

## PLANNING AND WORKING MEMORY EFFECTS ON L2 PERFORMANCE IN CHINESE EFL LEARNERS' ARGUMENTATIVE WRITING

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### Abstract

With the guidance of Skehan's cognitive model of L2 performance and Kellogg's model of working memory in writing, the present study explored the effects of planning and working memory on L2 performance in Chinese EFL learners' argumentative writings. The participants were required to complete one operation span task and two argumentative essays in pre-task planning and controlled conditions (no planning). Results showed that: 1) pre-task planning seemed to help a significant increase of lexical complexity in L2 writing performance; 2) working memory had a significant impact on syntactic complexity and fluency but no effect of working memory was found on lexical complexity and accuracy; 3) pre-planning could be integrated with working memory to affect L2 writing performance. In argumentative writings, working memory might be of great importance in planning while planning might enable learners to overcome limitations in working memory and enhance L2 writing performance.

**Keywords:** pre-task planning, on-line planning, working memory, complexity, accuracy

Planning is a procedure for achieving a particular goal or desired outcome and the appropriate organization of knowledge. It could facilitate integration of the component parts of a problem, allow for mental simulation to generate and evaluate new ideas, and afford increased understanding to test and detect problems before they occur (Ward & Morris, 2005). Some researches have showed that planning might exert a certain impact on individual memory, task completion, solving problem and academic achievement (Gillhooly, 2005; Morris, R. & Ward, G. 2005; Ward, 2005). Since 1980s, L2 researchers have investigated the effect of planning on L2 performance and acquisition (Ellis, 2009; Ellis & Yuan, 2004; Foster & Skehan, 1999; Wigglesworth, 1997). These studies have addressed the issue of task planning from different perspectives but most of them have investigated oral performance of L2 learners and have concentrated on exploring the effect of planning on accuracy, complexity, and fluency of language performance (Ellis, 2009; Foster & Skehan, 1996; Gilabert, 2007; Guara-Tavares, 2009; Huang, 2011; Mochizuki & Ortega, 2008; Sangarun, 2005; Skehan & Foster, 1997, 2005; Tavokoli & Skehan, 2005; Wendel, 1997; Wigglesworth, 1997; Yuan & Ellis, 2003) whereas few of them have dealt with writing performance of L2 learners (Rahimpour & Safarie, 2011; Meraji, 2011) and much fewer researchers have examined the effects of planning and individual cognitive differences such as working memory on L2 performance of learners (Ellis, 2009). Therefore, this research aims to explore the effects of planning and working memory on L2 writing performance of Chinese learners of English

and investigate how planning would be integrated with working memory to impact Chinese EFL learners' argumentative writings.

### Theoretic models of planning, working memory and L2 performance

Theoretically, Levelt's (1989) models of speech production and Kellogg's (1996) model of working memory in writing are generally adopted to account for the role of task planning and working memory in language production when language performance is researched. With respect to the present study concentrating on argumentative writings, Kellogg's (1996) cognitive model of working memory in writing is selected to guide the discussion of the role of planning and working memory in writing. According to Kellogg (1996), there are three systems of written production: formulation (planning and translating), execution (programming and executing) and monitoring (reading and editing) by adopting Baddeley's (2003) multi-component model of working memory. He clearly delineates the relationship between each writing process and the phonological loop, visuo-spatial sketchpad and central executive. In addition to reliance on the executive, the planning phase may draw on the visuo-spatial component, as many writers visualize images, and the translating phase imposed demands on the verbal components (Kellogg, 1996; Olive, 2004). All the steps place very heavy demands on working memory, especially on the executive and verbal components. Overall, written expression places so many demands on working memory that several aspects of writing

performance are probably competing for the same working memory resources (Kellogg, Olive, & Piolat, 2007). Thus working memory would surely be expected to play an important role as an internal work space for processes of developing, maintaining and executing plans (Gilhooly, 2005).

A measurement of CAF (complexity, accuracy and fluency) proposed by Skehan (1998) is generally accepted in L2 performance (Robinson, 2001, 2005; Ellis, 2005, 2009). It is worth noting that there are two controversial theoretical concepts adopted frequently to explain L2 performance of learners in spoken and written tasks. According to Skehan's (1998) cognitive model of L2 performance, it demonstrates the exact existence of trade-off effect which means that increase of accuracy would suffer complexity and increase of fluency is at the expense of accuracy and complexity due to the limited working memory capacity of individuals whereas Robinson's cognition hypothesis denies the existence of trade-off effect between accuracy, complexity and fluency in language performance in that Robinson (2001) holds that accuracy and complexity could increase simultaneously because different pools of attentional resources could be allocated to them.

#### **The empirical research about planning, working memory and L2 performance**

Ellis (2005) made a basic distinction between pre-task and within-task planning. Pre-task planning (initial planning) refers to the planning activity that takes place before overt problem solving action takes place (Ward, G & Morris, R, 2005: 2). Nowadays, 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 (Ortega, 2005). The majority of researchers have addressed the role of planning in L2 oral production by a concentration on CAF (complexity, accuracy and fluency) of L2 performance (Skehan, 1998). The variegated findings were obtained, for instance, pre-task planning enhanced complexity and fluency (Foster & Skehan, 1996; Wendel, 1997; Yuan & Ellis, 2003), pre-tasking planning benefited all of the three: complexity, accuracy and fluency (Ortega, 1999; Sangarun, 2005; Skehan and Foster, 2005; Tavokoli and Skehan, 2005; Wigglesworth, 1997). No effect of planning on any part of CAF (Elder & Iwashita, 2005; Rutherford, 2001). In a nutshell, most of their findings show clear effects of planning on fluency and complexity but findings about accuracy are not homogenous (Mochizuki & Ortega, 2008; Wendel, 1997; Yuan & Ellis, 2003).

With respect to the effect of working memory on L2 performance, recently, much research work has suggested that individual differences in working memory may be related to L2 performance, including L2 speech performance (Daneman, 1991; Fortkamp, 2000, 2003; Guara-Tavares, 2009) and L2 writing performance (Bergsleithner, 2010; Flower & Hayes, 1994; Baoshu & Luo, 2012). The findings from those existing investigations of working memory and writing are

consistent with the usual hypotheses, for example, individuals with longer verbal spans write more accurate and complex sentences than those with shorter spans (Flower & Hayes, 1994; McCutchen, 1996; Swanson & Berninger, 1996; Swanson & Seigel, 2001). Bergsleithner (2010) made an experimental research on working memory capacity and L2 writing performance. He found that learners with higher spans could process more accurate and complex grammatical and lexical cognitive processing during language performance. Baoshu & Luo (2012) also found that working memory had a significant effect on accuracy of L2 performance in studying Chinese EFL learners' descriptive writings. In opposition to the aforementioned findings, Bridges (2011), Juffs (2004, 2005), Li (2003) and Lu (2010) claimed that working memory capacity had no correlation with L2 writing performance according to their empirical researches.

From the aforementioned literature review, it should be pointed out that there are some limitations in the current studies. The first striking one is that most researchers have focused on the role of planning in L2 speech performance instead of L2 writing performance in which planning is believed to have a role to play (Meraji, 2011; Ramhimpour, 2011). A second weakness is no control of planning process in which the subjects are required to plan in a certain period time, and no idea of whether or not the subjects are engaged in planning. A third one falls on the variation of the tasks on which those studies are based, such as narrative and decision making tasks (Elder & Iwashita, 2005; Skehan & Foster, 2005; Tavokoli & Skehan, 2005), structured and unstructured tasks (Mehnert, 1998); an instruction task and an argumentative task (Sangarun, 2005); Three picture-based narrative tasks (Guara-Tavares, 2009; Kawauchi, 2005). It is worth noting that the inherent properties of the tasks such as task complexity, task difficulty and task conditions could also account for L2 performance in terms of complexity, accuracy and fluency (Baoshu & Luo, 2012; Ong & Zhang, 2010; Skehan, 2009). The fourth noteworthy limitation is that in the majority of the current studies the researchers take no consideration into individual cognitive differences such as working memory capacity when studying the effect of planning on L2 performance. Only a few relevant studies (Guara-Tavares, 2009; Wen, 2008) investigated how individual learner factors interacted with planning to influence L2 performance and their findings showed that working memory had a role to play in L2 performance. Therefore, studies investigating the role of WM and planning in L2 writing have been scarce indeed and much research work needs to be done.

In view of the preceding review, several factors motivated this research. The first one is that ample research has been made about the effect of planning in L2 speech performance instead of exploring the effect of planning on L2 writing performance. There is a scarcity of investigating the effect of planning in L2 writing. The second noteworthy one is the fact that preceding studies disregard the role of individual cognitive differences such

as working memory in L2 performance. The third factor falls on lack of studying controlled planning processes. Therefore, the present study aims to examine the effects of planning and working memory on Chinese EFL learners' performance in argumentative writings by adopting listing and outlining as a controlled planning process. A particular objective of the study is to explore to what extent working memory is integrated with planning to affect L2 performance in Chinese EFL learners' argumentative writings. Thus, the study has three research questions: (1) Do pre-tasking planning affect complexity, accuracy, fluency in Chinese EFL learners' argumentative writing?, (2) Does working memory capacity affect complexity, accuracy, fluency in Chinese EFL learners' argumentative writing?, and (3) To what extent is working memory integrated with pre-task planning to affect Chinese EFL learners' argumentative writing?

## METHOD

### Participants

A total of 31 participants were recruited from the subject pool at an ordinary university in China. Participants were all sophomores between the ages of 19 and 21 and had never been to English speaking countries. Since the present study took a mixed design (within subjects and between subjects), all of them were arranged to complete two tasks in two conditions (pre-task planning condition and controlled condition (no planning)). All the participants were also divided into three groups according to their working memory capacity: HWMC (High working memory capacity), MWMC (mid working memory capacity) and LWMC (low working memory capacity) ( $F=26.993, p<0.01$ ).

### Tasks and material

The operation span task: The operation span task was chosen to measure working memory capacity of the participants. The operation span task in English was from Unsworth, et al (2005). It had been used as an established test for working memory capacity in the field of psychology (Lu, 2010). The operations in the tasks are simple arithmetic operations involving addition, subtraction, multiplication and division, followed by an English word with high frequency, for instance,  $3 \times 4 - 5 = 6$  ? *take*. In the experiment, the operation span task was presented to the participants on a computer by E-prime 1.0. During the task, a target English word was first shown on the computer for half a second, followed by an arithmetic operation, for instance,  $5 + 4 \times 4 = 19$ ?. The participants were instructed to memorize the target word for later recall and judge whether the equation was correct or not by pressing a corresponding key on the keyboard. After the judgment was done, another word would appear immediately. The participants would repeat the aforementioned process until a prompt was seen on the screen which said "please recall and write down the English words in this set". There were a total of 15 sets with 60 items. The number of items varied randomly

within each set, with two items as the minimum and six as the maximum.

*Tasks in pre-task planning:* In the planning stages, the learners were believed to plan lexis and outline for their following writing tasks (Ellis, 2005). Therefore, in this study listing and outlining were adopted to simulate the process of planning. Listing refers to a task in which the participants were required to write down the words, phrases or sentence structures that might be used the coming tasks. Outlining means that the participants could work out a framework for the coming argumentative writing. The two planning tasks should be completed in 15 minutes.

*Timed argumentative writing tasks:* Participants were required to complete two argumentative writings. The first argumentative writing was concerned about what attitudes participants held towards the topic *should we study abroad*, which should be completed within 45 minutes. In the second argumentative writing, participants were instructed to complete a passage about a topic *should old buildings be pulled down for modern structures* in an hour limit.

### Procedure

After signing informed consents, all the participants completed the operation span task in Session 1. In Session 2, there were two conditions: pre-task planning condition and controlled condition (no planning condition). In pre-task planning condition, the participants were first instructed to spend one hour in completing two planning tasks (listing and outlining) and an argumentative essay. In the controlled condition (no planning), without planning tasks, the same participants were required to write the other argumentative essay within one hour limit.

### Variables

The study contained two independent variables (working memory capacity and pre-task planning) and dependent variables (L2 performance: syntactic and lexical complexity, accuracy and fluency). Working memory capacity was an independent variable which may have an effect on the writing performance of Chinese learners of English. In scoring working memory capacity, Friedman & Miyake (2005) recommended the total words scoring method because it yielded normal distribution and great reliability. Therefore, the total number of correctly recalled target words was recorded as the final score for a participant's working memory span. The target words could be recalled in any order within the set in which they were shown. However, a target word recalled from a different set was counted as a wrong one. Only when an exact target word was recalled by a participant could she or he obtain one point. The total score for working memory span was 60. The other independent variable was pre-task planning which was merely contained in pre-task planning condition and the pressured argumentative writing task.

Dependent variables referred to four aspects of L2 writing performance: syntactic complexity, accuracy,

fluency and lexical complexity (Skehan, 2009). Fluency was measured by the production rate, i.e., the total number of words produced divided by the total number of minutes a participant took to complete the writing task (Ellis & Yuan, 2005). Syntactic complexity was measured in terms of average sentence length (ASL): the number of words divided by the number of sentences. Lexical complexity was measured in terms of Word STTR (Standardized Type Token Ratio, Tokens = the total number of all occurrences of alphanumeric symbols; Word Types = the total number of distinct words (e.g. 10 instances of 'do' are counted as 1 TYPE of 'do')). Finally, accuracy measure was indexed by the number of errors per 100 words. Errors in the writing performance included spelling, ignored words, commonly confused words, use of articles, pronoun agreement, subject and verb agreement, use of verbs, modal verbs, sentence structure, use of conjunctions, use of nouns, incorrect use of numbers, incorrect use of prepositions, use of adjectives and adverbs, comparing two or more things, confusing modifiers, incorrect use of negatives, use of qualifiers and quantifiers, verb agreement conditional sentences, wordiness, passive voice use, ignored patterns, writing style, vocabulary use, unknown words.

**Data analysis**

Readability Analyzer 1.0 (Xu & Jia, 2009) was used to calculate fluency, syntactic complexity, and lexical complexity while Grammarly and SPSS 17.0 were used to calculate accuracy with an aim to guarantee the reliability of data collection and measurement.

**RESULTS**

**Descriptive statistics**

The results are firstly summarized in Table 1. As it is shown in Table 1, the measures of variables have generally acceptable values of internal consistency and most of the measures are normally distributed with values of skewness and kurtosis under the generally accepted values (Skewness <2 and kurtosis <4, see Kline, 1998).

**The effect of pre-task planning on L2 performance in Chinese EFL learners' argumentative writings.**

A paired samples T-test was first conducted on the argumentative writings written by the participants to analyze the differences of language performance in terms of complexity, accuracy and fluency between pre-task

Table 1. Descriptive statistics for all variables

Variables		Range	Mean	SD	Skewness	Kurtosis
WMC	Operation span	50.00	43.87	11.48	-1.29	2.22
L2 performance	Syntactic complexity	18.50	15.28	4.03	.98	1.21
	Fluency	4.40	4.33	.82	-.02	.36
	Accuracy	11.90	7.57	2.36	.15	-.15
	Lexical complexity	.28	.51	.06	.42	-.27

Table 2. L2 performance between pre-task planning condition and controlled condition

Variables	Conditions	Mean	SD	t	p
Syntactic Complexity	Pre-task planning	15.3194	3.95233	.072	.943
	No planning	15.2452	4.17874		
Lexical Complexity	Pre-task planning	.5346	.05406	3.734	<b>.000</b>
	No planning	.4836	.05345		
Fluency	Pre-task planning	4.0634	.90384	-2.684	<b>.009</b>
	No planning	4.5978	.64157		
Accuracy	Pre-task planning	7.6530	1.88476	.287	.775
	No planning	7.4802	2.77798		

Table 3. Regression co-efficient of the effect of working memory on L2 performance in Chinese EFL learners' argumentative writings

Variables		B	Std. Error	Beta	t	p
Working memory	Fluency	.022	.009	.302	2.458	.017
	Lexical complexity	.000	.001	.032	.245	.807
	Syntactic complexity	.123	.042	.350	2.899	.005
	Accuracy	-.007	.026	-.035	-.274	.875

planning condition and no planning condition. A variegated result was shown in Table 2 that with respect to syntactic complexity and accuracy, there was no significant difference between two conditions (pre-task planning and no-planning) ( $p=0.943, 0.775 >0.05$ ). However, the mean of syntactic complexity and accuracy in pre-task planning condition was slightly larger than that in no-planning condition ( $15.3194, 7.6530 > 15.2452, 7.4802$ ). Regarding lexical complexity and fluency, a significant difference could be found between the two

conditions. The participants in pre-task planning condition obtained much higher lexical complexity than what they did in the controlled condition ( $\text{mean}=0.5346 > 0.4836$ , and  $p=0.000 < 0.05$ ) whereas the participants in the controlled condition (no planning) gained much higher fluency than they did in pre-task planning condition ( $\text{mean}=4.5978 > 4.0634$ , and  $p=0.009 < 0.05$ ).

**The effect of working memory on L2 performance**

A regression analysis was made to examine whether or

Table 4: A comparison of correlations between working memory and CAF (complexity, accuracy and fluency) in two conditions

Variables	Pearson Correlation									
	On-line planning					Pre-task planning				
	1	2	3	4	5	1	2	3	4	5
1. Working memory	1.000					1.000				
2. Syntactic complexity	.399 <sup>*</sup>	1.000				.300	1.000			
3. Lexical complexity	.171	.147	1.000			-.099	.143	1.000		
4. Fluency	.330	.109	-.288	1.000		.321	.189	-.412 <sup>*</sup>	1.000	
5. Accuracy	.011	-.338	.258	-.209	1.000	-.105	-.224	.081	-.177	1.000

not working memory had a role to play in L2 performance. According to Table 3, it showed that working memory might exert great influence on fluency and syntactic complexity. The percentage of effect of working memory on syntactic complexity and fluency is 35% and 30.2% respectively ( $p=0.017, 0.005 < 0.05$ ). By contrast, working memory exerted no significant impact on lexical complexity and accuracy ( $p=0.807, 0.875 > 0.05$ )

However, when planning was taken into account in

investigating the effect of working memory on L2 performance in Chinese EFL learners' argumentative writings, an interesting result was obtained below in Table 4 that working memory seemed to have a stronger correlation with syntactic complexity, lexical complexity, fluency in on-line planning condition than did it in pre-task planning condition.

In Table 4, it was shown that in pre-task planning condition, as for correlation between working memory and CAF (complexity, accuracy and fluency), no strong

Table 5: A multiple comparison of mean differences of CAF between different working memory capacity groups in two conditions.

Variables	High	Mid	Low	On-line planning		Pre-task planning	
				Mean Difference	P	Mean Difference	P
Syntactic complexity	HWMC	MWMC		1.42727	.408	1.16263	.521
	MWMC	LWMC		3.98687 <sup>*</sup>	.034	2.14545	.216
Lexical complexity	HWMC	MWMC		.02145	.355	-.01211	.632
	MWMC	LWMC		.03205	.194	-.00801	.739
Fluency	HWMC	MWMC		.01059	.663	.00410	.871
	MWMC	LWMC					
Accuracy	HWMC	MWMC		-.21515	.436	-.43367	.294
	MWMC	LWMC		.21818	.453	.13333	.732
	MWMC	LWMC		.43333	.142	.56700	.173
Accuracy	HWMC	MWMC		1.20865	.323	1.33865	.122
	MWMC	LWMC		.18947	.882	.63363	.433
	MWMC	LWMC		-1.01918	.428	-.70502	.408

(HWMC=High working memory capacity, MWMC=middle working memory capacity, LWMC=Low working memory capacity)

correlation could be found while a strong negative correlation was found between fluency and lexical complexity ( $r=-0.412$ ,  $p=0.021<0.05$ ). In on-line planning condition, a strong correlation was found between working memory and syntactic complexity ( $r=0.399$ ,  $p=0.026<0.05$ ), in other words, in this condition, the participants with high working memory capacity performed better than did their counterparts with low working memory in syntactic complexity. Regarding working memory and other aspects of L2 performance no significant correlation could be found between them. With a comparison of correlations between working memory and CAF (complexity, accuracy, and fluency) in two conditions, it was found that correlations between working memory and CAF except for accuracy in on-line planning condition was slightly stronger than those in pre-task planning condition.

In Table 5, it was shown that in pre-task planning condition, as for syntactic complexity, lexical complexity, fluency and accuracy, no difference could be found between different working memory capacity groups while in on-line planning condition, the situation seemed to be complex, regarding lexical complexity, fluency and accuracy, there was no significant difference between three working memory capacity groups; with respect to syntactic complexity, the participants with high working memory capacity were able to obtain more complex or longer sentences than did their counterparts with low working memory capacity. Overall, the participants with higher working memory capacity in on-line planning condition slightly outperformed their counterparts in pre-task planning condition in terms of syntactic complexity, lexical complexity and fluency according to mean differences.

## DISCUSSION

The study investigated the effect of pre-task planning, on-line planning and working memory on L2 performance in Chinese EFL learners' argumentative writings. The first prediction was made that planning and working memory might have a great role to play in L2 performance in argumentative writings. The second prediction was that the integration of working memory and planning could be found in L2 performance in Chinese EFL learners' argumentative writings.

With respect to the first research question about whether pre-tasking planning and on-line planning affect complexity, accuracy, fluency in Chinese EFL learners' argumentative writings, the findings were inconsistent in that in pre-task planning condition the learners seemed to produce more complex and longer words than their counterparts in on-line planning condition while the learners in on-line planning condition were able to produce a higher fluency. No significant difference could be found with respect to syntactic complexity and accuracy in two conditions. As for accuracy, the findings in this study was consistent with some researches (Gilabert, 2007; Kawachi, 2005; Rutherford, 2001;

Yuan & Ellis, 2003) in which no effect of planning on accuracy could be found in the learners' L2 performance. Conversely, some researchers argued that pre-task planning could produce fewer grammatical mistakes (Guara-Tavares, 2009; Mochizuki & Ortega, 2008; Wigglesworth, 1997). Regarding fluency, the results in this study were contrary to many studies (Yuan & Ellis, 2003; Gilabert, 2007) in which pre-task planning could cause higher fluency. With respect to complexity, what was found in the present study was similar to some researches (Gilabert, 2007) in which planning exerted no effect on grammatical complexity but great impact on lexical complexity. Overall, the findings were not conclusive. There are some possible explanations as to why pre-task planning produced more complex words while on-line planning created higher fluency in this study. The first striking factor might be the inherent features of tasks such as task conditions, task complexity and task difficult, task types which may have a key role to play in L2 performance. For instance, in the narrative writings, it was frequently found that planning could produce more complexity, fluency and accuracy (Skehan & Foster, 2005; Tavokoli & Skehan, 2005). In the argumentative writings, as for Chinese EFL learners, they are usually instructed to write argumentative writings according to a fixed framework so that in pre-task planning and on-line planning conditions, no difference could be found in syntactic complexity. Moreover, argumentative writings may cause the learners to use less concrete or imaginable words. The second noteworthy explanation might be attributable to some cognitive factors. According to Kellogg's (1996) model of working memory in writing, in pre-task planning, listing and outlining could provide an organizational structure for a document before drafting begins. This organization should help writers to retrieve detailed and complex knowledge that are needed in writing. On the other hand, in on-line planning condition, the learners were required to begin writing immediately. The fluency of language production should be enhanced by the immediacy of beginning the creation of a rough first draft in which collecting, planning, translating and reviewing interact extensively (Kellogg, 1996). It should be pointed out that the role of planning in L2 performance was not exclusive. There might be other cognitive factors such as working memory which might account for L2 performance better.

With respect to the second research question about whether working memory capacity could affect complexity, accuracy, fluency in Chinese EFL learners' argumentative writing, a regression analysis was made to examine the effect of working memory capacity on L2 writing performance of Chinese EFL learners. It was found that working memory exerted a significant impact on syntactic complexity and fluency but no effect was found on lexical complexity and accuracy. The findings were not consistent with what was found in some other researches (Bergsleithner, 2010; Fortkamp, 1999; Guara-Tavares, 2008; Baoshu & Luo, 2012). For instance, Fortkamp (1999) displayed the effect of working memory

capacity on fluency, accuracy and complexity, Guara-Tavares (2008) found the only correlations between working memory capacity and fluency; Bergsleithner (2010) revealed the effect of working memory on accuracy and complexity, and Baoshu & Luo (2012) only found the effect of working memory on accuracy. There are several reasons to explain the inconsistency. First, Skehan's (1998) trade-off effect might account for this variation of the findings in many relevant researches. Complexity, accuracy and fluency compete for cognitive resources which are limited. One may gain at the expense of the others. Second, the tasks used in writing performance may contribute to the differences as it is mentioned above. In the present study argumentative writing tasks were adopted while Fortkamp's (1999) research was based on L2 speech performance, Baoshu & Luo (2012) and Bergsleithner (2010) based their studies on narrative tasks and descriptive tasks. It is believed that tasks features such as task complexity, task difficulty and task condition may account for the variation in accuracy, fluency and complexity of language performance (Foster & Skehan, 1996; Kuiken & Veddar, 2007). Thus, the inherent features of argumentative writing tasks may contribute to higher fluency and syntactic complexity. However, finally, it is undeniable that working memory has a role to play in writing performance. Arguing that the composition of a descriptive task implies more mental imagery than that of an argumentative task, according to Kellogg's (1996) model of working memory in writing, it could be hypothesized that overloading the visuo-spatial sketchpad should have more impact on descriptive tasks than on argumentative tasks. Therefore, writers' fluency may slow down when they compose descriptive tasks. Syntactic complexity relates to the stage and elaboration of the underlying inter-language system, which may be accounted for by working memory capacity. McCutchen (1996) accounted for developmental and individual differences in writing skills. The more efficient the writing processes are, the less they require resources from working memory and the more resources are available for activating other processes and coordinating goals. Accordingly, the learners with higher working memory capacity outperformed those with lower working memory capacity in fluency and syntactic complexity.

To summarize, despite the variation of the findings, it is believed that working memory capacity has a role to play in L2 performance in argumentative writings. Nevertheless, there is no truth that L2 learners with low working memory capacity would be a loser in L2 writings in that in writing essays working memory needs to co-work with many other factors such as language aptitude, language proficiency, and pre-writing strategies or planning.

With respect to the third research question about to what extent working memory is integrated with planning to affect L2 performance in Chinese EFL learners' argumentative writings. The present study, first, revealed that the effect of working memory on L2 performance (syntactic complexity, lexical complexity, fluency and

accuracy) varied from pre-task planning to on-line planning. In on-line planning condition, the greater effect of working memory could be found on syntactic complexity, lexical complexity and fluency except for accuracy. Second, the present study displayed that correlations between working memory and some aspects of L2 performance such as syntactic complexity, lexical complexity and fluency might be stronger in on-line planning condition than those in pre-task planning condition. A typical instance that might account for this situation is syntactic complexity. In either condition, working memory has a certain positive correlation with syntactic complexity. In particular, in on-line planning condition working syntactic complexity is tightly related to working memory capacity. In reference to Gibson's (1998) locality of syntactic dependencies, the longer a predicted category must be kept in memory before the prediction is satisfied, the greater the cost is for maintaining that prediction; the greater the distance between an incoming word and the most local head or dependent to which it attaches, the greater the integration cost. Thus, more complex or longer sentences demand much for working memory capacity which has limited attentional resources, particularly, in on-line planning condition, the learners might be easier to rely on working memory to produce long or complex sentence structures, therefore, the learners with high working memory capacity did much better than their counterparts with low working memory capacity. By contrast, pre-task planning such as listing and outlining in this study might reduce the computational load of working memory so that the participants with low working memory capacity could do as well as those with high working memory capacity in some aspects of L2 performance.

Overall, as demonstrated in Kellogg's (1996) writing model, writing consists of three important interactive and recursive processes: formulation, execution, and monitoring. Formulation involves planning the content of the writing and translating ideas into words. During planning, writers retrieve ideas from their long-term memory or from the input provided in the task rubrics and organize them into a coherent order. Hence, working memory might be important in formulating and revising plans. However, it should be pointed out that planning is conversely a means of helping learners overcome limitations in working memory capacity and improve performance.

## **CONCLUSION**

This study investigated the effect of pre-task planning, on-line planning and working memory on L2 performance of Chinese EFL learners in two argumentative writings. Kellogg's (1996) model of working memory in writing guided this research theoretically. Based on the aforementioned data analysis and discussion, it was found that planning and working memory had a role to play in L2 writing performance of Chinese EFL learners despite the inconclusive findings

obtained in this study. In a nutshell, this study showed 1) pre-task planning seemed to help the learners produce greater lexical complexity while on-line planning enabled the learners to produce higher fluency, no significant effect of planning could be found on syntactic complexity and accuracy; 2) working memory exerted a significant impact on syntactic complexity and fluency but no effect of working memory was found on lexical complexity and accuracy; 3) planning might be integrated with working memory to affect L2 writing performance. Pre-task planning might help alleviate cognitive load of the learners in writing so that they might be less reliant on their working memory in composition whereas in on-line planning, the learners might be more dependent on their working memory in writing essays. Thus, in argumentative writings, working memory might be of great importance in planning while planning might aid learners to overcome inadequacy in working memory and enhance their performance.

Despite the contribution of the present study to L2 writing and teaching research, some limitations should be acknowledged in this research. First, the number of the participants was small, future research might as well increase the sample size. Second, consideration was not taken into no-planning condition which could be designed as a baseline. Third, working memory was regarded as a holistic unit, the study failed to examine the role of multi-components of working memory which are proved to have a role to play in planning and writing processes (Olive, 2004; Kellogg, et al, 2007). Thus, the effect of four components of working memory on writing and planning might be a significant topic in future research. Lastly, in the present study, planning was only simulation of real planning processes in writing, therefore, research on the real planning processes in writing needs to be done in the future.

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