

The Relationship among L2 Proficiency, Inhibitory Control and L2 Writing

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Keywords: L2 proficiency; inhibitory control; L2 writing performance

Abstract: The present study investigated whether there is a relationship among different levels of second language (L2) proficiency, L2 writing performance and levels of inhibitory control by using SPSS. Fifteen learners of L2 English in junior high school at different levels of inhibitory control performed a Stroop effect task, an adapted L2 proficiency test, and a narrative L2 writing task. L2 writing performance was assessed by means of the quantitative measures of complexity, accuracy, and fluency (CAF). The results demonstrated that L2 proficiency was positively correlated with accuracy for response inhibitory control ($P < 0.05$). At low levels of proficiency, response inhibitory control had lower accuracy, while at high levels of proficiency; response inhibitory control had higher accuracy. Meanwhile, as for CAF for L2 writing, accuracy for L2 writing was significantly negatively correlated with complexity for L2 writing ($P < 0.01$). These results can shed light on how junior high school English learners improve their L2 proficiency to enhance inhibitory control and how junior high school English teachers help English learners to ensure the accuracy for writing on the basis of ensuring complex sentence patterns.

1. Introduction

In China, English is treated as a core subject, similar to Chinese and Mathematics. Students' English proficiency plays an important role in their future education and careers. However, influenced by the mother tongue, most of English learners often struggle when using it, resulting in a great deal of variability in their writing outcomes, with some learners producing better proficiency of English writing in their language producing experience while some other learners do not. In view of the great deal of variability in English writing success across English learners, researchers in the field of second language acquisition (SLA) have been interested in investigating different factors that lead to successful L2 writing, including cognitive (working memory capacity, inhibitory control and etc.) and affective factors (writing anxiety, writing self-efficacy and etc.)^[1]. Although present studies on L2 learners are fruitful, there is no scholar taking junior high school English learners in Chinese as subjects to explore their English writing performance.

Most of the evidence has examined second language proficiency and its effect on cognitive control. Some studies have reported that high level of L2 proficiency were better at regulating inhibitory control through psychological experiments^{[2][3]}. Some previous studies have studied the moderating role of L2 proficiency in the relationship between working memory and L2 processes

and products. For instance, in the process of exploring the relationship among the effects of working memory and L2 proficiency on L2 writing, it is found that at high levels of proficiency, there was a positive link between working memory and lexical sophistication ^[4]. Most of the evidence has examined the effect of inhibitory on L2 using, including the role of inhibitory control in overcoming English written errors related to the past tense marking of irregular verbs ^[5], the effect of inhibitory control on speech understanding ^[6], the role of inhibitory control in second language phonological processing ^[7] and etc.. However, it is still unclear that whether there is a relationship among L2 proficiency, L2 writing and inhibitory control. Thus, the current study aims to explore the relationship among L2 proficiency, inhibitory control and L2 writing by taking junior high school L2 learners as subjects. Based on previous results, it is hypothesized that there could be a relationship among L2 proficiency, L2 writing performance and inhibitory control. And if it does, the specific relationships between the different dimensions will be explored separately.

2. Method

2.1 Participants

A total of 15 Chinese EFL learners (7 male, 8 female; age: M = 14.4 years old) participated in this experiment. Although these junior high school English learners came from different schools, they were divided into 3 groups according to their grades (seven grades: 5 subjects; eight grades: 5 subjects; nine grades: 5 subjects). All subjects were exposed to finish three similar tasks including Stroop effect task, an adapted L2 proficiency test, and a narrative L2 writing task.

2.2 Instruments

2.2.1. Measure of L2 Proficiency

According to the pen-and-paper version of the Oxford Quick Placement Test (QPT) ^{[4][8]}, the new L2 proficiency test (NLPT) was revised based on the level of junior high school students and the difficulty of the middle school entrance examination. In order to test subjects' different language skills, NLPT includes 20 items and requires subjects to select the appropriate answer to three option multiple-choice items targeting parts of speech (eg., nouns, verbs, adverbs) and a range of grammatical structures in English (eg., prepositions, tense, aspect, gender) by focusing primarily on vocabulary and grammar knowledge. These fill-in-the-gap exercises require subjects to choose and complete in 15 minutes, out of the provided options, the word (all options are nouns) or phrase (lexical collocations) which best fits the spaces in the text. With one point per sub-question, the final score of NLPT is used to measure the level of L2 proficiency.

2.2.2 Measure of inhibitory control

Among quite a few experimental tasks to measure inhibitory control ranging from card sorting tests, go-no-go and stop-signal tests, Simon tests, Flanker tests and Stroop effect task, language-related Stroop effect task was selected to measure inhibitory control in this experiment ^[9]. Subjects were told in advance that experiment was divided into two parts, practical experiment and formal experiment to make sure subjects practice proficiently to participate in the formal experiment. Each trial started with the presentation of a fixation cross in the center of the screen until subjects press "SPACE" key to begin the experiment. Following a 1000 ms fixation point, the color words were projected one-by-one in the middle of the screen. Subjects were asked to press the response key "1, 2, 3" to correspond to word ink colors "red, green, and blue". All color words were

randomly displayed with an infinite duration until subjects pressed the key. In response to press the key, subjects need to inhibit the interference of word meaning on word ink color. For example, the word “red” may be written in blue ink and subjects should respond to blue, ignoring red. Thus, trials can either be congruent (the ink color and word correspond) or incongruent (where there is a discrepancy between the two). Feedback followed the reaction of subjects in each trial. In case of a correct response, the feedback message “Correct!” appeared in the center of the screen for 1500 ms, while the feedback message “Incorrect!” appeared if subjects responded incorrectly.

2.2.3 Measure of L2 Writing

In order to measure the level of subjects’ L2 writing, the narrative task was chosen to elicit subjects to write a story based on a sequence of pictures (in the form of a cartoon strip) and what they imagined was happening in those pictures ^[1]. The copy of three pictures as a stimulus was handed out to each subject or was sent to them through the Internet. The sequences of pictures were about a group of boys playing football when suddenly they broken the window of an old man. They came to his house to apologize and the old man forgave them by giving them back the football. The rationale behind using such a narrative task to measure the level of L2 writing is that the monotonically writing task for evaluating the level of L2 writing performance is not affected by interactional variables. By piloting the task with English learners which they were required to do the task as fast as they could, the average time (10 minutes) to finish this task was made to conduct the following formal experiment. There was no requirement of a minimum text length and no access to dictionaries or any other external sources was available. The subjects were prompted to start writing immediately after having looked at these pictures and no specific instructions were given regarding planning or revision.

2.3 Procedure

Stroop effect task, an adapted L2 proficiency test, and a narrative L2 writing task were completed in the following order:

- (1) Basic information questionnaire and new L2 proficiency test (NLPT)
- (2) Stroop effect task
- (3) Narrative L2 writing task

Smart phones, a laptop and papers were used in the process of data collection. Firstly, by view of smart phones, subjects completed a basic information questionnaire and a L2 proficiency test, which took 20 and 25 minutes to complete. Secondly, each subject performed the Stroop effect task on a laptop, which took between 15 and 20 min to complete. The subjects started with the Stroop effect task, with all the instructions appearing on the screen. After completing it, the subjects proceeded with the writing task on their papers within 10 minutes.

3. Result analysis

3.1 Analysis of basic information

Among 15 Chinese EFL learners (7 male, 8 female; age: $M = 14.4$ years old), just 12 Chinese EFL learners (5 male, 7 female; age: $M = 14.25$ years old) competed this experiment. Statistical results are as follows (see Table 1). All subjects were right-handed. Among these subjects, almost 91.67% had learned English for 10 years or above prior to the study (Mean = 11.083). As for grades, 5 learners are at seven grades, 4 learners are at eight grades and 3 learners are at nine grades. 83.33%

learners use language mostly at school, others use language mostly through language learning software.

3.2 Analysis of L2 Proficiency

The overall score of new L2 proficiency test (NLPT) for junior high school students decides the level of L2 proficiency. The total score is 20 points with four levels (first level: 1-5 points; second level: 6-10 points; third level: 11-15 points; fourth level: 16-20 points). Table 2 provides scores of L2 proficiency test. Minimum (5) and maximum (16) values for the new L2 proficiency test. Table 3 displays specifically the number of learners at each point of score.

Table 1: Scores of L2 Proficiency Test (N=12)

Variables	Mean	SD	Median	Min	Max
Score	8.33	1.43	8.00	5.00	16.00

Table 2: Descriptive Statistics for L2 Proficiency Tests (N=12)

Score	Number	Percent
5	2	16.67%
6	1	8.33%
7	2	16.67%
8	3	25.00%
10	3	25.00%
16	1	8.33%

3.3 Analysis of inhibitory control

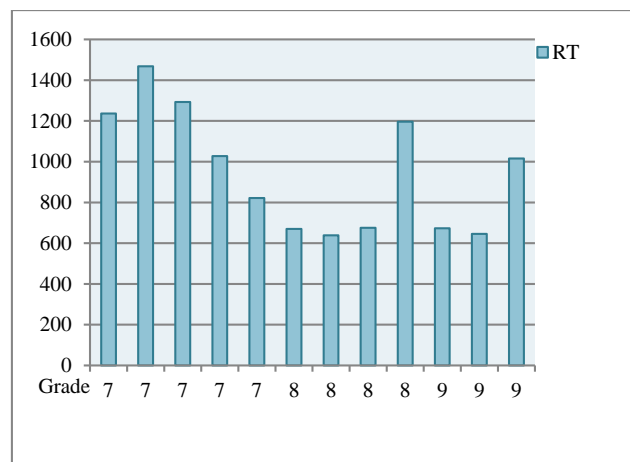


Figure 1: Reaction times

For measuring the level of inhibitory control, reaction times (see Figure 1) and correct rates (see Figure 2) were calculated. The average level of reaction time for subjects in grade seven is 1169.5333318ms, subjects in grade eight is 794.979166575ms and subjects in grade nine is 778.11111ms. From this, it can be concluded that the speed of reaction time to Stroop effect task is constantly increasing with age. Due to the influence of the subjects' own differences, the response accuracy rate was not found to be reflected in the rules between grades. Therefore, the most robust findings of the Stroop effect test is that English learners in higher grade show shorter response latencies on the incongruent trials than the congruent trials, reflecting their automatic processing of the color word that has to be inhibited in the Stroop test.

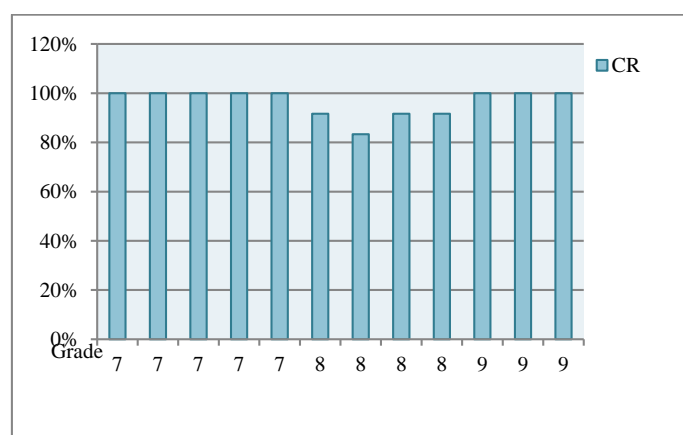


Figure 2: Correct rates

3.4 Analysis of L2 Writing

L2 writing performance was assessed by means of the quantitative measures of complexity, accuracy and fluency (CAF) [4]. CAF analysis was carried out through manual coding of grammatical and lexical errors, segmentation of syntactic units and automatic calculations using Excel. A T-unit is defined in this study as “one main clause plus whatever subordinate clauses happen to be attached to or embedded within it” [1]. According to the study of Zabihi in 2018, the complexity of L2 writing performance was measured by the syntactic complexity, including the ratio of T-units (T-units /total number of sentences), the ratio of coordinate phrases (coordinate phrases/total number of clauses) and the ratio of dependent clauses (dependent clauses/total number of clauses) was obtained. The accuracy of L2 writings was measured by calculating the number of error-free T-units [1][10] against the total number of T-units (EFT/T). Moreover, following Kroll [1], the present study took grammar errors and vocabulary errors into consideration to measure inaccuracy in learners’ writings, while spelling errors and punctuation errors were ignored. As for the fluency of L2 writing performance, following Larsen-Freeman [11], fluency of learners’ writings was estimated with regard to the average number of words per T-unit.

3.5 Correlation analysis

In order to explore whether there is a relationship among L2 proficiency, L2 writing performance and inhibitory control, correlation analysis was carried out. Next, a relative more specific correlation analysis was used to further discover relationship. According to Table four, it is indicated that there is a positive relationship between reaction correct rate and English proficiency (P=0.614*) and a obviously negative relationship syntactical complexity and accuracy (P=-0.714**). It means that when English learners have high English proficiency they were more prone to write more accurate narratives. While when English learners produce more complex narratives, the accuracy of writing is decrease, as shown in Table 3.

Table 3 Pearson Correlation Analysis

	Proficiency	Complexity	Fluency	Accuracy	Reaction	Correct
Proficiency						
Complexity	-0.54					
Fluency	0.449	-0.061				
Accuracy	0.162	-0.714**	0.308			
Reaction	-0.114	-0.043	-0.330	0.180		
Correct	0.614*	0.230	0.477	-0.030	0.419	

4. Discussion and Conclusion

Statistics using SPSS was employed to analyze the relationship among L2 proficiency, the reaction time and accuracy for response inhibitory control and CAF for L2 writing.

Results of correlation analysis demonstrated that L2 proficiency was positively correlated with the correction rate of inhibitory control ($\text{sig} < 0.05$). It explains that at low levels of proficiency, response inhibitory control had lower accuracy, while at high levels of proficiency; response inhibitory control had higher accuracy. This finding is in line with the previous study indicating that high proficient bilinguals were better at regulating inhibitory control when the demand on inhibition was high compared to that of low proficient bilinguals [2] [3] [12]. However, this finding is also in contrast to the results obtained by some scholars that working memory was positively related to L2 proficiency and learning, but inhibitory control was not [13]. Such a discrepancy in findings could be explained by the fact that cognitive control especially inhibitory control has an impact on L2 proficiency, but working memory may have much influence on it. Therefore, this study verified the relationship between English proficiency and inhibitory control from the perspective of junior high English learners, which extends the previous study.

Meanwhile, as for CAF for English writing, this study has reported evidences that accuracy for English writing was significantly negatively corrected with complexity for English writing ($\text{sig} < 0.01$). In other words, more complex narrative writing English learners produce, less accuracy this writing will be. This finding is related to people's common sense.

5. Conclusions

Taken together, results of the present study may shed more light on the cognitive aspects of English writing. However, being different from previous results, these findings have not displayed the relationship between L2 proficiency and L2 writing syntactic complexity. It is deserved to be mentioned that the present study extends the relationship between inhibitory control and L2 proficiency in writing by taking junior high school English learners as subjects and finds the relationship between complexity for L2 writing and accuracy for L2 writing. In terms of these results, they can shed light on how junior high school English learners improve their L2 proficiency to enhance inhibitory control and how junior high school English teachers help English learners to ensure the accuracy for writing on the basis of ensuring complex sentence patterns.

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