The relationship among pre-task planning, working memory capacity, and L2 speech performance: a pilot study

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Abstract: *This article reports on a pilot study that investigated the relationship among pre-task planning (Skehan, 1996, 1998), working memory (WM) capacity, and L2 speech performance. Participants were 25 learners of English as a foreign language performing two tasks each. Results show that (1) planning leads to gains in fluency and accuracy but not complexity of L2 speech performance, (2) there are no significant correlations between WM capacity and L2 speech performance of the first narrative tasks for both control and experimental groups under no planning conditions, (3) there are significant correlations between WM capacity and L2 speech performance of the second narrative task of the experimental group (planning condition), and also between WM capacity and L2 speech performance of the second narrative task of the control group (no planning condition). Therefore, results are not conclusive and suggest a complex relationship between pre-task planning, WM capacity and L2 speech performance. Results are discussed in terms of Fortkamp's (2000) view of L2 speech production as a controlled processing activity (Engle, Kane & Tuholsky, 1999).*
Key words: *working memory; planning; oral performance.*

Introduction

Over the last decade there has been a considerable body of research on tasks (Ellis, 2005). Within the study of tasks, one construct which has attracted much attention is planning. According to Ortega (2005, p.77), planning seems to have evolved into an area of inquiry in its own right and "has become a burgeoning area of investigation within task-based learning". Planning is conceptualized as the opportunity to plan task performance before the *actual* performance. In general, studies have shown a positive impact of planning on L2 performance. Several studies have shown that planning leads to gains in fluency (Foster; Skehan, 1996; Mehnert, 1998; Ortega, 1999). Planning has also led to gains in accuracy, although results have been more mixed in this respect (Ellis, 1987; Mehnert, 1998; Ortega, 1999; Skehan; Foster, 1999). Finally, studies have also shown that planning enhances complexity (Crookes, 1989; Foster; Skehan, 1996; Mehnert, 1998; Ortega, 1999;

Yuan; Ellis, 2003). One interesting finding of the studies on the impact of planning on L2 speech performance is the evidence of trade-off effects. Foster and Skehan (1996), Mehnert (1998), and Yuan and Ellis (2003) discuss results of their studies in terms of an attentional model of learning and performance. In this sense, they emphasize that there are trade-off effects among the goals of fluency, complexity and accuracy in the context of the use of the learners' limited capacity attentional[1] resources. In other words, these three goals of performance-fluency, accuracy and complexity-compete for learners' limited attentional resources. The trend of research results tends to show that planning leads to gains in fluency and complexity at the expense of gains in accuracy (Mehnert, 1998). Working memory (hereafter WM) is the limited capacity cognitive system responsible for both storage and processing of information during the performance of complex cognitive tasks (McLaughlin; Heredia, 1996; Daneman; Carpenter, 1980, 1983; Baddeley, 1992a). Despite the fact that researchers explain results in terms of learners' limited attentional resources, individual differences in WM capacity have not been taken into account in any of these studies as a feasible variable affecting learners' planned performance. Although planning is a means of helping learners overcome limitations in WM capacity and improve performance (Ellis, 2005), in my view, there are at least two reasons to suppose that individual differences in WM capacity may still emerge in planned performance. First, planning seems to assist performance by triggering a range of strategic, metalinguistic and metacognitive behaviors (Ortega, 2005). Research on memory has shown that individuals with higher WM capacity tend to be more strategic (Mendonça, 2002; McNamara; Scott, 2001; Weissheimer, 2004), thus, WM capacity may play a role on how successful one is in engaging in strategic behavior during planning. Second, the benefits of planning on performance may also depend on the ability to execute what was planned into performance (Ortega, 1999). In

[1] In the present paper, the terms limitation in attentional resources and limitations in WM capacity will be used interchangeably as they have frequently been used in the literature. However, it is beyond the scope of this paper to discuss the relationship between attention and working memory. The present researcher is fully aware that although researchers claim that there is a close relationship between these two constructs, this relationship is still an issue of debate in cognitive psychology (see Miyake; Shah, 1999 for a review).

other words, on the ability to actually *retrieve* what was planned into on-line performance. According to Rosen and Engle (1997), WM capacity plays a crucial role in retrieval, that is to say, individuals with higher WM capacity tend to more effectively retrieve information during the performance of complex cognitive tasks.

Review of the literature

L2 Speech Production

Levelt's (1989) model of L1 speech production has four specialized components, which underlie the speech production: the conceptualizer, the formulator, the articulator, and the speech comprehension system. In the conceptualizer, the message content is planned by retrieving background knowledge, knowledge about topic as well as knowledge of discourse patterns. In the formulator, the preverbal message turns into a linguistic structure through two processes: grammatical encoding and phonological encoding. In the articulator, the phonetic plan is executed and results in overt speech. Finally, the speech comprehension-system makes overt and internal speech available for monitoring.

According to Levelt (1989, p.10), working memory plays a crucial role in the act of speech. It is the limited capacity system that makes information currently accessible to the speaker- processed information in message generation and monitoring. "It is the information attended to by the speaker". Speaking requires procedural knowledge because of the limited nature of working memory capacity and the usual speed of speech production (Levelt, 1989).

De Bot (1992) made a few adaptations to Levelt's (1989) model in order to account for L2 speech production. The first assumption of De Bot's (1992) model is that the speaker has, first of all, to decide what language to speak. This decision takes place in the conceptualizer, more specifically, during macroplanning. As far as the formulator is concerned, De Bot (1992) proposes that it is language-specific, thus, different procedures are applied to the grammatical encoding of L1 and L2 speech. Moreover, De Bot (1992) assumes that the mental lexicon is language independent,

that is, there is only a single lexicon; however, it is divided into different subsets which undergo activation in different extents, according to the language being spoken. Finally, De Bot (1992) suggests only one articulator for both languages and it is assumed to store a large amount of sounds and pitch patterns from both L1 and L2. By assuming only one articulator in which sounds and pitch patterns of both languages are stored together, L1 interferences in L2 can be explained. While L1 speech production is highly automatized, Poulisse (1997) postulates that: (1) L2 knowledge is not complete, (2) L2 is more hesitant, has shorter sentences and slips of the tongue, (3) L2 may carry traces of L1 and (4) proficient speakers can keep one or more languages apart when they wish to do so. Thus, such a high degree of automatization as in L1 does not apply to an L2 to the same extent. For this reason, in many situations L2 learners may need to creatively construct plans for communicative situations since ready-made chunks may not be available and this activation of procedures demands high degrees of cognitive control (Mehnert, 1998). These control processes take place under a limited capacity cognitive system, namely, working memory.

Working memory and L2 speech performance

The construct of working memory is, according to Miyake and Shah (1999, p.xii), "one of the hottest topics in Cognitive Psychology and Cognitive Neuroscience". Even with a whole body of research on working memory (Baddeley, 1990, 1992a, 2000; Baddeley; Hitch, 1974; Baddeley; Logie, 1999; Cowan, 1999; Engle; Kane; Tuholsky, 1999, among many others), there are still controversies in the field as regards the nature, structure, and function of working memory. However, the view of working memory as an active cognitive system, responsible for *both* storage and processing as opposed to the traditional concept of short-term memory as a passive buffer responsible for storage of information, is widely accepted in the current days (see Miyake; Shah, 1999 for a review). Daneman and Green (1986) developed the Speaking Span Test (hereafter SST) in order to investigate whether WM capacity would be a good predictor of learners' ability to use context to both comprehend and *produce* words in their L1. They

tested whether there was a relationship between WM capacity and the ability to produce synonyms for words presented in context. They found a correlation between WM capacity scores and the synonym lexical test scores. Later, Daneman (1991) investigated whether WM capacity could account for individual differences in verbal L1 fluency. Fortkamp (1999) expanded Daneman's (1991) study in order to investigate whether working memory would be a good predictor of *L2* verbal fluency. Fortkamp (1999) also found significant correlations between WM capacity as measured by the SST and L2 speech rate in the speech generation task. Fortkamp (2000) investigated whether WM capacity would predict individual differences in L2 fluency, accuracy, complexity and weighted lexical density. Results indicated that individuals with higher working memory capacity tend to be more fluent, accurate and complex in L2. Interestingly, the study provided evidence of trade-off effects since accuracy, fluency and complexity of speech tended to be achieved at the expense of weighted lexical density.

Planning and L2 speech performance

A considerable body of research has suggested that allowing learners time to plan their performance before the *actual* task performance leads them to produce more fluent (Foster; Skehan, 1996; Mehnert, 1998; Ortega, 1999), accurate (Ellis, 1987; Mehnert, 1998; Ortega, 1999; Foster; Skehan, 1999) and complex L2 speech (Foster; Skehan, 1996; Mehnert, 1998; Ortega, 1999). Researchers have investigated planning from a variety of perspectives such as different types of planning (Foster; Skehan, 1996; Sangarun, 2005); different amounts of planning time (Mehnert, 1998); planning and different task types (Foster; Skehan, 1996); effects of planning on different levels of proficiency (Kawauchi, 2005), and what learners do when they plan (Ortega, 1999, 2005). In general, studies have shown a positive impact of planning on performance but gains do not seem to be achieved simultaneously to the same extent for the different aspects of performance- fluency, accuracy and complexity- since these aspects compete for learners' limited capacity attentional resources (Foster; Skehan, 1996; Mehnert, 1998).

The current study

Based on the preceding review, individual differences in WM capacity seem to be a potential source of individual differences in L2 speech performance. In addition to that, WM capacity may play a role in how successfully one may engage in strategies during planning as well as in how effectively one may retrieve what was planned into performance. Previous studies on planning have raised the issue of trade-off effects in performance due to limitations in attentional resources (Foster; Skehan, 1996; Mehnert, 1998; and Yuan; Ellis, 2003). However, individual differences in working memory capacity have not been taken into account as a feasible variable for affecting 'planned' performance. In order to address this gap, three research questions are pursued:

1. Does L2 speech performance (under no planning conditions) significantly correlate with learners' WM capacity ?
2. Does pre-task planning significantly increase fluency, accuracy and complexity of L2 speech performance?
3. Does L2 speech performance (under planning conditions) significantly correlate with learners' WM capacity?

Method

Design of the study

The study employed a between-subject design, in which participants in the control group completed both first and second narrative tasks under a no-planning condition, and participants in the experimental group completed the first task under a no-planning and the second task under a planning condition.

ParticipantsThe participants in the study were 25 adult learners of English at the Extracurricular Language Courses offered by the Federal University of Santa Catarina. They were all undergraduate students from a variety of backgrounds (engineering, biology and business, among others). There were 16 female and 9 male, and their ages ranged from 18 to 27. They were all intermediate learners from 7th and 8th semester classes.

Data collection procedures

Table 1.1 – Data collection procedures for the experimental group

PHASE	SETTING
1. Control of proficiency level / task 1 (no-planning condition)	Whole groups/Language Lab
2. SST	Individually with the researcher /room
3. Planning and performance of Task 2 (planning condition)	Individually with the researcher /room

Table 1.2 – Data collection procedures for the control group

PHASE	SETTING
1. Control of proficiency level / task 1 (no-planning condition)	Whole groups/Language Lab
2. SST	Individually with the researcher /room
3. Performance of Task 2 (no-planning condition)	Individually with the researcher /room

Data collection of the present study was divided in three phases as displayed in Tables 1.1 and 1.2. In the first phase, I selected 70 participants from three classes of semester 7 and four classes of semester 8 at the Extracurricular Language Courses. Participants of the same class did the first task all together in the language lab. The first task consisted of a picture-cued narrative. Participants had to look at 9 pictures and organize them in a sequence in order to tell a story. Participants' oral production was recorded and given to three raters who were instructed to evaluate their performance according to the rating scale proposed by D'Ely and Weissheimer (2004). According to this scale, participants are assessed in terms of fluency, accuracy and complexity on a scale from 0 to 5. Raters were all experienced ones who have been trained and have used the scale previously. The scores given by the raters were submitted to statistical treatment in order to verify the inter-reliability of the rating procedures. A Cronbach Alpha Coefficient

was run in order to find the degree of reliability, the means and the standard deviation of participants' performance. Reliability estimates for the rating procedure were .85, which is considered an acceptable level.The mean of participants' performance was 2.5. In order to be able to select 25 participants at proximal[2] levels of proficiency, participants with means ranging from 2.2 to 3.2 were selected. Due to participants' time constraints and for the sake of practicality, the first narrative task was used for assessing proficiency level as well as for eliciting the first sample of speech in the no planning condition. After selecting the 25 participants of the present study according to their level of proficiency, they were randomly divided into a *control group* and an *experimental group*. Independent t-tests indicated no significant differences between the two groups in the performance of the first task in terms of accuracy (errors per 100 words: t = .549; p = .591), fluency (Speech rate unpruned: t = .206; p = .143 and speech rate pruned: t = .343; p = .178) and complexity (clauses per c-unit: = .198; p = .202), thus, the two groups were similar in terms of proficiency level. In the second phase of data collection, all participants of both groups performed a Speaking Span Test (SST) in order to assess their working memory capacity scores. Each participant completed the test individually with the present researcher in the language lab. In the third phase of data collection, participants of the *control group* performed a second picture-cued narrative task also under a no-planning condition. On the other hand, participants of the experimental group performed the second narrative task under a planned condition in which they had 10 minutes to plan their performance.

The speech generation tasks

The two tasks used in the present study were both 'there-and- then' picture cued narratives (Robinson, 1995). In both tasks, participants had 40 seconds to look at the set of pictures and then put pictures away. According to Robinson (1995), these tasks are more complex since in 'there-and-then' narratives, as opposed to 'here- and-now', the participants are not allowed access to the visual stimuli of the tasks during performance. In order for

[2] In order to investigate individual differences in WM, it is important that individual differences in levels of proficiency are minimized as much as possible.

individual differences in WM capacity to emerge, the task performed has to be complex (Just; Carpenter, 1992; Tomitch, 1996; Fortkamp, 2000), thus, the choice of 'there-and-then' narratives for the present study.The order of tasks was counterbalanced among participants. In other words, half of the participants carried out Task A as their first task (no-planning condition) and Task B as their second task (planning condition). The other half of participants carried out the opposite procedure; they performed Task B as their first task and Task A as their second task.The control group carried out both tasks under a no-planning condition. They were instructed to start telling their stories immediately after looking at the pictures for 40 seconds. On the other hand, participants of the experimental group were instructed to plan the second task for 10 minutes after looking at the pictures for 40 seconds. The pictures were removed from them before they started planning their task. Since one minute planning may be enough for gains in accuracy to take place (Mehnert, 1998), the purpose of giving both groups only 40 seconds to look at the pictures was to minimize planning as much as possible while they were looking at the pictures.

The Speaking Span Test

A version of Daneman and Green (1986) Speaking Span Test was used in the present study. The test contained 60 unrelated words organized in three sets each of two, three, four, five and six words. Each word was presented individually, on the middle line of a computer screen for one second. Participants were instructed to read each word silently. At the end of each set, question marks appeared. These marks signaled the number of words that had to be stored and the number of sentences to be produced. Participants were instructed to use the words in the exact form and order they appeared to generate syntactically and semantically acceptable sentences, aloud, in English. There were no restrictions concerning the length or complexity of the sentences produced. For instance, after being presented a set of three words: guy point train, a participant produced the following sentences: "I am a guy", "what's your point?"; "The train was dirty". A training phase (20 words) preceded the testing phase (60 words).Participants' speaking span score was defined as the maximum number of words for which

they could generate grammatically and semantically acceptable sentences in English. Following Daneman (1991) and Daneman and Green (1986), in this study, participants' responses, which were recorded, transcribed and analyzed, generated two different speaking span scores: a speaking span *strict score*, when all the sentences the subject produced contained the target word in the exact form and order of presentation, and a speaking span lenient score, when credit was given for sentences that contained the target word in a form other than that of presentation (e.g., target word being 'guy' and the word in the sentence produced being 'guys'), and half credit was given to words recalled in a different order. No credit was given to ungrammatical sentences in terms of syntax and semantics.

The measures of L2 speech production

Measures of accuracy, fluency and complexity were used in the present study to evaluate participants' oral performance. These measures have all been used in previous studies (e.g. Foster; Skehan, 1996; Bygate 2001; Skehan; Foster, 1999, 2005; Mehnert, 1998; Ortega, 1999 among others).

Fluency

Fluency was operationalized in two versions of speech rate: unpruned and pruned (Lennon, 1990; Ortega, 1999; Fortkamp, 2000). Speech rate unpruned, which was calculated by dividing the total number of semantic units produced, including repetitions, by the total time –including pausing time and expressed in seconds- the participant took to complete the task. Speech rate pruned is calculated in the same way but excluding repetitions. The resulting figure was then multiplied by 60 to express the number of semantic units produced per minute.

Accuracy

Accuracy was operationalized in terms of number of errors per a hundred words (Mehnert, 1998; Fortkamp, 2000; Sangarum 2005). It was obtained by dividing participants' total number of

errors by the total number of words produced and multiplying the result by 100. All errors in syntax, morphology or lexical choice were counted, including repetitions. Errors which were immediately self-corrected were not counted and errors in pronunciation were not included in the analysis.

Complexity

Complexity was measured through the number of clauses per c-unit (Foster; Skehan, 1996), which was obtained by dividing the total number of clauses in the speech sample (either a simple independent finite clause or a dependent finite clause or nonfinite clause) by the number of c-units (independent utterances providing referential or pragmatic meaning).

Data analysis

The normal distribution of the two groups' scores on all variables (Fluency, accuracy, complexity and WM capacity) was tested by checking skewness and kurtosis. A series of Pearson Correlations was performed to verify the relationship between performance and WM capacity. One way ANOVAs were run to compare the performance in the second narrative task of the two groups (under a planning condition for the experimental group and under a no-planning condition for the control group). The alpha for achieving statistical significance was .05.

Results

In this section, results will be briefly reported. In the next section, results will be further discussed by readdressing research questions in light of existing research in the areas of pre-task planning, WM capacity and L2 speech performance.

Does L2 speech performance (under no-planning conditions) significantly correlate with learners' WM capacity?

In the present study, L2 speech performance under no-planning condition is the one in which participants had no time to plan before performance. The control group carried out both first and second narrative tasks under no-planning conditions. However, the experimental group carried out only the first narrative task under no-planning condition.

Table 2 – Correlations between measures of working memory capacity (lenient and strict scores) and speech production in the *first* narrative task (no-planning condition) *of control group*

WM	Errors per 100 words	S (2-tailed)	Speech rate unpruned	S (2-tailed)	Speech rate pruned	S (2-tailed)	Clauses per c-unit	S (2-tailed)
Lenient scores	-.330	.271	.058	.850	.079	.798	-.281	.353
Strict scores	.100	.744	.271	.371	.253	.404	-.308	.306
N	13		13		13		13	

* p<0. 05

Table 3 – Correlations between measures of working memory capacity (lenient and strict scores) and speech production in the *second* narrative task (no-planning condition) of *control group*

WM	Errors per 100 words	S (2-tailed)	Speech rate unpruned	S (2-tailed)	Speech rate pruned	S (2-tailed)	Clauses per c-unit	S (2-tailed)
Lenient scores	.149	.626	.129	.647	.116	.705	.234	.441
Strict scores	-.051	.870	.580*	.038	.588*	.034	-.163	.595
N	13		13		13		13	

*p<0. 05 Correlation is significant at the 0.05 level (2-tailed)

Table 4 – Correlations between measures of working memory capacity (lenient and strict scores) and speech production in the *first* narrative (no-planning condition) task of *experimental group*

WM	Errors per 100 words	S (2-tailed)	Speech rate unpruned	S (2-tailed)	Speech rate pruned	S (2-tailed)	Clauses per c-unit	S (2-tailed)
Lenient scores	-.468	.125	.130	.686	.195	.543	.569	.055
Strict scores	-.168	.602	-.028	.930	.104	.749	-.214	.504
N	12		12		12		12	

*p<0. 05

As can be seen in Table 2, the correlations between measures of working memory capacity and fluency scores (SRU, SRP), failed to show significance. Similarly, correlations between measures of WM capacity and accuracy scores (ACC) failed to reach significance. Finally, WM capacity scores and complexity scores also failed to show significance. Thus, measures of WM capacity failed to show significance with *all* measures of L2 speech production (in no-planning conditions) in the performance of the *first* narrative task of the control group. As for the correlations between the measures of WM capacity and measures of L2 speech performance (in no planning conditions) in the *second* narrative task of the *control group*, the only correlations which reached significance were the ones between WM capacity *lenient* scores and fluency. As can be seen in Table 3, Speech rate unpruned (SRU) and speech rate pruned (SRP) both significantly correlated with working memory lenient scores, r(12) 0.579* and r(12)= 0.588*, respectively. These results indicate that higher WM spans were the most fluent ones in the performance of the second narrative task, which was carried out in no-planning condition, that is, participants had no time to plan their performance. By contrast, *no* correlations between WM capacity measures (either strict or lenient) and accuracy (ACC), r (12) = -0.056 and r (12) = 0.149, reached significance. The same lack of significant correlation is also shown between both measures of WM capacity (strict and lenient) and complexity scores r (12) = 0.162 and r (12) =0.234, respectively.As can be seen in Table 4, the

correlations between measures of WM capacity and fluency scores (SRU, SRP) failed to reach significance. Likewise, correlations between measures of working memory capacity and accuracy scores failed to reach significance (ACC). Finally, WM capacity scores and complexity scores also failed to show significance. Thus, measures of WM capacity failed to show significance with *all* measures of L2 speech performance (no-planning condition) of the *first* narrative task of the experimental group. These results are similar to the results displayed in Table 2 in which performance of the *control* group in the *first* narrative task also yielded *no* significant correlations between measures of WM capacity and measures of L2 speech performance. In brief, results show no correlations between WM capacity and L2 speech production in the performance of the first narrative task of the control group (no planning condition) and no correlations between WM capacity scores and L2 speech production in the performance of the first narrative task of the experimental group (no planning condition). As for the performance of the second narrative task of the control group (no planning condition), significant correlations were found between WM capacity lenient scores and fluency as measured by both speech rate unpruned and pruned.

Does pre-task planning lead to significant differences in L2 speech performance in terms of fluency, accuracy and complexity?

Table 5 – Summary of descriptive statistics for the four performance measures

Variable	Condition	Control and Experimental	N	Mean	Std. Deviation	Std. Error Mean
Errors per 100 words	No planning	Control	13	6.6392	2.5933	.7192
	Planning	Experimental	12	2.4192	1.3004	.3754
Speech rate unpruned	No planning	Control	13	74.1554	13.8731	3.8477
	Planning	Experimental	12	92.7867	15.1195	4.3646
Speech rate pruned	No planning	Control	13	71.8031	14.0761	3.9040
	Planning	Experimental	12	90.3650	14.7413	4.2555
Clauses per c-unit	No planning	Control	13	1.3785	.1909	5.295E-02
	Planning	Experimental	12	1.4425	.2180	6.293E-02

Table 6 – Summary of findings from ANOVAs in all performance measures

		Sum of Squares	df	Mean Square	F	Sig.
Errors per 100 words	Between Groups	111.128	1	111.128	25.739	.000
	Within Groups	99.302	23	4.317		
	Total	210.430	24			
Speech rate unpruned	Between Groups	2166.058	1	2166.058	10.327	.004
	Within Groups	4824.150	23	209.746		
	Total	6990.208	24			
Speech rate pruned	Between Groups	2149.961	1	2149.961	10.371	.004
	Within Groups	4768.014	23	207.305		
	Total	6917.975	24			
Clauses per c-unit	Between Groups	2.559E-02	1	2.559E-02	.613	.442
	Within Groups	.960	23	4.175E-02		
	Total	.986	24			

Table 5 presents a summary of the descriptive statistics for the four performance measures of the second narrative tasks of the control group (no planning condition) and the experimental group (planning condition). As can be seen, all means favored the experimental group (planning condition) over the control group (no-planning condition). In order to further determine where the statistically significant effect in favor of the planning condition might be obtained, univariate analyses of variance were performed.Table 6 shows a summary of the ANOVAs for the four performance measures. As can be seen, speech rates unpruned and pruned were significantly higher in the planning condition. As regards grammatical accuracy, the number of errors per a hundred words was significantly lower in the planning condition. Finally, the difference in the mean of clauses per c-unit in favor of the planning condition was not statistically significant. It important to highlight that there were no significant differences between the two groups in the performance of the first task in which both groups performed under no planning condition.

Does L2 speech performance (in planning conditions) significantly correlate with learners' WM capacity?

Table 7 – Correlations between measures of working memory capacity (lenient and strict scores) and speech production in the *second* narrative task (planning condition) of the *experimental group*

WM	Errors per 100 words	S (2-tailed)	Speech rate unpruned	S (2-tailed)	Speech rate pruned	S (2-tailed)	Clauses per c-unit	S (2-tailed)
Lenient scores	-.916**	.000	.576	.050	.585*	.046	.036	.912
Strict scores	-.295	.236	.291	.359	.283	.372	.261	.413
N	12		12		12		12	

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

As can be seen in Table 7, the correlation between speech rate unpruned and WM capacity lenient scores only approached significance r(12).576 *(p =.050),* whereas speech rate pruned correlated significantly with WM capacity lenient scores, r(12).585*. The correlations between accuracy and WM capacity lenient scores also reached significance, r(12).916**. There were no significant correlations between complexity and WM capacity lenient scores. In addition to that, there were no significant correlations between WM capacity strict scores and measures of L2 speech performance.

Discussion

This section readdresses the research questions of the study in light of the results reported in the previous section and existing research in the areas of working memory capacity, L2 speech production, and pre-task planning. The section is divided in two parts: 1.the relationship between WM capacity and L2 speech performance under no-planning and planning conditions, and 2. the impact of pre-task planning on L2 speech performance.

The relationship between WM capacity and L2 speech performance (under no- planning and planning conditions)

To reiterate, research questions 1 and 3 asked whether L2 speech performance (under no-planning and planning conditions) significantly correlates with learners' WM capacity. There were three instances of L2 speech performance under no-planning conditions in the present study: the *first* narrative tasks of both *control* and *experimental* groups, and the *second* narrative task of the *control* group. As regards the performance of the first narrative task of the control group, there were no correlations between WM capacity and measures of L2 speech performance. Likewise, the performance of the first narrative task of the experimental group yielded no significant correlations between WM capacity and L2 speech performance. These results contradict previous studies in the literature (Daneman, 1991; Fortkamp 1999, 2000). However, measures of WM capacity correlated significantly with fluency (as measured by speech rate unpruned and pruned) in the *second* narrative task of the *control* group which was also carried out under no planning conditions. These results, therefore, corroborate previous studies in the literature (Daneman, 1991; Fortkamp 1999, 2000). In face of these mixed results, the intriguing question to be asked seems to be: in no-planning conditions, why did WM measures *only* correlate significantly with *fluency* in the performance of the *second* narrative task of the *control* group?In order to propose a tentative explanation for these results, I start by highlighting the similarities and differences in the no-planning conditions of L2 speech performance in the present study. As previously stated, there were three instances of L2 speech performance under no-planning conditions in the present study: the first narrative tasks of both control and experimental groups and the second narrative task of the control group. In all no-planning conditions, participants had 40 seconds to look at the set of nine pictures, then, pictures were removed from them and they were supposed to start telling their stories immediately. The questionnaires applied to participants after performance of the tasks revealed that these no-planning conditions may have been extremely difficult for them. The following excerpts of the questionnaire answers illustrate that:

Excerpts

Participant 7: " time to look at the pictures was very short and I didn't understand the story after this time and I think my story was terrible because I didn't have what to say"
Participant 13: "It's impossible to understand the story, the sequence, the story in 40 seconds and it's impossible to tell a story after the 40 seconds, my vocabulary was very bad"
Participant 21: "It's good to do things in a calm way, I was so stressed"

As can be seen, the no-planning conditions seem to have been extremely difficult for participants of the present study. For individual differences in WM capacity to emerge, the task under performance has to be complex. In other words, tasks which are either *too* complex or *too* easy do not seem to reveal individual differences in WM capacity (Just; Carpenter, 1992; Tomitch, 1996; Fortkamp, 2000). The picture cued tasks chosen for present study- 'there and then' narratives- are considered complex (Robinson, 1995) and, thus, would allow individual differences to emerge. However, the time pressure imposed to look at the pictures in the no-planning conditions may have turned the task into an overly complex one. In face of these results, one question still remains: if lack of correlations between WM measures and L2 speech performance (in no-planning conditions) may be tentatively explained by the extreme complexity of the tasks and task performance condition, why correlations between working memory capacity measures and *fluency* in the performance of the *second* narrative task of the control group achieved significance? In the attempt to provide a tentative explanation for such question, I find it necessary to pinpoint the only difference between the second narrative task performance of the control group and the other two performance under no-planning conditions (first narrative tasks of control and experimental groups). In all tasks carried out under no–planning conditions, learners were given only 40 seconds to look at the set of pictures in order to tell the stories. The only difference between the *second* narrative task of the control group and the other no-planning conditions was the fact that learners had performed a narrative task under the same conditions a priori.

Thus, participants were somehow familiar with task type (there-and- then narratives) and task conditions. I may argue that participants in the control group had a content free plan of the first narrative task when they performed the second narrative task under a no-planning condition. Greene (1984) and Greene and Capella (1986) provided learners opportunities to plan the sequence of problem solution tasks, and results showed that even this type of content free planning of task sequences releases cognitive pressure and leads to fluency enhancement. My proposal is that since participants in the control group carried the second narrative task having a content free plan of the first narrative task, cognitive pressure may have been released and the second task condition was no longer *too* complex, but complex *enough* for individual differences in WM capacity to emerge. Therefore, measures of WM capacity did correlate with fluency measures. It appears that having a content free plan of the task may have been enough to release cognitive pressure as long as being able to convey ideas in real time is concerned, that is as long as fluent speech production is concerned. However, in terms of accuracy and complexity of speech the task may still have been too complex and all learners may have performed up to the limits of their cognitive resources, thus, explaining the lack of significant correlations between WM capacity scores, accuracy and complexity of speech performance.As previously stated, there was only one instance of L2 speech performance under planning conditions, that is, the performance of the second narrative task of the experimental group. As for the relationship between WM capacity and L2 speech performance under planning conditions, results revealed that WM capacity lenient scores significantly correlated with fluency and accuracy of L2 speech performance. These results are in line with previous studies in the literature (Daneman, 1991; Fortkamp, 1999, 2000). According to Daneman (1991), speaking involves a complex coordination of storage and processing components. "Speakers must plan what to say and temporarily store the plans until ready to execute them" (p.446). Thus, a general explanation for the correlations between WM capacity and L2 speech performance may be that individuals with higher WM capacity are more able to coordinate the storage and processing components involved in speaking. Fortkamp (2000) provides a more specific explanation

for correlations between WM and L2 speech production. According to Fortkamp (2000), L2 speech production at the *formulation* stage, more specifically at *grammatical encoding* (Lelvet, 1989), is a controlled processing activity. According to Engle and Orasky (1999), a controlled processing activity involves activation, temporary maintenance, suppression, serial search and retrieval and monitoring. In other words, in L2 speech production, individuals need to activate L1 and L2 information, maintain activation of L2 information, suppress L1 information, search and retrieve L2 information and monitor L2 production (Fortkamp, 2000). In a controlled processing activity it is attention that is controlled to be shared among activation, maintenance, suppression, serial search and retrieval, and monitoring (Engle, Kane; Tuholsky, 1999). Individuals with higher WM capacity have more attentional resources available to allocate towards these processes more effectively and, thus, achieve more fluent and accurate speech performance (Fortkamp, 2000). By contrast, the correlations between WM capacity scores and complexity of L2 speech performance under planning conditions failed to show significance and are, therefore, at odds with previous results reported in the literature (Fortkamp, 2000; Weissheimer; Fortkamp, 2004). One possible explanation for the lack of correlations between WM capacity scores and complexity measures of speech performance may be that participants could only attain more accurate and fluent language in planned speech performance at the expense of complexity. In other words, it seems that the attentional resources allocated to achieve two goals (speaking more accurately and more fluently) reduced the capacity remaining for achieving a third goal (using more complex language). As a consequence, accuracy and fluency became the preeminent goals, but complexity was penalized to some degree. This explanation is in line with other empirical results from studies in the area of planning and L2 speech performance (Foster; Skehan, 1996; Mehnert, 1998; Skehan; Foster, 2005; among others) which have, similarly, reported trade-off effects among features of speech production. Researchers on the effects of planning on L2 speech performance discuss results in terms of a limited attentional model of learning. They claim that gains in accuracy, fluency and complexity may not be achieved simultaneously since these aspects of speech performance compete for our limited

attentional resources (Foster; Skehan, 1996; Mehnert, 1998, among others). Therefore, it would be expected that higher spans would have more cognitive resources available to be allocated towards fluency, accuracy and complexity of speech, and would, thus, deal better with such trade-off effects. Since correlations between working memory capacity scores and complexity measures of speech performance failed to achieve significance, it seems that even higher spans suffered trade-off effects. Then, an intriguing question can be raised: why did not higher spans have more cognitive resources available to be allocated in a more balanced way among the goals of fluency, accuracy *and complexity*? A possible explanation for the lack of correlations between WM capacity scores and complexity measures of speech performance may be that complexity of speech involves taking risks and may be a goal which was beyond these learners' priorities. Thus, higher spans despite having more cognitive resources to allocate among fluency, accuracy *and complexity* may have decided not to take any risks[3] and prioritized fluency and accuracy as preeminent goals. According to Ellis' (2003), it is the learner who decides on what kind of 'activity' to engage in during performance, and such choices determine what to prioritize.Bearing these results in mind, it is important to highlight that correlations between WM capacity and L2 speech performance were only found in the performance of the *second* task of the control group (no-planning) and experimental group (planning). This suggests that it may not necessarily be *pre-task planning* but rather *familiarity* (performing a task of the same type a priori) that makes the task more manageable and, thus, individual differences in WM capacity can emerge. Therefore, results seem inconclusive as regards the relationship between WM capacity, pre-task planning and L2 speech performance. It is also important to highlight that *strict* scores of WM capacity were the ones which correlated with fluency in the performance of the first narrative task of the control group under no-planning conditions, whereas *lenient* scores correlated with measures of L2 speech performance (fluency and accuracy) under planning conditions. Daneman (1991) argued in favor of *lenient* scores for assessing the relationship between WM and L1 speech fluency; Fortkamp (1999)

[3] As previously stated, complexity is related to learners willingness to take risks and produce more elaborated language (Skehan, 1996, 1998).

argued in favor of *strict* scores for assessing the relationship between WM and L2 speech fluency. In the present study, strict scores correlated with L2 speech under no-planning conditions and lenient scores with L2 speech under planning conditions. In face of these mixed results it is not possible to state which measures of WM – strict or lenient scores – are more suitable.

The impact of planning on L2 speech performance

Research question 2 asked whether pre-task planning significantly increases fluency, accuracy and complexity of L2 speech performance. Results showed significant differences in fluency and accuracy. However, differences in complexity were far from achieving significance. In most studies so far results have shown a stronger impact for fluency (Foster; Skehan, 1996; Mehnert, 1998; Ortega, 1999) and complexity (Crookes, 1989; Foster; Skehan, 1996; Ortega, 1999; Yuan; Ellis, 2003). Results have been more mixed for accuracy. According to Ellis (2005), planning leads to gains in accuracy according to the grammatical features being used (Ellis, 1987; Ortega, 1999), different task types (Foster; Skehan, 1996) and different planning conditions (Mehnert, 1998). In this sense, most studies show that gains in fluency and complexity may be achieved at the expense of accuracy (Mehnert, 1998). However, in the present study planning effects were positive for fluency and accuracy, but not complexity. It seems that fluency and accuracy improved at the expense of complexity. Learners' willingness to take risks and, thus, produce more elaborated language seems to have been penalized by the attempt to produce speech that was faster and contained fewer errors. Ortega (2005) claims that some learners seem to be oriented towards form, while others towards meaning. It may be that learners' predispositions towards prioritizing fluency, accuracy or complexity plays a role in determining what aspects will be involved in such trade-off effects. Some learners may be more willing to take risks, and others may take a more conservative approach and prioritize error-free performance. It may be that learners in the context of the present study are more conservative and tend to be more oriented towards error free performance. In order to establish learners' orientation, introspective and/or retrospective protocols could include questions tackling this issue.

Summary and conclusion

The present study sought to examine the relationship among WM capacity, pre-task planning, and L2 speech performance. No correlations were found between WM capacity and L2 speech performance in the first narrative tasks of the control group (no-planning) and the experimental group (no-planning). The first narrative task performance conditions may have turned the task into a too difficult one. Learners may have performed the tasks up to the limits of their cognitive resources and, thus, individual differences in WM capacity could not emerge. The only correlations were found between: 1. WM capacity strict scores and fluency in the performance of the second narrative task of the control group (no-planning), and 2. WM capacity lenient scores and fluency, and WM lenient scores and accuracy of planned speech performance. Perhaps it was task familiarity (by performing a task of the same type twice) rather than pre-task planning which made the second tasks more manageable to learners so that individual differences in WM capacity could emerge. Therefore, findings are inconclusive as regards the relationship between WM capacity, pre-task planning and L2 speech performance. As for the impact of planning on L2 speech performance, results showed that planning led to significant differences in fluency and accuracy, but differences in complexity were far from reaching significance. Most studies so far showed stronger effects for fluency and complexity (Ellis, 2005), whereas the present study showed stronger effects for fluency and accuracy but not complexity. This difference in results was tentatively explained by learners' orientation. Learners in the context of the present study may be more conservative and, thus, aimed at error free performance and did not take any risks in the attempt to achieve more elaborated performance. Further research is needed in order to scrutinize learners' orientation as well as *why* learners may be more oriented towards form or meaning. The context of learning may play a role in learners' orientation. It may be that some learning contexts emphasize more grammatical aspects of the target language, whereas others may emphasize form and meaning connections when teaching and evaluating learners. Future research should seek to find out more about participants' contexts

of learning in order to expand the bases of interpretation on learner's orientation.

As expected, the present study also has several limitations. As a small scale study, the findings reported here are to be seen as modest and suggestive rather than conclusive. First of all, the reduced sample size (25) does not allow results to be generalized. No strong claims can be made based on this small data set. Moreover, limited sample size may also have weakened correlations between WM capacity and L2 speech performance.Secondly, due to time constraints, only the SST was used for assessing WM capacity. Future studies should employ complementary measures of WM capacity. In addition to that, more research is needed in order to understand the complexities of the SST concerning the relationship between its strict and lenient scores. Although there is a considerable body of research on the complexities of the RST (Duff; Logie, 2001; Friedman; Miyake, 2004; Saito; Miyake, 2004, among others), not much is known about the SST. The finding that the correlations between WM capacity and accuracy were higher than between WM capacity and fluency (under the planning condition) may have been an artifact of the SST. Participants are instructed to produce grammatically acceptable sentences which may lead them to focus on grammar. Moreover, participants varied considerably in the *time* they took to perform the SST. Research on the Reading Span Test has shown that lack of time control in the performance of span tests may allow participants to employ strategies to improve their scores (Friedman; Miyake, 2004). Therefore, in my main study the *time* participants take to perform the SST will be taken into account.

Thirdly, speech performance was measured only by two versions of speech rate, errors per a hundred words, and clauses per c-unit. No strong claims can be made based on this small set of measures of L2 performance. Complementary measures such as pauses, mean length of run, number of errors per c-unit, and weighted lexical density should be included in order to reach firmer grounds on the relationship between WM capacity, pre-task planning and L2 speech performance. It is also important to highlight that, particularly given the small sample size and limited number of measures for assessing WM capacity and L2 speech performance, WM capacity is *not* the only factor involved on how learners benefit

from planning. A range of factors other than WM capacity may play a role on planned performance. Despite its limitations and lack of conclusive evidence, the findings of the present study may be relevant since they seem to demonstrate that the relationship among WM capacity, planning and L2 speech performance is a complex one which merits further scrutiny. Although the present study revealed correlations between WM capacity and L2 speech performance, it is still not possible to determine whether higher spans were more able to benefit from task familiarity *or* pre-task planning. In general terms, results suggest that if the task is made more manageable (either due to task familiarity or pre-task planning); individuals with higher WM capacity outperform individuals with lower WM capacity. One interesting avenue of investigation on the relationship between WM capacity and planning would be to explore whether higher and lower spans undergo similar strategies during planning. It is possible that higher spans are more strategic during planning and, thus, may benefit more from planning than lower spans. Moreover, it would also be interesting to investigate whether higher spans are actually more able to retrieve what was planned into performance. It may be that lower and higher spans undergo similar strategies during planning and the differences may rely on the ability to retrieve what was planned. More research is needed in order to reach firmer grounds on the relationship between WM capacity, planning and L2 speech performance. According to Ellis (2005), the study of planning is relevant both for its importance for theorizing about L2 acquisition in terms of information processing theory and for its usefulness to language pedagogy once it is a condition that can be implemented in language classrooms. Thus, individual differences in WM capacity may be an interesting avenue from which to look at pre-task planning for at least two main reasons. First, WM as a limited cognitive system is one of the tenets of information processing theory (McLaughlin; Heredia, 1996), hence, being a relevant construct for theorizing about L2 acquisition.Second, WM may constitute a central component of language aptitude (Miyake; Friedman, 1998), a predictor of reading comprehension (Daneman; Carpenter, 1980; Harington; Sawyer, 1992) and speech performance (Daneman; Green, 1986; Daneman, 1991; Fortkamp, 1999, 2005). Perhaps planning is not an easy task for lower span learners who

may need more teacher assistance and guide on how to plan. Therefore, a better understanding of the relationship among WM capacity, pre-task planning, and L2 speech performance may also shed some light on how to implement pre-task planning more effectively so that both higher and lower capacity individuals may benefit from planning their performance. Research on planning has focused solely on *performance* (Foster; Skehan, 1996; Mehnert, 1998; Ortega, 1999; Yuan; Ellis, 2003, just to mention a few). I believe the field of research on planning seems ripe for taking a further step and investigate the impact of planning on *learning* as well. Further research is needed in order to investigate whether planning leads to L2 learning. Research focusing on the impact of planning on *learning* will hopefully shed some light on how to implement planning as a pedagogical tool for fostering L2 speech in the L2 classroom.

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Título: *A relação entre planejamento pré-tarefa, memória de trabalho e desempenho oral em L2: um estudo piloto*

Resumo*: O presente estudo piloto teve como objetivo investigar a relação entre planejamento pré-tarefa (Skehan, 1996, 1998), memória de trabalho e desempenho oral em L2. Os participantes foram 25 aprendizes de inglês como L2 os quais desempenharam duas tarefas orais. Os resultados indicam que (1) o planejamento leva a ganhos em fluência e acurácia da produção oral, mas não leva a ganhos em complexidade, (2) não há correlações significativas entre desempenho oral e memória de trabalho na primeira tarefa dos grupos controle e experimental (sem planejamento), (3) há correlações significativas entre desempenho oral e memória de trabalho na segunda tarefa dos grupos controle (sem planejamento) e experimental (com planejamento). Portanto, os resultados não são conclusivos e apontam para uma complexa relação entre planejamento pré-tarefa, memória de trabalho e desempenho oral. Os resultados são discutidos com base na proposta de Fortkamp (2000), segundo a qual a produção oral em L2 é uma tarefa que demanda controle da atenção por parte dos aprendizes (Engle; Kane; Tuholsky, 1999).*

Palavras-chaves*: memória de trabalho; planejamento; desempenho oral.*