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Online processing of verb-noun collocation for Chinese learners of English as a foreign language

中国英语学习者动名词搭配的在线加工

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Abstract

This study focused on two distinct Chinese groups of English as a Foreign Language (EFL) learners: those with advanced proficiency and those with basic proficiency. The objective was to explore the mechanisms used by Chinese EFL learners in processing and comprehending verb-noun collocations in an online context. The key metrics under consideration were learner response time, the influence of collocation appropriateness, and the alignment between their native language (L1) and English (L2). The findings reveal that: 1) The advanced learners demonstrated significantly faster reaction times overall, particularly when dealing with both appropriate and inappropriate collocations. 2) Accuracy was higher for appropriate verb-noun collocations compared to inappropriate ones, and the advanced group outperformed the basic group in this regard. 3) Notably, there was no significant difference in processing time between the two proficiency levels for both appropriate and inappropriate collocations. These results provide valuable empirical insights into the factors influencing EFL learners' online comprehension of verb-noun collocations, highlighting the role of L2 proficiency and the congruence with their L1.

Keywords: Online processing, verb-noun collocation, Chinese EFL learners, response time, L1-L2 congruence.

Introduction

The analysis of EFL learners' collocation errors in their L2 output has garnered significant attention (McCarthy & O'Dell, 2014, p. 2; Prodromou, 2003, p. 42). Additionally, Conrad and Biber (2005, p. 57) emphasized the role of collocation in imparting the extended semantics of words. Nesselhauf (2005, p. 7)

摘要

本研究以两组不同水平的中国英语学习者为研究对象：一组是高水平学习者，一组是基础水平学习者。研究目的是探索中国英语学习者在线加工和理解动名搭配的机制。考量的关键指标包括学习者的反应时间、搭配恰当性的影响，以及母语和英语之间的一致性。研究结果表明：1) 高水平学习者总体上表现出更快的反应时间，尤其是在处理恰当和不恰当的搭配时；2) 与不恰当的动名搭配相比，恰当的动名搭配的准确率更高，且高水平者在这方面表现优于基础组；3) 值得注意的是，对于恰当和不恰当的搭配，两组学习者之间没有显著差异。这些结果为影响英语学习者在线理解动名搭配的因素提供了有价值的实证见解，强调了外语水平和母语水平之间一致性的作用。

关键字: 在线加工，动名搭配，中国英语学习者，反应时间，母语和英语的一致性

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further suggested that collocation is a stable word combination that demonstrates lexical cohesion. Recent studies have demonstrated that L1 and L2 collocations differ in their psychological processing paradigms (Wei, Yang, & Zhang, 2017, p. 103). When it comes to the native language, most collocations are deeply ingrained in the psychological structure of users. In the acquisition of the first language (L1), collocation knowledge typically evolves alongside the formation of vocabulary and conceptual systems. This involves numerous collocation patterns or frames, where specific words can activate the corresponding structures or frames (Wolter & Gyllstad, 2013, p. 480; Goldberg, 2019, p. 26). Conversely, L2 collocation knowledge primarily originates from classrooms and textbooks, with the accuracy of collocation largely dependent on the learner's vocabulary knowledge. Therefore, it poses a challenge for EFL learners to grasp the actual context of collocation, and they exhibit low sensitivity and recognition towards L2 collocation. In most instances, L1 thinking influences the processing speed of L2 collocation. EFL learners find equivalence collocations easier to accept and produce, whereas non-equivalence collocations tend to stimulate L1 thinking, resulting in interference and hindrance in the output of L2 collocation. Among all types of collocations, verb-noun collocation is generally perceived as the most challenging for EFL learners to master (Alruwaili, 2020, p. 2).

In recent years, the establishment of Chinese learner English Corpus (CLEC), along with advancements in corpus retrieval (Kita & Ogata, 1997, p. 229), statistical analysis, and other associated technologies, has furnished an extensive repository of authentic language data and innovative research perspectives for a deeper examination of the collocation patterns exhibited by Chinese EFL learners. Leveraging corpus-based research techniques, numerous Chinese scholars have delved into the verb-noun collocation errors present in the linguistic output of EFL learners, striving to comprehensively categorize these errors through extensive big data analysis (Zhang & Yang, 2009, p. 41). Nevertheless, a limited number of studies have integrated the corpus approach with the response time method, a prevalent tool in psycholinguistic research, to examine the linguistic output traits of Chinese EFL learners (Xia, Xia & Li, 2014, p. 69). Hence, this article seeks to explore the online processing of L2 verb-noun collocations among Chinese EFL learners by employing a combined corpus and real-time response time methodology.

Literature review

Previous research, conducted from diverse theoretical perspectives, has delved into the verb-noun collocation errors committed by Chinese EFL learners. The majority of these studies reveal that Chinese EFL learners encounter difficulties with verb-noun collocation, yet their proficiency in this area improves as their proficiency in L2 rises (Wang, Xu & Li, 2015, p. 15). Zhang and Li's (2016, p. 30) statistical analysis of the corpus of college English learners revealed that verb-noun collocation exhibited the highest error rate, accounting for 55.83% of all collocation errors. Zhang and Yang (2009, p. 42) categorized verb-noun collocation errors and identified numerous instances of improper verb usage in collocation. Laufer and Waldman (2011, p. 647) examined the production of verb-noun collocation in the English writing of EFL learners from three distinct proficiency levels (low, medium, and advanced) who were native speakers of Hebrew. By comparing the self-constructed learner English corpus with the Louvain Corpus of Native English Essays (LOCNESS), they discovered that learners across all levels employed appropriate English Verb collocation significantly less frequently than native English speakers. Advanced learners demonstrated a relatively higher level of accuracy, yet errors, particularly interlingual ones, persisted. While corpus-based research primarily focuses on the influence of L1 on the production of L2 collocation (Yamashita & Jiang, 2012, p. 665), the processing of verb-noun collocation among Chinese EFL learners remains unexplored.

Siyanova and Schmit (2008, p. 454) conducted a study on the processing of adjective-noun collocations among EFL learners in Russia. Their findings indicated that non-native English speakers exhibit slower processing speeds compared to native English speakers when it comes to collocation processing. Although advanced EFL learners are capable of producing appropriate English collocations, they still lag behind native English speakers in terms of sensitivity and fluency. Yamashita and Jiang (2012, p. 647) conducted a study comparing English collocation processing among native English speakers, Japanese English as a Second Language (ESL) users, and Japanese EFL learners. The experimental materials were categorized into two types: consistent collocations that can be translated directly between Japanese and English (e.g., "make lunch" and "heavy stone") and inconsistent collocations that cannot be translated directly (e.g., "kill time" and "slow learners"). Their findings revealed that both collocation consistency and English proficiency play crucial roles in verb-noun collocation processing.

Szudarski and Conklin (2014, p. 833) investigated the processing of English adjective-noun and verb-noun collocations among advanced English learners with Polish as their native language. They compared the short-term and long-term memory effects of rote rehearsal and enhanced rote rehearsal. Their findings indicated that both methods of rote rehearsal had no significant impact on learners' processing and acquisition of verb-noun collocations. This was attributed to the congruence effect between their first language (Polish) and second language (English). The experiment involved 30 inconsistent verb-noun collocations out of 40, while only one inconsistent adjective-noun collocation was included.

Previous research conducted by Wolter and Gyllstad (2011, p. 123) and Yamashita and Jiang (2012, p. 647) has revealed that EFL learners encounter challenges when dealing with inconsistent items. Cao (2016, p. 11) employed the method of cross-language priming conditions through a collocation semantic judgement task to assess the significance of Chinese word semantics in aiding Chinese EFL learners' acquisition of interlanguage collocations. Their results indicate that the learners' native language, Chinese, has a substantial influence on the process of acquiring target language collocations. Furthermore, the research suggests that Chinese lexical semantics may underlie the formation of interlanguage collocations among Chinese EFL learners. Consequently, it can be concluded that the processing of L2 vocabulary relies on the vocabulary of the native language, and the collocation patterns of the native language also exert an influence on the acquisition of L2 collocations (Choi, 2017, p. 403; Cao, Wen & Zhang, 2016, p. 27). The knowledge of the native language facilitates the extraction and processing of consistent collocations.

Cognitive linguistics maintains that the construction meaning of verb-noun collocation arises from the integration of two distinct semantic concepts, rather than a mere summation of verb and noun semantics (Goldberg, 2019, p. 87). When EFL learners engage in the recognition and meaning assessment of verb-noun collocation phrases, they inevitably draw upon the mental operation mechanisms of both their native language and the target language. Advanced EFL learners often approach verb-noun collocation from the lens of their L2 acquisition experience. However, in scenarios where L1 and L2 diverge, L1 acquisition experience acts as a hindrance (Gyllstad & Wolter, 2015, p. 296). Conversely, novice English learners tend to view verb-noun collocation through the prism of their L1 acquisition experience. When confronted with inconsistencies, the L1 learning experience takes precedence in semantic processing by activating the mental vocabulary and semantic framework of the native language. Ultimately, both L1 and L2 are stimulated via conceptual representation and task schema, and an inhibition mechanism is employed to reconcile the conflict between the two simultaneously stimulated languages. The degree of inhibition is contingent upon the English proficiency level of the EFL learners (Ma, Li & Guo, 2016, p. 35).

Methodology

Research questions

In this experiment, it is postulated that Chinese EFL learners varying in proficiency levels exhibit disparities in their response time when processing verb-noun collocations. Additionally, the experiment assumes that the congruence between their native language (L1) and English (L2) plays a pivotal role in their online processing of verb-noun collocations. These assumptions give rise to the following three research questions:

1. What is the overall performance of Chinese EFL learners in their online processing of verb-noun collocations?
2. Do learners differing in English proficiency levels exhibit disparities in their processing of noun-verb collocations? If so, what are the nature of these differences?
3. Does the congruence between learners' L1 and L2 influence their online processing of verb-noun collocations? If so, how does it do so?

To answer these inquiries, a 2x2 factorial design was employed in the experiment, encompassing the factors of English proficiency levels (high versus basic) and the appropriateness of collocations (appropriate versus inappropriate). The dependent variable measured was the response time.

Participants

The study was conducted with two distinct participant groups. Group 1 comprised of 20 doctoral students majoring in English from Beijing Foreign Studies University. This group consisted of 10 males and 10 females, with an average age of 34.7 years and an average of 22 years of English learning experience.

Participants in Group 1 were designated as advanced EFL learners for the experiment. In contrast, Group 2 encompassed 20 first-year undergraduate students from Beijing Sport University, also with 10 males and 10 females. These students were non-English majors and had an average English learning duration of 12 years, while their average age was 19.5 years. Participants in Group 2 were designated as basic EFL learners in the experiment. All participants were native Chinese speakers with normal corrected vision and were right-handed. Prior to the experiment, all individuals self-assessed their English proficiency using a 7-level scale. Independent sample T-test results indicated a significant difference in English proficiency between the two groups ($t = 9.395$, $df = 11$, $p < 0.05$), with Group 1 exhibiting significantly higher English proficiency than Group 2 ($MD = 2.619$). (Refer to Table 1 for further details.)

Table 1.
Essential details regarding the study participants.

Participants	Age	English learning period	Self-assessment of English proficiency
Advanced	M = 34.7	M = 22	M = 6.3
	SD = 4.786	SD = 4.855	SD = 0.488
Basic	M = 19.5	M = 12	M = 3.7
	SD = 1.225	SD = 1.673	SD = 0.516

Instruments

In the study, learner corpora were utilized as a powerful tool to search and screen prevalent verb-noun collocation expressions employed by EFL learners across various proficiency levels. This approach allowed us to gain a deeper understanding of the language patterns and preferences of EFL learners in their use of verb-noun collocations. To ensure reliability and validity, we sourced our expressions from three reputable corpora: the Chinese Learner English Corpus (CLEC, Gui & Yang, 2003), the Ten-thousand English Composition of Chinese Learners (TECCL, Xue, 2015), and the Louvain Corpus of Native English Essays (LOCNESS). These corpora provided a rich and diverse dataset, enabling us to identify verb-noun collocations that were appropriate for the experiment.

In contrast, inappropriate verb-noun collocations were derived from the interlanguage corpus of Chinese EFL learners. This approach allowed us to identify common errors and misuses of verb-noun collocations, providing valuable insights into the challenges EFL learners face when acquiring this linguistic feature.

To meet the experimental requirements, a comprehensive set of online processing test questions was compiled, focusing specifically on verb-noun collocation as the experimental material. The online processing test encompassed 120 collocation phrases, with 60 phrases designated for the formal experiments, 20 for practice, and 40 serving as fillers. This structure ensured that participants were gradually introduced to the task, with the practice questions helping them familiarize themselves with the format and requirements of the test.

The 60 pairings used in the formal experiment comprised 30 pairs of appropriate and inappropriate English collocations, presented in a randomized order. This randomization was crucial to eliminate any potential bias or order effects that could influence participants' responses. The content of the practice test materials differed from the formal test materials, although the presentation method and probability remained consistent. This approach ensured that the practice questions did not provide any unfair advantage to participants in the formal experiment. Fillers were chosen from the experimental materials of Cao (2016, p. 37), with 4 items being verb-noun collocation and 36 items not being verb-noun collocation. The inclusion of fillers helped to disguise the true purpose of the test, ensuring that participants' responses were not influenced by their knowledge of the experiment's objectives.

In order to ensure the authenticity and effectiveness of the test questions, the compiled online processing test questions of verb-noun collocation were checked one by one in TECCL and LOCNESS to calculate their collocation strength. BFSU Collocator 1.0 (Xu & Jia, 2009) was employed for the calculation of collocation strength to examine mutual information (MI) and log-likelihood ratio. Liang, Li and Xu (2010, p. 96) claimed that MI reflected the mutual attraction between node words and collocation words, and the greater the MI, the higher the collocation. Hunston (1994) proposed that collocation with MI greater than three should be regarded as strong collocations, but it was easy to treat low-frequency words as strong

collocations. Hence, some scholars advanced the concept of MI3, that is, the co-occurrence frequency of low-frequency words and node words should be cubed to show strong collocations.

The log-likelihood ratio is recognized as an effective approach for assessing the strength of collocations. In the conducted experiment, the evaluation of verb-noun collocations necessitated attention to the span. Consequently, a combined approach of MI3 and the log-likelihood ratio was employed to offer a comprehensive assessment of collocation strength. The chosen verb-noun collocations were validated and affirmed through reference to the Oxford English Collocation Dictionary (Tables 2 and 3).

Table 2.

Partial list of inappropriate verb-noun collocations.

No.	Chinese priming phrases	Inappropriate verb-noun collocations	Oxford English Collocation Dictionary	TECCL		
				Freq.	MI3	Log-likelihood
1a	扩大知识面	*Enlarge one's knowledge	×	8	10.6161	74.0468
19a	学习知识	*Learn knowledge	×	99	16.773	420.5632
17a	看报	*See newspaper	×	31	15.2088	200.7103
34a	开阔视野	*Enlarge one's knowledge	×	2	10.4238	23.9029
5a	操作计算机	*Type a computer	×	1	2.8398	4.7923

* indicates inappropriate English verb-noun collocations; × signifies collocation not found in Oxford English Collocation Dictionary.

Table 3.

Partial sample of appropriate verb-noun collocations.

No.	Chinese priming phrases	Appropriate verb-noun collocations	Oxford English Collocation Dictionary	LOCNESS		
				Freq.	MI3	Log-likelihood
1b	扩大知识面	Broaden one's knowledge	√	2	7.3211	13.9048
19b	学习知识	Acquire knowledge	√	0		
17b	看报	Read newspaper	√	1	5.4863	11.7186
34b	开阔视野	Broaden one's horizon	√	0		
5b	操作计算机	Run a computer	√	4	5.8643	23.4397

Vilnius (2016, p. 2) proposed a distinction between adjacent and nonadjacent collocations. Specifically, adjacent collocations refer to the absence of intervening words between two collocation components, whereas nonadjacent collocations involve the presence of additional elements between the two components, often to provide additional contextual information. Given the impact of word proximity on processing time, we made adjustments to the material screening process to ensure that there are no intervening words between verb and noun collocations. However, articles (the, a, an) and pronouns preceding nouns were excluded from this constraint. Analysis using the independent sample t-test revealed no statistically significant difference in word length between appropriate and inappropriate collocations, with a t-value of -1.072, degrees of freedom (df) of 118, and a p-value of 0.286 (greater than 0.05). Cohen's d value was 0.52, indicating a moderate effect size. The mean difference (MD) was -0.633. These results are presented in Table 4.

Table 4.*Statistics of word length T-test for verb-noun collocations.*

Word length (number of letters)	Appropriate (n = 60)		Inappropriate (n = 60)		MD	t (118)
	M	SD	M	SD		
	12.43	2.948	13.07	3.502	-0.633	-1.072*

* $p > 0.05$ **Procedures**

Drawing upon a rich body of prior research conducted by Siyanova and Schmitt (2008, p. 429), Yamashita and Jiang (2012, p. 647), Szudarski and Conklin (2014, p. 833), and Cao (2016, p. 6), the current experiment was meticulously designed to encompass two distinct yet complementary components: a practice test and the formal experiment. The protocol for the practice test was meticulously crafted to mirror that of the formal experiment, ensuring that participants had the opportunity to familiarize themselves with the procedures and repeat the process until they were thoroughly acquainted with every step. This iterative approach aimed to eliminate any potential confusion or unfamiliarity that could have interfered with the accuracy and reliability of the final results.

To ensure that participants had achieved a satisfactory level of familiarity with the procedures, they were required to demonstrate their understanding and proficiency through a series of practice trials. Once they had demonstrated a consistent and proficient grasp of the tasks, they were ready to proceed to the formal experiment. This transition was seamlessly facilitated by the simple press of the space bar, marking a clear boundary between the preparatory phase and the main event. The experiment was conducted in a state-of-the-art soundproofed environment, designed to guarantee the integrity of the results and prevent any external distractions or interference. Participants were tested individually, ensuring that their attention and focus were not diluted by any external factors. This isolation also precluded any potential communication or collaboration between participants, ensuring that each individual's performance was a true reflection of their individual abilities and skills.

To further enhance the accuracy and readability of the experiment, the computer screens were configured with a crisp white background, a resolution of 1280×768, and carefully selected font settings. The font size was meticulously set to 32, ensuring that the text was large enough to be easily readable without any strain on the eyes. Chinese text was displayed in the classic Song typeface, renowned for its clarity and legibility, while English text was presented in the timeless Times News Roman font, renowned for its elegance and readability. These meticulous attention to detail aimed to maximize participant comfort and minimize any potential distractions, ensuring that the focus remained squarely on the experiment and the tasks at hand.

The formal experiment proceeded in a precise sequence. Firstly, a red "+" fixation point was presented for 250 milliseconds to orient the participants' attention. Then, a priming phrase, specifically a Chinese verb-noun collocation, was displayed for 800 milliseconds. Subsequently, the English translation corresponding to the Chinese verb-noun collocation was shown for 5000 milliseconds. Participants were instructed to promptly respond by pressing the designated button - D for appropriate collocations and K for inappropriate ones - to indicate whether the target phrase was appropriate or not. If no response was made within the allocated time, the system automatically moved on to the next stimulus. Prior to the formal experiment, all participants underwent a practice session to familiarize themselves with the testing procedures. It was ensured that each participant encountered 100 questions during the formal test, of which 40 were fillers and did not contribute to the data collection.

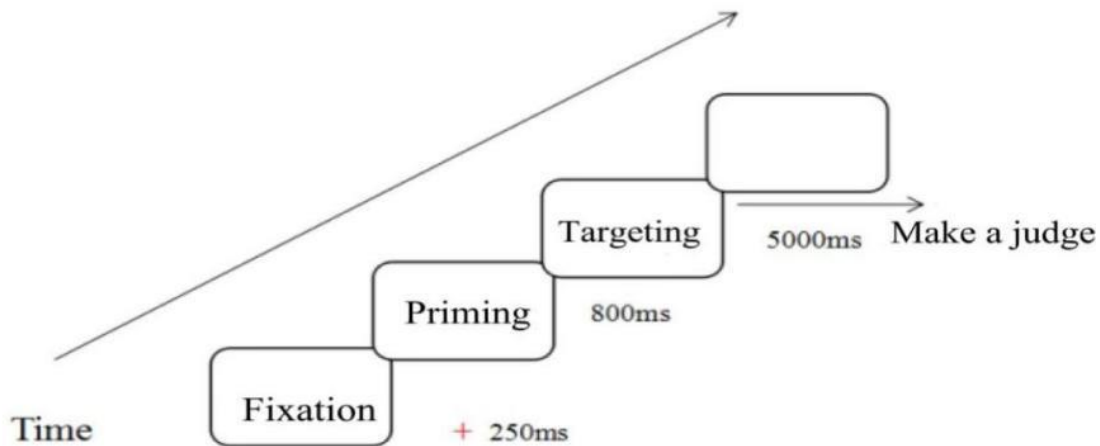


Figure 1. Experimental flowchart for verb-noun collocation response times.

Results and discussion

During the data processing stage, aside from considering the overall response time of the subjects, any data containing incorrect responses from the subjects were excluded. Additionally, any invalid data, defined as having a response time exceeding two standard deviations from the mean value or a recorded response time of 0, were also disregarded. Out of the collected dataset, 39% were identified as incorrect, while 6.5% were determined to be invalid. Following the prescribed experimental protocol, the experimental findings were then presented and discussed from the perspectives of response time, processing accuracy, and the appropriateness of the collation process.

Online processing response time overview

Based on the results of an independent sample test conducted with valid data, without excluding subjects' erroneous responses, it was evident that there existed a statistically significant difference in the response time among Chinese EFL learners of varying proficiency levels when processing verb-noun collocations ($t = -4.549$, $df = 727$, $p = 0.000 < 0.05$, Cohen's $d = 0.21$). Specifically, the high-level group of EFL learners demonstrated significantly faster response times compared to the low-level group (Mean Difference = -211.342) (see Table 5 for detailed data).

Table 5.

Average response time comparison between advanced and basic groups.

Response time	Advanced (n = 397)		Basic (n = 332)		MD	t (727)
	M	SD	M	SD		
	1330.45	485.922	1541.80	758.059	-211.342	-4.549*

(Error response included)

* $p < 0.05$

After excluding the erroneous responses from the subjects, the results of the independent sample T-test conducted on the valid data revealed significant disparities in the processing response time among Chinese EFL learners of various proficiency levels when dealing with verb-noun collocations. Specifically, the test statistics were as follows: $t = -3.953$, degrees of freedom (df) = 443, and p -value = 0.000, which is less than the significance level of 0.05. Additionally, the effect size, measured by Cohen's d , was 0.27. Notably, the response time of advanced Chinese EFL learners was significantly faster compared to that of basic learners, with a mean difference (MD) of -223.050. These findings are summarized in Table 6 and suggest that there are notable variations in the average response time for target collocations among learners at different English proficiency levels.

Table 6.

Average response time comparison between advanced and basic groups.

Response time	Advanced (n = 262)		Basic (n = 193)		MD	t (443)
	M	SD	M	SD		
	1302.95	476.773	1526.00	713.421	-223.050	-3.953*

(Error response excluded)

* $p < 0.05$

The independent sample T-test revealed significant disparities in the response time of appropriate verb-noun collocations among Chinese EFL learners across different proficiency levels ($t = -3.030$, $df = 276$, $p = 0.003 < 0.05$, Cohen's $d = 0.39$). Notably, the response time of the learners in the advanced proficiency group was significantly faster compared to those in the basic proficiency group ($MD = -212.031$). These findings are presented in Table 7.

Table 7.

Average response time for appropriate verb-noun collocations between advanced and basic groups.

Response time	Advanced (n = 152)		Basic (n = 126)		MD	t (276)
	M	SD	M	SD		
	1238.07	443.830	1450.10	711.942	-212.031	-3.030*

* $p < 0.05$

Based on the results of the independent sample T-test, it is evident that there exist substantial disparities in the processing response time among Chinese EFL learners of varying proficiency levels when dealing with inappropriate verb-noun collocations. Specifically, the test statistics reveal a t-value of -3.196 with a degree of freedom of 165, resulting in a p-value of 0.002, which is less than the significance level of 0.05. Furthermore, the effect size, measured by Cohen's d , is 0.46, indicating a moderate to large difference between the groups. Notably, the response time of the high-level EFL learners was significantly faster compared to that of the basic-level learners, with a mean difference (MD) of -301.172 (Table 8).

Table 8.

Average response times for inappropriate verb-noun collocations between advanced and basic groups.

Response time	Advanced (n = 110)		Basic (n = 57)		MD	t (165)
	M	SD	M	SD		
	1392.60	507.378	1693.77	693.654	-301.172	-3.196*

* $p < 0.05$

The above results indicate that learners with varying levels of English proficiency exhibit notable disparities in the average response time for both appropriate and inappropriate collocations. This finding suggests that language proficiency plays a crucial role in the speed and accuracy with which learners process and recognize appropriate word combinations. It may also imply that learners at different proficiency levels employ different strategies or have varying degrees of familiarity with certain collocations, leading to varying response times. Understanding these differences can help educators and language learners alike design more effective teaching and learning strategies to improve language proficiency and fluency.

Chinese EFL learners' online processing accuracy rate

In terms of processing accuracy, both item analysis and subject analysis demonstrated that the overall accuracy rate was 61%, which fell within the average range ($M = 34.23$, $SD = 6.60$). Specifically, the accuracy rate for appropriate verb-noun collocations exceeded that for inappropriate ones, reaching 76.2% and 45.9% respectively. Additionally, the high-level group exhibited a slightly higher overall accuracy rate than the basic-level group, with percentages of 66.0% and 55.1% respectively.

When comparing the accuracy rates of appropriate and inappropriate verb-noun collocations, it was evident that the former had a higher accuracy rate of 76.2% ($M=21.38$, $SD=3.45$). Furthermore, the online processing accuracy of the high-level and basic-level groups was comparable, with percentages of 76.0% and 76.4% respectively. Conversely, in terms of inappropriate verb-noun collocations, the subjects' accuracy rate was average, with an overall accuracy rate of 45.9% ($M=12.58$, $SD=6.39$). Notably, the high-level group performed better than the basic-level group, achieving accuracy rates of 55.3% and 34.5% respectively. (Refer to Table 9 and 10 for further details.)

Table 9.

Accuracy rate of verb-noun collocations between advanced and basic groups.

Subjects	Accuracy rate		
	Overall	Appropriate collocations	Inappropriate collocations
Advanced	66.0%	76.0%	55.3%
Basic	55.1%	76.4%	34.5%
Overall	61.0%	76.2%	45.9%

(Item analysis)

Table 10.

Accuracy rate of verb-noun collocations between advanced and basic groups.

Subjects	Accuracy rate					
	Overall		Appropriate collocations		Inappropriate collocations	
Advanced (n =7)	<i>M</i> 37.43	<i>SD</i> 6.85	<i>M</i> 21.71	<i>SD</i> 2.63	<i>M</i> 15.71	<i>SD</i> 6.10
Basic (n =6)	<i>M</i> 30.50	<i>SD</i> 4.13	<i>M</i> 21.00	<i>SD</i> 4.47	<i>M</i> 9.50	<i>SD</i> 5.32
Overall	<i>M</i> 34.23	<i>SD</i> 6.60	<i>M</i> 21.38	<i>SD</i> 3.45	<i>M</i> 12.85	<i>SD</i> 6.39

(Subject analysis)

Chinese EFL learners' response time in processing verb-noun collocations

The paired sample T-test was conducted to investigate the processing speed of EFL learners in the advanced learners when dealing with appropriate and inappropriate verb-noun collocations. The results of the statistical analysis revealed that there was no significant difference in their response time when processing these two types of collocations. Specifically, the test statistic value (t) was 1.012, with a degree of freedom (df) of 190. The p -value was found to be 0.191, which is greater than the commonly accepted significance level of 0.05. This indicates that the difference observed in the response time was not statistically significant. Additionally, the effect size (Cohen's d) was 0.29, indicating a small effect, and the mean difference (MD) was 44.702. The findings suggest that Chinese EFL learners in the high-level group are equally efficient in processing both appropriate and inappropriate verb-noun collocations. This may be due to their proficient language skills, enabling them to recognize and handle collocations with equal ease, irrespective of their appropriateness (Table 11).

Verb-noun collocations are crucial in English language learning as they contribute significantly to the fluency and accuracy of language use. The ability to process these collocations efficiently is particularly important for advanced learners who aim to communicate effectively in English. The results of this study suggest that Chinese EFL learners in the high-level group possess this crucial skill, which is essential for achieving proficiency in the language. The results of the paired sample T-test indicate that there is no significant difference in the response time of Chinese EFL learners in the high-level group when processing appropriate and inappropriate verb-noun collocations. This finding highlights the efficiency of these learners in processing collocations, regardless of their appropriateness, which is crucial for achieving proficiency in English.

Table 11.

Average response time of advanced learners in both types of collocations.

Response time	Appropriate (n =191)		Inappropriate (n =191)		MD	t (190)
	M	SD	M	SD		
	1346.39	496.159	1301.69	463.005	44.702	1.012*

* $p > 0.05$

The results of the paired sample T-test indicated that there was no statistically significant difference in the response time exhibited by Chinese EFL learners in the basic-level group when processing both appropriate and inappropriate verb-noun collocations. The test statistics revealed a t-value of -0.525 with a degree of freedom of 154, resulting in a p-value of 0.271, which was greater than the significance level of 0.05. Additionally, the effect size measured by Cohen's d was 0.23, and the mean difference (MD) was -38.574 (Table 12).

Table 12.

Average response time of basic learners in both types of collocations.

Response time	Appropriate (n =155)		Inappropriate (n =155)		MD	t (154)
	M	SD	M	SD		
	1496.59	764.609	1535.16	751.754	-38.574	-0.525*

* $p > 0.05$

The results indicate that there is no noteworthy difference in the response speed exhibited by Chinese EFL learners at different proficiency levels when processing the two types of verb-noun collocations. Furthermore, a two-factor ANOVA revealed that English proficiency significantly influenced the processing response time of Chinese EFL learners ($F(1,668) = 16.376$, $p = 0.000 < 0.05$), whereas the appropriateness of collocation did not have a significant effect ($F(1,668) = 0.004$, $p = 0.948 > 0.05$). Specifically, learners with higher proficiency levels demonstrated significantly faster response times compared to those with lower proficiency levels. However, the appropriateness of collocation had minimal influence on learners' processing speed, and no significant difference was observed between the response times of learners processing appropriate and inappropriate collocations (refer to Table 13). Additionally, English proficiency and collocation appropriateness did not exhibit a significant interactive effect on the response time of Chinese EFL learners ($F(1,668) = 0.772$, $p = 0.380 > 0.05$, Cohen's $f^2 = 0.01$) (Figure 2).

Table 13.

Response time statistics of advanced and basic learners.

Response time	Advanced learners (n =382)				Basic learners (n =310)			
	Appropriate (n =191)		Inappropriate (n =191)		Appropriate (n =155)		Inappropriate (n =155)	
	M	SD	M	SD	M	SD	M	SD
	1346.39	496.159	1301.69	463.005	1496.59	764.609	1535.16	751.754

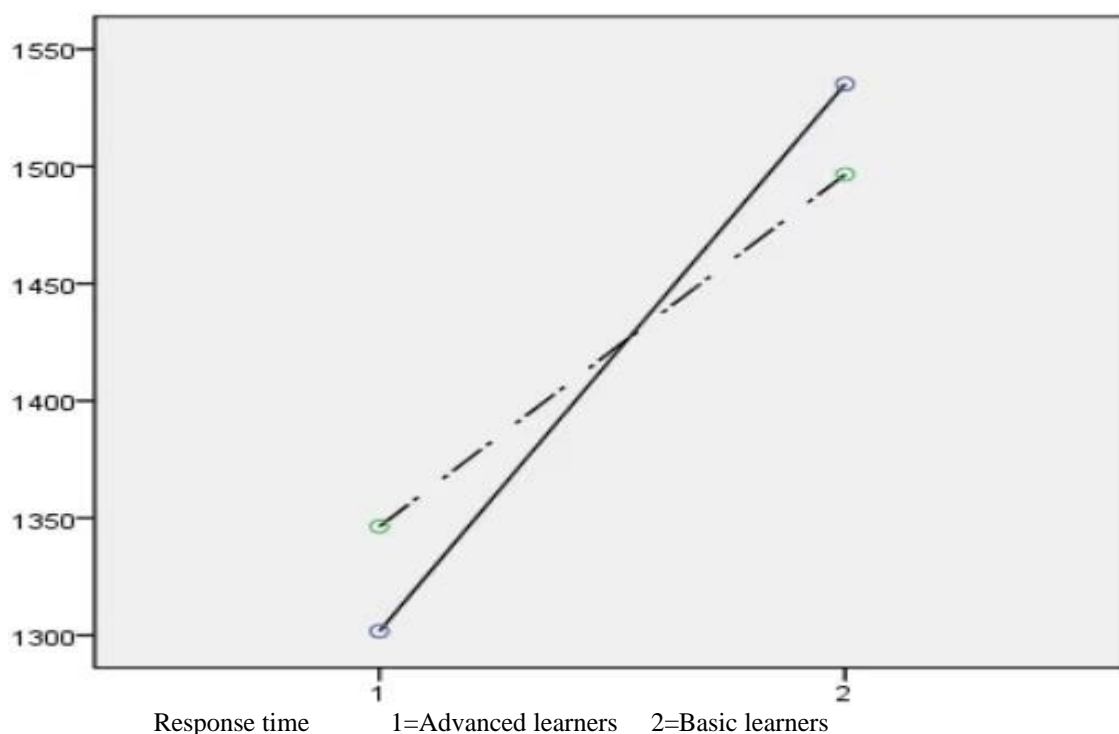


Figure 2. Correlation between English proficiency and appropriateness of collocation on response time.

The results show that Chinese EFL learners at different proficiency levels have no significant difference in response speed when processing two types of verb-noun collocations. A two-factor ANOVA reveals that English proficiency significantly affects the processing response time, with higher proficiency learners having faster response time, while the appropriateness of collocation has little impact and no significant difference is found between processing appropriate and inappropriate collocations. Moreover, there's no significant interactive effect between English proficiency and collocation appropriateness on the response time of these Chinese EFL learners.

The independent sample T-test results clearly show that Chinese EFL learners of different proficiency levels have significantly different processing response times for inappropriate verb-noun collocations. The negative t-value of -3.196, with 165 degrees of freedom and a p-value of 0.002 (less than 0.05), indicates a real difference between the groups. The Cohen's d-value of 0.46, suggesting a moderate to large effect size, further emphasizes the distinction. The mean difference of -301.172 shows that high-level learners respond much faster. For processing accuracy, the overall 61% accuracy rate ($M = 34.23$, $SD = 6.60$) being in the average range is a significant finding. The fact that the accuracy rate for appropriate collocations (76.2%) is much higher than that for inappropriate ones (45.9%) indicates that learners are better at recognizing correct combinations. Also, the high-level group having a higher overall accuracy rate (66.0% compared to 55.1% of the basic-level group) shows the influence of proficiency on accuracy.

Previous research on EFL learners' processing of collocations may have found different results depending on factors such as the sample characteristics (e.g., age, learning environment), the types of collocations tested, and the measurement methods. Some studies might have focused more on native-like collocation use rather than just response time and accuracy. For example, Digtyar et al. (2023) have found that in a different language learning context, proficiency had a different impact on collocation processing, perhaps due to more exposure to authentic language materials in their sample.

From a psycholinguistic perspective, the difference in response times could be related to the mental lexicon organization. High-level learners may have a more interconnected and efficient mental lexicon, allowing them to retrieve appropriate verb-noun collocations more quickly. For accuracy, the schema theory can be applied. Learners may have developed schema for appropriate collocations through more exposure and practice, which helps them identify correct combinations more accurately. The lower accuracy for inappropriate collocations might be due to less-developed inhibitory mechanisms to reject incorrect combinations.

The study sheds some light on improving EFL teaching methods and curriculum design. In the first place, teachers should be encouraged to design activities that enhance learners' awareness of collocations. For example, using corpus-based materials to show the frequency and usage of appropriate and inappropriate collocations. This can help learners build a more accurate mental representation of collocations. Secondly, more collocation-focused exercises need to be incorporated in the curriculum, especially for lower-proficiency learners. And more opportunities for practice and feedback to improve both response time and accuracy should be provided to students as well. In the third place, it is important for teachers to recognize the different needs of EFL learners at various proficiency levels. High-level learners can be challenged with more complex collocations and real-life language tasks, while basic-level learners can start with more common and simple collocations.

Limitations of the study are as follows: the sample might not be representative of all Chinese EFL learners. It could be limited in terms of geographical location, educational background, or age range. A more diverse sample would improve the generalizability of the results. What's more, the study only focuses on verb-noun collocations. Other types of collocations, like adjective-noun, adverb-verb collocations, might have different processing patterns. Also, the task used to measure response time and accuracy may not fully capture the complexity of real-life language use. Future studies should be conducted with a larger and more diverse sample of Chinese EFL learners, including those from different educational systems, regions, and age groups. And the processing of different types of collocations is going to be investigated to get a more comprehensive understanding of how proficiency affects collocation processing. To get more reliable results, more ecologically valid tasks will be developed to measure collocation processing, such as using natural language in context rather than isolated collocations.

Conclusions

This article delves into the intricate realm of online processing of verb-noun collocations among Chinese EFL learners. Specifically, we delve into the three critical aspects: response time, accuracy rate, and the influence of L1-L2 congruence. The findings of this study offer valuable insights into the online processing mechanisms of EFL learners, providing empirical support for the influence of proficiency level and L1-L2 congruence. Firstly, the analysis of response time reveals a significant difference between advanced and basic EFL learners. This observation is particularly noteworthy as it highlights the role of proficiency level in online processing. Precisely, advanced learners demonstrate a shorter average response time overall, indicating a more efficient processing mechanism. This efficiency is further emphasized in the processing of appropriate verb-noun collocations, where advanced learners exhibit a quicker response time. This finding suggests that proficiency level plays a crucial role in determining the speed and efficiency of online processing among EFL learners.

Secondly, in terms of collocation accuracy, the study finds that the overall accuracy for appropriate collocations surpasses that of inappropriate ones. This finding is significant as it underscores the importance of accurate collocation use in language processing. Furthermore, advanced learners exhibit greater precision in their use of appropriate collocations, further emphasizing the role of proficiency level. This precision is not only reflected in their overall accuracy but also in their ability to distinguish between appropriate and inappropriate collocations. Lastly, the study examines the time taken by advanced and basic learners to process both appropriate and inappropriate verb-noun collocations. Surprisingly, there is no substantial difference in the time taken by these two groups. This finding challenges the common assumption that proficiency level solely determines processing speed. Instead, it suggests that other factors, such as L1-L2 congruence, may also influence processing time. This observation is particularly intriguing as it opens up new avenues for further research into the role of L1-L2 congruence in online processing among EFL learners.

Overall, this research offers a comprehensive understanding of the online processing of verb-noun collocations among Chinese EFL learners. The findings highlight the influence of proficiency level and L1-L2 congruence in determining response time, accuracy rate, and overall processing efficiency. These insights are invaluable for language teachers and learners alike, as they provide a foundation for improving language processing skills and enhancing language proficiency.

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