The role of working memory capacity in noticing and accuracy of L2 speaking

Joara Martin Bergsleithner
Universidade de Brasília

This article focuses on the role of working memory capacity (WMC) in noticing and in L2 speaking. The aim of this paper attempts to present a brief theoretical foundation on two L2 speech production models and on how accuracy of L2 speaking could be constrained by WMC and noticing. The findings of this study reveal that individuals with a larger WMC are more prone to notice L2 instances of the target structure in input and to outperform L2 oral tasks.

1. Introduction

Recently, research on speech production in second language (L2) has acknowledged the fact that working memory capacity (WMC) may be seen as a possible independent constraint on the process of noticing instances of L2 input (Bergsleithner, 2007; Robinson, 1995, 1996, 1997) and also of output performance of L2 speaking (Bergsleithner, 2007; Fortkamp, 1995, 1999, 2000; Daro & Fabbro, 1994; Daneman & Green, 1986; Mota, 2003, 2009; Payne & Ross, 2005; Payne & Whitney, 2002; Weissheimer, 2007; Weissheimer & Mota, 2009).

Generally, several studies (e.g. Daneman & Green, 1986; Fortkamp, 1995, 1999, 2000; Weissheimer & Mota, 2009) on this field have empirically shown that individuals with a higher WMC tend to outperform those with a lower WMC at various aspects of L2 speech production such as: fluency, accuracy, complexity, lexical density, among others. Although all these aspects are relevant to be investigated, this particular study considered only the aspect of grammatical accuracy in the oral performance of a specific target structure – Indirect Questions.

Bearing in mind this investigation, there is a need to understand the constraint that WMC and noticing may cause on the production of L2 speech in oral tasks, especially here on the accounts of grammatical accuracy. The findings of this study reveal that individuals with a larger WMC are more prone to notice L2 instances of the target structure in input and to outperform L2 oral tasks, if compared to those individuals with a smaller WMC.

2. Theoretical foundation

In the last decades, several researchers have raised their voices in claiming that humans have individual differences (Daneman & Green, 1986) when dealing with a complex cognitive task, such as producing a second language (L2) (Bergsleithner, 2007; Bergsleithner & Weissheimer, 2009; Daro & Fabbro, 1994; Fortkamp, 1999; 2000; Mota, 2003, 2009; Payne & Ross, 2005; Payne & Whitney, 2002; Weissheimer, 2007, Weissheimer & Mota, 2009, among others).

Fortkamp (2000) suggested that individuals with a larger WMC tend to have a larger amount of attentional resources to be allocated to language input, and then outperform those with a lower WMC since they probably better coordinate the cognitive processes involved in L2 oral production. In addition, she claimed that individuals with a higher WMC are more prone to control the processes of speech in L2. For her, L2 speech production is a complex cognitive task, which demands regulation and control of the individual’s attentional resources at the time of speaking. Other researchers have also shown that WMC may constrain noticing of formal instances in L2 input (Bergsleithner, 2007; Bergsleithner & Weissheimer, 2009; Robinson, 1995, 1996, 1997, 2001), and also individuals’ L2 production (Bergsleithner, 2007, 2010; Mota, 2003; Bergsleithner & Frota, forthcoming; Weissheimer, 2007) and grammatical sensitivity (Harrington & Sawyer, 1992).

L2 speaking is an extremely complex cognitive task. In order to produce the speech, for example, all information that is currently accessed and manipulated by the speaker is placed in WMC, which determines the degree and amount of attention that different aspects of such information might receive (Levlt, 1989).

In Levelt’s Speech Production Model (1989), the role of working memory (WM) is essential since it stores intermediate representations of messages before speaking (such as preverbal message, surface structure, and phonetic plan), and makes them available for further processing at the time of speaking. Therefore, WMC has a crucial role since it is the limited capacity resource which takes part in both conceptualizing and monitoring processes of the speech in L2.

In a further study, De Bot (1992) adapted Levelt’s (1989) L1 speaking model to L2 speaking. He presupposes that a speaker needs to choose which language to use before actually starting to encode the message. For him, this decision takes place in the conceptualizer, by assuming that macro-planning is language-specific and micro-planning is language-independent. De Bot also suggests that L1 and L2 lexical items make part of the same conceptual network,
though they are stored in different subsets, and that the articulator is language-independent, which means it contains syllable programs and patterns for both languages.

During the speech production process, WMC plays a crucial role on the speakers’ ability to dispense attention to what is going to be produced, to all the decisions they have to make such as words and grammar structures, as well as on the process of recalling information from long-term memory to build their utterances (Bergsleithner, 2007; Fortkamp, 1999, 2000).

Together, WMC and awareness at the level of noticing may be related to the process of speaking and the control of attention to dispense to input and to output processes, as well as may constrain grammatical accuracy in the individual’s oral performance (Bergsleithner, 2007, 2010) and grammatical sensitivity (Harrington & Sawyer, 1992). The former idea of noticing was proposed by Schmidt (1990, 1995), that is, learners should naturally notice formal linguistic aspects in L2 input, and instruction could lead to noticing in subsequent input but not during the teachers’ formal instruction (Schmidt & Frota, 1986; Robinson, 1995, 1997).

For some researchers (Bergsleithner, 2007; Robinson, 1995, 1996, 1997), WMC may constrain the amount of noticing (Schmidt, 1990, 1995) and attention (Schmidt, 2001) one dispenses to L2 input, and afterward it may affect L2 speaking (Bergsleithner, 2007) additionally. Therefore, WMC plays a crucial role in both input and output processes in L2 learning.

3. Method

This quantitative study investigated whether WMC may be an independent constraint on the process of noticing instances in L2 input and on the process of output performance in L2 speaking. The main hypothesis of the study was that WMC may constrain noticing in input of instances of formal features and language output as well.

Although the initial thought of noticing was the one proposed by Schmidt (1990), this paper suggests a notion of noticing within consciousness raising through instruction (Bergsleithner, 2007; Fortkamp & Bergsleithner, 2007) in order to call learner’s attention to the teacher’s explicit instruction or to give them a form-focused-instruction – FFI (Ellis, 2001). This type of formal instruction presupposes that learners may notice a particular linguistic feature in input by means of explicit or incidental learning. The term consciousness raising refers to the drawing of learners’ attention to the formal aspects of a second or foreign language (Rutherford & Sharwood-Smith, 1985).

Prior to discussing the conception of noticing and its role as an interface in language processing and learning as well, it is necessary to briefly consider instructional treatments that may call or “force” learners’ attention to form in the L2 input. Thus, the design of the study involved:

(a) a pre-test (an oral task to elaborate 6 Indirect questions), instructed in Portuguese, to test whether the participants previously knew the target structure (Indirect Questions) or not. In case they did, they were eliminated from the study;
(b) a WM test - Speaking Span Test – SST – (Daneman & Green, 1986), before instruction, to test participants’ WMC.
(c) an explicit instruction of the target structure – Indirect Questions;
(d) an immediate posttest on the same day of instruction (the same oral task than the pre-test); and, an oral protocol to assess whether participants notice instances of the target structure right after the immediate posttest (on the same day of instruction);
(e) a delayed posttest (the same oral task 15 days after the instructional treatment).

3.1. Data collection procedures

All participants were required to record their speech when they were producing Indirect Questions in the three oral tasks, at the same time as looking at different pictures of a map (one picture at each task). In the three oral test occasions, all pictures were about maps in order to induce the participants to elaborate Indirect Questions by asking for information about places one could encounter at the map. A WM test – the Speaking Span test (SST) – was applied to assess participants’ WMC, in which they were instructed to memorize sets of words, which appeared on the middle of a computer screen, and produce oral sentences with the retained words in their short-term memory during the memory test. An oral protocol, based on Robinson’s (1995) framework, was applied. It consisted of questions concerning whether the participants noticed the target structure, looked for it when they speak, and could verbalize it by giving examples (for more details, see Bergsleithner, 2007).

3.2. Data analyses procedures

The three oral tasks (tests) occasions were analyzed by taking into account the accuracy of the grammatical utterances required for the tests, in order to assess specifically accuracy of the target structure without involving other grammar aspects or structures, which were not instructed neither were the focus of this investigation. Then, noticing in the instructional treatment was individually assessed by means of the oral protocol. Participants received one point to each answer they said yes, that is, when they realized they had noticed the formal instruction, and one point to each accurate Indirect Question they produced. Then, WMC scores were assessed by counting accurate sentences in the SST. Furthermore, this test was applied to verify whether accuracy in the oral production in the memory test correlates with accuracy in the oral tasks performance. Again, only the aspect of grammatical accuracy was assessed in the sentences.
participants orally produced without involving complexity in language production assessment. Thus, one point was attributed to each accurate sentence.

4. Results and discussion

One-way ANOVA analysis was performed with the pretest, immediate posttest, and delayed posttest as the three levels of the within-subjects variable – accuracy in the target structure in the questions performance. The results show that there is a large difference in the mean participant performance between OP1 (0.97) and OP2, and between OP1 and OP3, in the three speech production tasks (one pretest and two posttests). Though, there is a considerable similarity in the mean participant performance between OP2 (7.27) and OP3 (7.17), in both posttests after instruction. As regards individual inconsistency, it can be observed that there was a large overall difference in the performance of L2 speaking after instruction, if compared to the pre-test. This finding suggests that noticing instances of formal structures occurred in input of the instructional treatment, since most participants could accurately produce oral sentences using the target structure.

Pearson correlations were analysed among the variables of the study – WMC, noticing, and L2 speech production on the oral tasks – in order to see whether the variables themselves correlate or not. Together, the findings suggest that WMC may constrain the ability to dispense attention to input, and accordingly to output performance. The two cognitive variables in this paper -- WMC and noticing -- seem to be reasonably related to the immediate posttest performance after treatment (for WMC: r = .61 on the immediate posttest and r = .63 on the delayed posttest) and noticing seems to some extent be interrelated to maintenance on the delayed posttest (for noticing: r = .60 on the posttest and r = .70 on the delayed posttest). In general, the findings demonstrated a significant improvement in the mean performance as regards the scores of grammatical accuracy in the oral performance of Indirect Questions.

In addition, pairwise comparisons were calculated and showed statistically significant differences between the pretest and the immediate posttest (p = .000), and between the pretest and the delayed posttest (p = .000), but not between the two posttests (p = .766). Apparently, the participants changed in statistically magnitude from the pretest to the posttests after instruction. However, there is a slightly perceptible change from the immediate posttest to the delayed posttest, thus indicating occurrence of sustained performance.

Thus, the findings show that WMC may be an independent constraint that may have an effect on noticing instances in L2 input, and these two cognitive variables (WMC and noticing) may influence the performance in L2 speaking. In addition, correlational findings suggest that the variables of the study -- WM capacity, noticing of L2 linguistic aspects, and L2 oral performance -- statistically correlate among themselves. Based on these results, the hypothesis of the study was supported since most of the higher spans or higher processors showed evidence for noticing L2 instances of the target structure in input. Moreover, the higher spans accurately produced Indirect Questions. On the other hand, most of the lower spans could neither notice nor orally produce language using the target rule with the same degree of accuracy.

In sum, WMC had a crucial role in the process of noticing instances of formal aspects in input and in the process of recalling noticing by showing sustained performance as well, especially when participants were required to use the target structure accurately in the delayed posttest.

5. Conclusion

The results of this study corroborate Fortkamp’s (1999), Bergsleithner’s (2007), Mota’s (2003, 2009), Payne and Ross’s (2005), Payne and Whitney’s (2002), and Weisheimer’s (2007) findings that WM correlates with L2 oral production and might be a constrain in L2 speaking (Bergsleithner, 2007) and for grammatical sensitivity (Harrington & Sawyer, 1992). The results also corroborate Schmidt’s (1990, 1995, 2001) and Robinson’s (1995, 1996b, 1997, 2001, 2002) proposal that WM is strongly related to noticing, and that noticing could be constrained by WM capacity (Bergsleithner, 2007; Robinson, 1997, 2001).

In addition, the results show rationale with other researchers’ proposals, as for example, with Ellis’s (2001) FFI, which suggests that noticing instances of L2 forms during instruction may facilitate L2 learning, and thus enhance grammatical accuracy in L2 production. Accordingly, instruction may improve language development (Fortkamp & Bergsleithner, 2007; Robinson, 1995, 1996, 2001), grammatical sensitivity (Harrington & Sawyer, 1992) as well as grammatical accuracy in L2 oral performance, which is closely related to WMC (Bergsleithner, 2007; Fortkamp & Bergsleithner, 2007).

Further studies need to verify noticing in subsequent input after instruction, as well as to investigate on-line occasions through interaction in the input, and in instructed and incidental learning occasions, that is, with or without instructional treatment in input.

Moreover, further studies should replicate this study by applying a longitudinal study in order to assess learning of the target structure in a longer period than that after treatment.

Furthermore, other oral tasks should be applied, as well as other grammatical structures should be investigated. Besides, other researchers should also replicate this study by assessing other aspects of speech production such as: fluency, complexity, in future studies.
To conclude, this paper can be taken as an investigation to better make researchers aware of individual differences that L2 learners have when they are learning an L2. Some individuals will orally outperform others with more accuracy in their speech, while others will have difficulty in accurately producing an L2 due to cognitive constraints.

References


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