any rain today.

This duck is beautiful.
I need a pen.
I'm running out of gas.

Let's go to the club.
I love the spring.
I need the knife to cut the meat.

My arm is hurt.
There's a cup on the desk.

The sun is shining.
My bag is empty.

I'm going to the bank.
Your hair is very beautiful.

This is a tool for gardening.
I need a map.

I'm going to take the bus in fifteen minutes.

Strict score: 19
Lenient score: 19

Subject 14

I eat cake everyday.
Give me your hand please.

This week I will finish this work.
It's going to rain tomorrow.

I never hunted a duck.
I will wright with a pen.
I need gas.

Let's go to the club.
I will use this knife.

My arm hurts.
What a blue sky.
I want to hunt a deer.

Put it on the desk.

The sun is shining.
Put it in the file.

I'll eat an egg.
I'll cut my hair.

Last year I was very busy.

I wanna take that bus.

Strict score: 19
Lenient score: 19

Subject 15

I love cake.
His hand is hurt.

We're having a nice week.
According to the sky it's not going to rain.

I love to eat duck.
She will write with a pen.
Pedro has to stop in a gas station.

Many people enjoy going to the club on the weekends.
I hate knives.

Pedro broke his arm last week.
The sky was full of stars last night.
The deer is a beautiful animal

Doing this activity I have to use my brain.

The sun in shining today.
When you go to the dentist you have to open your mouth.
I lost my key.

I hate to go the bank.
My mother does not like to eat eggs.
I like to comb my hair in the morning.

I love waves in the sea.
I bought a new coat yesterday.

When travelling I like to see cows.
He likes to play the drum.

Strict score: 19
Lenient score: 23

Subject 16

I love to eat cake.
I'm left-handed.

I love week days.
I don't like the rain.

The duck is a kind of animal.
I love to write with my pen.

I never go to the club.
Knife is a dangerous instrument.

My left arm is always injured.
The sky is beautiful.

Good-bye yellow brick road.
I usually break glasses.
Brain tumour is a terrible disease.

The sun is shining.
My file is always filled with a few things.

I usually go to the bank on Thursday.
I don't like eggs.
My hair is brown.

It's two o'clock.
I love to collect maps.
I went to Brasilia last year.

The cows are brown.
I like my pair of shoes.

Strict score: 17
Lenient score: 23

IV. Reading Span Test in English

Subject 1

band
oil

bird
spoon

train
corn

dog
church

lock
class
room

blouse
baseball

day
mail

mug
prize

finger
stamp
dress

wrist
cheese
face
tree

Score: 24

Subject 2

band
oil

bird
spoon

corn

dog
church

room

rock
baseball

fire
mail

mug
farm
prize

box
cup
stamp
dress

wrist
summer
face
tree

Score:23

Subject 3

band
oil

bird
spoon

train
gun
corn

dog
church

class
room

blouse
baseball

bath
mail

farm
prize

finger
stamp
dress

cheese
tree

Score:22

Subject 4

band
oil

bird
spoon

train
corn

dog
church
nut

lock
room

rock
seat
blouse
baseball

mail

door
mug
farm
prize

finger
box
cup
rice
dress

wrist
summer
tree

Score: 28

Subject 5

band
oil

bird
spoon

train
corn

dog
church
nut

lock
room

rock
seat
blouse
baseball

fire
day
mail

door
mug
prize

finger
cup
rice
dress

wrist
chair
cheese
face

Score: 29

Subject 6

band
oil

bird
spoon

train
gun
corn

dog
church

snow
lock
class
room

seat
blouse
baseball

day
wall
mail

door
mug
number
farm
prize

finger
box
cup
stamp
dress

wrist
summer
face
tree

Score: 33

Subject 7

band
oil

bird
spoon

train
gun

dog
church
nut

class
room

rock
seat
blouse
baseball

fire
day
bath
wall
mail

door
mug
farm
prize

box
cup
rice
stamp
dress

cheese
face
tree
Score: 32

Subject 8

band
oil

bird
spoon

train
gun
corn

nut

class
room

rock
blouse
baseball

fire
bath
wall
mail

mug
number
prize

finger
cup
stamp
dress

summer
cheese
face
tree

Score: 28

Subject 9

band
oil

bird
spoon

train
corn

dog
church

snow

seat
blouse
baseball

fire
bath
wall
mail

farm
prize

stamp
dress

face
tree

Score: 22

Subject 10

band
oil

bird
spoon

corn

dog
church
nut

room

blouse
baseball

mail

mug
prize

finger
cup
dress

face
tree

Score: 19

Subject 11

oil

bird
spoon

train
corn

nut

room

blouse
baseball

mail

door
mug
farm
prize

finger
cup
dress

chair
face
tree

Score: 20

Subject 12

band
oil

spoon

corn

church
nut

class
room

baseball

mail

prize

rice
dress

tree

Score: 14

Subject 13

band
oil

bird
spoon

train
gun
corn

class
room

rock
blouse
baseball

day
mail

door
prize

finger
box
dress

wrist
summer
tree

Score: 22

Subject 14

band
oil

bird
spoon

train
corn

dog
church
nut

snow
class
room

rock
seat
blouse
baseball

fire
mail

door
mug
farm
prize

finger
box
cup
rice
dress

cheese
tree

Score: 29

Subject 15

band
oil

spoon

corn

church

room

rock
baseball

fire
bath
mail

door
mug
number
prize

finger
stamp
dress

cheese
tree

Score: 20

Subject 16

band
oil

bird
spoon

gun
corn

dog
church
nut

lock
room

rock
baseball

bath
wall
mail

mug
farm
prize

dress

summer
tree

Score: 22

V Speech Generation Task

Subject 1

Ok, so, what I see is a house the parents are are I can see two rooms in fact there is a cut and I can see the kitchen where's there is a woman washing the dishes probably a maid because of the way she she is dressed there is a stove a sink and uh some things hanging uh pans something being cooked on the on the stove and in the oven well in the other room I can see a family the family there're five members father mother and three children two are playing one is studying the man is uh well he wa at least was reading something he has his hair his uh leg uh hurt so it's resting there and then there's the woman who's ironing there typical of a mother and uh one of the ch one of the children is studying by the window there is a clock and it's now ten-fifteen there's also a fireplace there seems to be fire in the fireplace and there's a plant uh some books and some toys well in terms of my impression of the picture I see that uh it's a kind of typical family where while the man is sitting and reading the woman is doing housework and while the older uh the oldest child is uh probably doing homework the younger ones are paying with toys.

number of words: 223

Subject 2

Well that's a eh eh an interesting picture of a family in a house probably at the end of the day because dad's back home oh poor dad he probably broke his uh left... luh left foot (laugh) and mom as always is cleaning and washing and well she's working at that and the children are playing and there's a lady by the window she's writing a a letter probably to a friend she's probably younger than mother I'm not sure if she's her daughter or what... and... there's a maid in the kitchen and by the way she's black...(laugh) and uh this I would say that the family is a middle-class family you know uh in America or in an European country because of the fireplace there's you know there's fire in the fireplace uh and the family is enjoying a an evening oh now I see there's a clock there it's a quarter past ten so the children should be going to bed pretty soon and uh I just wish the mother would be talking to to the father instead of ironing her clothes uh she could uh or maybe they could be reading a book together or or just enjoying their time together that's it.

number of words: 195

Subject 3

Ok so it's a house and there is a kitchen and a living room in the kitchen there is probably a maid and in the living room there is there are all the family right? including the father the mother and the three children so the father is reading the mother is ironing the clothes one of the child is writing and the other two are playing and the maiden who is in the kit é the kitchen she is washing the dishes right? and there is a clock in the living room there is a pa fireplace uh and there are the toys all around there is a dog a tree a small tree in a vase there are some I I guess there are some books on the over the fireplace there is a table where one

of the children is writing I don't know if she's really a ch ę a child because now it seems that she is a bit older perhaps she is a uhm a relative I don't know and in the kitchen there is a a uhm there is a stove there there is a a cupboard there is the sink and the faucet and the thrash can there is a cat there is something in the oven I guess it's a cake and I think that that's all it's I think it's a typical family (laugh) scene.

number of words: 225

Subject 4

Okay this is a very colourful picture it's a house there is a family and a maid the maid is working in the kitchen she's washing the dishes uh it's a middle-class family I suppose there is a man sitting on the sofa he has a broken leg he's reading a magazine or a newspaper there is a woman ironing a shirt white shirt there are two children playing with cars uh there's a woman writing on a de on a table she's probably writing a letter she's wearing a purple dress uh it's ten fifteen on the clock the clock is on the wall uh there's a fireplace near the the the sofa where the man is sitting uh there are books on the fireplace there is a cat a white cat in the kitchen uh the weather is kind of sunny the the sky is blue uh the chimney is ... is there's smoke coming out of s ch of the chimney uh it seems a happy family the there is a the the the children are boy and girl they are about the same age maybe six or seven years old uhm what else uh there are five cars they are playing with five cars uh the cat is near the the stove.

number of words: 203

Subject 5

Uh it's the picture of the interior of a house and it's a there is a family in the living room uh there is a maid uh in the kitchen everybody is doing something it seems like a the ING form of a (laugh) a lesson in in a book it seems like a Brazilian maid in the kitchen uh ... in the living room there is man he has a broken leg... uh there are two girls one of them is ironing a sh white shirt the other one is uh writing a letter there are two kids... playing on the ground uh ... it's there is a clock it's ten fifteen in the middle of the morning everybody is in the room the maid is washing the dishes she wouldn't do ah she is a oh ok there are some pans on the stove and she's preparing lunch it's too early to prepare lunch there is a cat trying to to jump in the stove to get food oh there is also a fireplace that it's not in Brazil and they have activated the fireplace uh é it's ten fifteen in the morning.

number of words: 180

Subject 6

I see a picture of a house é... mainly a kitchen and a living room and é in é we we I can see a family there and the cook who's washing dishes uhm this seems to be very relaxed everybody everybody is doing something different the children are playing é one man is seem he seems to have a broken feet foot he's reading a book é a woman on the table at the

table is writing something there is a fireplace the whole the whole é... the whole room seems very cozy and... this seem to be kind of a middle-class family é there is something cooking on the stove...é the cook is black woman the colours are kind of they're not too bright they're very pleasant (pronounced plisant) they are in accordance to the overall é... I never find this word when I need it well é anyway in accordance to the way everybody seems to be feeling.

number of words: 150

Subject 7

It looks like a traditional family uhm the kids are playing in the living room well not that traditional because uh the the mother the wife is working and the father is uh reading something and resting his feet on something ah I think he has a broken feet okay uh this person who's ironing her clothes I don't know whether this is a man or a woman (laugh) I'm not sure I'm not quite sure but there is a maid of course she's black (laugh) okay and she is cooking no she's washing the dishes and coking yeah uhm what else... it is in uh water colours... what else... don't know it's uh ten fifteen probably ten fifteen in the morning because it's a blue the blue sky is blue outside that's right okay uhm what else what should I say well the the girl is playing cards with the the the boy so that's nice too she's not playing with the dolls uhm ...oh... what else should I say about it ... it's probably winter ... because of the fireplace in fire uhm... what else...

number of words: 170

Subject 8

Okay, so it's a house uh there's a kitchen a maid washing dishes and cooking something there's a living room a family mother ironing and father reading book couple of kids playing by the fireplace and another person maybe another daughter I don't know writing uh... typical middle-class uh bourgeuois family (laugh) the maid is black typically and uh the woman the wife is uh working while her husband rests and reads something and so typically a traditional relationship and what else well it's a almost no it's a a quarter past ten in the morning in the evening I don't know maybe in the morning what else... uh... the man has something funny on on his foot I don't know he has a plaster in it maybe he does and he has his other feet right on top of the railway whatever it is the children are playing with and there's also a cat in the kitchen.

number of words: 152

Subject 9

Well it seems to be a holiday everybody is at home the maid in the kitchen doing the dishes perhaps they have just had lunch or breakfast or something like that the kids are

playing...there's a woman writing perhaps the mother the father is reading there's another one ironing the clothes... it's ten-fifteen they have had breakfast or something like that the cat is trying to eat the cake in the oven (laugh) I think he's not going to get it and the maid is preparing the lunch for sure there are pans in the oven ok... well that's...uh... the father has a f.. foot in ... bandage or something like that ... they have two children a boy and girl ... but they are playing with cars both of them.

number of words: 128

Subject 10
Well it's a house a common house not very common it seems to be a a medium class maybe because there is a maid and the maid uh she's black and she's wearing a pink apron there's something cooking here maybe beans uh there's a man well there's another kind of maid I think ironing passing clothes and the woman is writing in on the table a kind of 'perua' and there's a fireplace with the fire in it must be winter the children playing in the carpet oh sorry on the carpet the man is reading uh some book he has a broken feet well this is a common situation I guess nothing so special I think it's about ten fifteen well it must be morning because é the maid couldn't be cooking at that time well maybe maybe maybe not the house is kind of tidy it's not a messy only because of the toys the children are playing.

number of worods: 155

Subject 11

"It's a house... there is... a kitchen and a living room... there is a ... woman doing the dishes... there is a woman writing on a piece of paper... there are children playing... uh there is a there is man on the sofa he's reading and I think that uh it's a family the maid is in the kitchen and uh I think it is in Brazil because the maid is black (laugh) and uh...it's a: happy family uh... maybe the woman there is uh... that is uh writing something... maybe she's a secretary don't know and uh ... it's uh ten fiftenn (laugh) there's a cat in the kitchen...uh...that's all

number of words: 100

Subject 12

here's a maid in the kitchen she is uh cleaning the dishes there is a a cat near the I don't know fogão cooker and uh she's a black woman and there are a lot of people in the di in the living room there are two children they are playing one of them are cars you know boys are on pay playing always playing with carsd cars there is a man reading newspapers and I don't know he seems to be a nice person I don't know I like his his glasses and there's a woman and she's near the window and she's she seems to be writing probably a letter to a friend or I don't know probably she has a another son because I consider these two children uhm uhm the son and the daughter and probably she had another daughter she's living far from from from her uh I think it's ten-fifteen or (laugh) ten to three you know and there's it seems to be a man he's I don't know he's taking care of the clothes and uh there is uhm the the children seem to be so calm you know they are playing and enjoying the situation.

number of words: 194

Subject 13

"I can see... some children playing...the father is sitting ... he he has the his foot broken... his reading... he's probably looking at the children... uh the it the mother? (laugh) probably it is the mother I don't know... he's sitting at the desk writing near the window and there's someone there's someone in the kitchen...perhaps is the maid she's washing the dishes there's a cat near the the stove a white cat what else...there's a fire the children are near the fire uh it's interesting that the children are are playing with cars and they built a road that is right and (laugh) and the one of the father's foot is right in the way of the the road...and what else?

number of words:121

Subject 14

Well I can see a family first of all a black woman in the kitchen as always that's a problem in Brazil ... always we have black people working as employers from the black ones ... ... it's a I think it's a ... medium fam é class é family because they've got a fireplace it must be wint é winter because the fire is on uh the children are playing in the room as always making noise and the father is reading the newspaper or a book it seems to me as normal a newspaper like Diario Catarinense well as always he's he he's got a ...uhm his leg broken and he's reading patiently as always the mother is ironing some clothes he's helping I don't think is it seems to be a a woman but I think it is a man ... é she's a woman... and now we've got a girl writing something maybe she's writing a final paper (laugh).

number of words: 149

Subject 15

Well, this picture shows an harmonic family, and this kind of harmony is very discussed nowadays because ... people are trying to discover what is harmony what harmony in a family is...is the woman at home? the children playing or the woman working outside the home okay and this picture shows exactly this type of harmony discussed uh children are playing in the room in the living room with their toys uh a girl is is doing her homework daddy is sitting in the sofa reading a book ... uh the mother is ironing and in the kitchen there is the maid and this maid also represents something which is being discussed nowadays because she's black so this uh position black people uh always being...uh
slaves of a family okay?

number of words: 124

Subject 16

Okay well I can see a house a family uh uh ... together you know and a a lot of different members of the family each one of them doing different activities uh we see a I can see first of all in the left side of the picture uh the maid in the kitchen in the kitchen uh I think she might she se she might be yeah she's doing the dishes uh a in the living room is uh I can see a all the members of the family I suppose uh the father uh sitting uh on the sofa resting and reading a magazine or a book and uh there is uh two women there're two women I don't know whether they are which one of them might be the the men's wife one of them is ironing the clothes uh the other one is sitting on a on a table she's writing something and uh right uh in the middle of the picture almost now uh down le below I I can see the children uh chil uh a boy and a girl playing the boy is playing with uh cars little cars okay.

number of words: 184

VI. Subject's oral reading times (in seconds):

Subject 1: 137.58
Subject 2: 124.98
Subject 3: 141.10
Subject 4: 123.05
Subject 5: 148.76
Subject 6: 124.54
Subject 7: 125.85
Subject 8: 120.35
Subject 9: 113.98
Subject 10: 141.98
Subject 11: 154.34
Subject 12: 171.98
Subject 13: 117.29
Subject 14: 129.87
Subject 15: 159.46
Subject 16: 116.18

VII. **Oral Slip Task (total number of errors):**

Subject 1: 0

Subject 2: 2

Subject 3: 1

Subject 4: 0

Subject 5: 0

Subject 5: 0

Subject 6: 0

Subject 7: 2

Subject 8: 2

Subject 9: 4

Subject 10: 1

Subject 11: 1

Subject 12: 3

Subject 13: 2

Subject 14: 1

Subject 15: 1

Subject 16: 3

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