THE JOINT EFFECTS OF

PRIME WORD FREQUENCY AND SEMANTIC RELATEDNESS

ON VISUAL SEMANTIC PRIMING

BY

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Abstract

To investigate the hypothesis that the prime word frequency and semantic relatedness jointly influence visual semantic priming in simplified Chinese, this research examined their interaction effect on lexical decision task. A 2 (prime word frequency: high or low) X 2 (semantic relatedness: related or unrelated) within-subjects design was used. Thirty participants participated in the semantic relatedness rating task. Forty-three participants participated in a lexical decision task and their response time and accuracy were recorded. The results showed a reliable interaction effect between prime word frequency and semantic relatedness. Specifically, semantically related primes facilitate the recognition of target words when the primes were low in frequency, while semantic relatedness had no effect when the primes were high in frequency. These findings suggest that semantic relatedness plays a critical role in the processing of targets preceded by low frequency prime words, highlighting the complex interplay between prime word frequency and semantic context in visual word recognition. The interaction may reflect underlying mechanisms of lexical access and semantic activation in simplified Chinese.

Keywords: word frequency, semantic relatedness, semantic priming, lexical decision

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Thesis Submission Declaration Form

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Thesis Submission Declaration Form

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Title of Thesis: The Joint Effects of Prime word Frequency and Semantic Relatedness on Visual Semantic Priming

Course: **PSY4075 Scientific Study in Psychology II: Honours Project**

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Chapter 1

Introduction

Visual word recognition is fundamentally influenced by two key factors: word frequency and semantic relatedness (Howes & Solomon, 1951; Meyer & Schvaneveldt, 1971). However, the interaction between the two factors remains unclear, especially in logographic systems such as Chinese. Existing research report inconsistent findings across languages (Plaut & Booth, 2000; Wu & Chou, 2000; Yap et al., 2009; Zhou & Marslen-Wilson, 1997). And most studies focused on target word frequency while neglecting the potential influence of prime word frequency on semantic priming. This study examines how prime word frequency and semantic relatedness jointly influence lexical decision performance in Chinese. The results will clarify underlying cognitive mechanisms in Chinese processing and inform language teaching strategies.

1.1 Literature review

Word frequency effect

The word frequency effect is a well-established phenomenon in psycholinguistics, where high-frequency words are processed more efficiently than low-frequency words. This effect was first introduced by Howes and Solomon (1951), who demonstrated that words encountered more frequently are recognized faster and more accurately in English. This finding had been replicated many times in alphabetic system across different tasks. In reading tasks, Rayner et al. (2004) found that high frequency words in English skipped more often than low frequency words. Kliegl et al. (2006) observed shorter total fixation durations for high frequency words compared to low frequency words in German. Boin et al. (2001) reported frequency effects in lexical decision task in French. Moreover, Schilling et al. (1998)

demonstrated consistent word frequency effects across different experimental tasks, including naming, lexical decision and reading.

In Chinese, studies have revealed similar word frequency effects. Early work by Wu et al. (1994) demonstrated that both single-character Chinese words and two-character Chinese words elicited frequency effects in lexical decision and naming task. Subsequent eye-tracking study of Yang and McConkie (1999) revealed significant word frequency effects in Chinese sentence reading task, with higher character skipping rate, low refixation frequency and shorter gaze duration for high-frequency words than low-frequency words. Consistently, Yan et al. (2006) found robust word frequency effects in Chinese reading, with shorter rereading time and total fixation time for high-frequency words than low-frequency words. More recently, a study replicated the word frequency effects across three different tasks, with faster and more accurate lexical decision, reduced naming latencies and shorter fixation time on high-frequency words (Xiong et al., 2022).

Semantic priming effect

The semantic priming effects refers to the facilitation of word recognition in a word when it is preceded by a semantic related prime word. This phenomenon was initially reported by Meyer and Schvaneveldt (1971), who found that participants responded faster and more accurately in recognizing a target word when it went after a semantic related prime word compared to a semantic unrelated prime word in English. This effect has been studied in other alphabet-based languages. For instance, Perea and Gotor (1997) found significant semantic priming in Spanish for both lexical decision and naming task. Similarly, Zwitserlood (1994) demonstrated semantic priming effects in Dutch.

Beyond alphabetic languages, research has also explored semantic priming in logographic systems such as Chinese. Perfetti and Tan (1998) examined the time course of semantic

activation and found significant semantic priming effects for medium and high frequency Chinese characters in a naming task. Further supporting this, Chen and Shu (2001) observed reliable semantic priming effects across multiple stimulus onset asynchrony (SOA) conditions. SOA refers to the time interval between the appearance of the prime word and the subsequent target word. Their study tested SOAs of 43ms, 57ms and 85ms, demonstrating consistent semantic priming effects in both Mandarin and Cantonese using a naming task.

Interaction between word frequency and semantic relatedness

Research has also explored the interplay between word frequency and semantic relatedness. Becker (1979) found that the interaction between word frequency and semantic relatedness was significant, and the semantic relatedness enhanced the processing of low frequency words more than high frequency words in English. This suggests that semantic priming is particularly beneficial for words that are less familiar or harder to access. However, further studies found the interaction effect in alphabetic languages is not always consistent. Plaut and Booth (2000) points out that the interaction effect was modulated by participants' perceptual ability, with greater interaction effects on participants who had high perceptual ability. Another study found significant interaction effects in participants with relatively low vocabulary but an additive effect in participants with high vocabulary (Yap et al., 2009). Both studies found greater facilitation for low frequency words, further supporting the idea that low frequency words benefit more from semantic priming.

Turning to Chinese, studies revealed both similar and distinct patterns. Zhou and Marslen-Wilson (1997) observed significant semantic priming effects across target word frequency conditions in a naming task, suggesting that semantic relatedness did not interact with target word frequency. In contrast, Wu and Chou (2000) identified reliable interaction effects between target word frequency and semantic relatedness in both naming and word

recognition tasks, where semantic priming significantly facilitated the processing of low-frequency words only. Similar to findings in alphabetic languages, Chinese also shows interaction between word frequency and semantic relatedness, with stronger semantic priming effects for low frequency words. However, the interaction effect is not universally observed.

Unique properties of Chinese

Chinese, as a logographic writing system, differs fundamentally from alphabet-based languages like English. In English, where letters are grouped into syllables and phonemes, readers typically process phonological information before accessing semantic meaning. In contrast, Chinese character often composed of radicals and strokes that provide semantic cues, allowing for more effective process of semantic information in Chinese (Zhou & Marslen-Wilson, 1999). The semantic cues from Chinese character radicals may directly attenuate the recognition advantage of high frequency words, making semantic priming effect more pronounced for low frequency words. An ERP study by Wang et al. (2021) found that semantic activation in Chinese does not necessarily occur later than phonological activation, suggesting semantic processing can be rapid and relatively independent of phonological processing in logographic scripts. Within a short time, high frequency words may activate both semantic and phonological pathways, whereas low frequency words can only access the semantic pathway. Consequently, the advantage of semantic processing in Chinese may result in low frequency words being more influenced by semantic priming effects.

Research gaps and Research Questions

Existing research in alphabetic languages has established robust word frequency effects on target words and semantic priming effects, and similar effects have been observed in Chinese. However, findings of interaction between word frequency and semantic priming are

inconsistent in both writing system (Plaut & Booth, 2000; Wu & Chou, 2000; Yap et al., 2009; Zhou & Marslen-Wilson, 1997). Besides, the special properties of Chinese may influence the processing different from alphabetic systems. Therefore, significant research gaps are identified. Firstly, most studies have focused on target word frequency, neglecting the potential effects of prime word frequency on semantic priming. Secondly, the findings of word frequency and semantic priming remain inconsistent. Thirdly, the research findings in alphabetic languages cannot be simply generalized to Chinese due to its unique properties.

The current inconsistencies in findings may stem from methodological variations across studies. Notably, different experimental tasks exhibit varying sensitivity to word frequency effects. According to Schilling et al. (1998), word frequency effects manifest across multiple task types, with greater effects in lexical decision task than naming and reading tasks. Regarding semantic priming, naming tasks involve greater engagement of phonological processing pathways, which may attenuate the semantic priming effects. It may explain some studies failed to find significant interaction between word frequency and semantic priming in naming tasks (Zhou & Marslen-Wilson, 1997). To address these methodological concerns, the present study used a lexical decision task, allowing for sensitivity in detecting word frequency effects and interaction between word frequency and semantic priming effects. Additionally, variations in SOA settings may affect the word processing. According to Jones and Estes (2012), SOAs influence the degree of prime word processing before target presentation, where longer SOAs facilitates deeper prime processing. Therefore, this study used a fixed long SOA of 500 ms to ensure adequate prime processing and avoid possible confounding effects.

To address these research gaps, the current study aims to investigate two key questions: (1) What is the joint effect of prime word frequency and semantic relatedness on visual semantic priming in Chinese? (2) How do prime word frequency and semantic relatedness interact?

Examining these research questions bring crucial implications for Chinese language pedagogy. If the study demonstrates superior semantic priming advantages for high-frequency prime words, it suggests that the instruction should prioritize the systematic reinforcement of high frequency vocabulary with their semantically associated words. Conversely, if low frequency primes exhibit stronger semantic priming effects, it suggests that teachers should emphasize the link between low frequency words and established semantic context when teaching novel or low frequency words.

1.2 Conceptual framework and hypotheses

Based on previous findings in the psycholinguistic literature, three hypotheses are formulated to examine how prime word frequency and semantic relatedness interact in visual semantic priming.

Hypothesis 1: Main effect of prime word frequency

Firstly, there will be a main effect of prime word frequency. This is because high frequency words can be recognized faster compared to low frequency prime words, which allows for more processing time for the target word. Thereby, participants are able to make faster decisions on the target words after high frequency primes.

Hypothesis 2: Main effect of semantic relatedness

Secondly, there will be a main effect of semantic relatedness. Semantic related primes will enhance recognition of the target words more than unrelated primes by activating their shared semantic networks.

Hypothesis 3: Interaction effect between prime word frequency and semantic relatedness

Thirdly, the interaction between prime word frequency and semantic relatedness is hypothesized to be significant, with high frequency primes expected to produce a stronger semantic priming effect compared to low frequency primes.

Regarding the interplay of target word frequency and semantic relatedness on semantic priming, it is generally well-founded that the semantic priming effect is larger in low frequency target words. The rationale behind as follows: High frequency targets are recognized faster due to strong lexical representations. This results in limited potential for further facilitation from semantic priming, which may lead to a ceiling effect and make the semantic priming effect small. In contrast, low frequency targets are more difficult to process, which leave a larger room for semantic priming effects. Therefore, the semantic priming compensates for their delayed activation compared to the high frequency targets, leading to stronger semantic priming effects.

However, this study predicted a contrast pattern in the interaction between prime frequency and semantic priming, with greater semantic priming in low frequency prime condition. This difference emerges because prime frequency affects the strength of semantic activation spreading to the target. This prime frequency hypothesis is grounded in the assumption that high frequency words are recognized more rapidly due to their greater lexical accessibility, allowing for faster activation of semantic information. As a result, high frequency primes should enhance semantic priming effects to a greater degree than low frequency primes. Specifically, it is anticipated that high frequency primes will demonstrate robust semantic priming effects, as reflected in faster lexical decision latencies and higher accuracy rates for related versus unrelated targets; Low frequency primes will also show semantic priming effects for related targets but show reduced effect magnitude compared to high-frequency primes. The hypothesized interaction effects are consistent with previous findings in the morphological priming literature. Giraudo and Grainger (2000) demonstrated significant

interaction effects between prime word frequency and morphological priming effects. The results showed faster recognition of targets when preceded by high-frequency morphologically related primes while there were no priming effects for low frequency prime conditions.

Chapter 2

Methodology

2.1 Subjects

A total of seventy-three university students who are native speakers of simplified Chinese participated in this study. All of them reported good visions and have never been diagnosed with learning disorders before. Thirty of them participated in the semantic-rating task and forty-three of them participated in the later lexical decision task. One participant who was involved in the lexical decision task withdrew from the study due to personal reasons.

2.2 Design

In the lexical decision task, a 2(prime word frequency: high-frequency, low-frequency) x 2(prime word semantic-relatedness: related, unrelated) within-subjects factorial design was employed. Four conditions were created: (a) high prime frequency and related, (b) high prime frequency and unrelated, (c) low prime frequency and related, and (d) low prime frequency and unrelated. There are four lists of stimuli, with each list containing nonword trials and all the word trials but in a systematically rotated order of conditions across word trails to ensure that each condition appears equally often in each trial position across groups. Each participant only saw one of the primes for each target word. And each of them was exposed to all four conditions but with different target words. The dependent variables were response time and accuracy, which were measured by the computer automatically.

2.3 Materials

A total of 152 two-character Chinese words were served as target words. Each of the target words were matched with four prime words, including a high frequency and related prime, a high frequency and unrelated prime, a low frequency and related prime, a low frequency and

unrelated prime. The semantic relatedness between prime-target pairs was collected through a rating task. Participants evaluated semantic relatedness on a 5-point Likert scale, with 1 representing completely unrelated pairs and 5 representing highly semantically related pairs. And the word frequency was obtained from an existing Chinese vocabulary database. The word frequency used in this study was log10-transformed to account for the nonlinear diminishing-returns relationship between frequency and processing (Adelman, 2012). The log-transform also normalizes the skewed distribution of raw frequency values and improve model fit.

To ensure the four conditions of prime words were well-matched and suitable for comparison, an analysis was conducted on relatedness, frequency and strokes. Descriptive statistics for word stimuli are displayed in Table 1. For related and unrelated groups, the related groups had significantly higher relatedness ratings than the unrelated groups, $F(1,151)= 5370.00$, $p<.001$. There was no significant difference in frequency between related and unrelated groups, $F(1,151)= 0.02$, $p= .967$, and no interaction effects, $F(1,151)= 3.22$, $p= .075$.

For high frequency and low frequency primes, the high frequency groups had significantly higher log frequency than the low frequency groups, $F(1,151)= 5416.29$, $p< .001$. There was no significant difference in semantic relatedness between high frequency and low frequency groups, $F(1,151)= 0.06$, $p= .807$, and no interaction effects, $F(1,151)= 0.07$, $p= .194$.

For stroke count, there were no significant differences or interaction effects across any comparison, all p-values$> .05$, ensuring that stroke count was balanced across four conditions. This indicates that all the selected prime words do not have significant differences in orthographic characteristics. Besides, the selected prime words did not share the same character or syllables with their target words to prevent repetition effects and phonological

priming effects. These results demonstrate that the materials were appropriately controlled, allowing for clear examination of semantic relatedness and prime word frequency effects in the priming task.

In addition to these word pairs, there are 100 pairs of prime words and pseudo words served as filler trials to provide a baseline for comparison and prevent participants from developing task strategies. The prime words were selected from an existing Chinese vocabulary database. To prevent repetition effects, none of the prime words appeared in word trials. The pseudo words were created by combining two common Chinese characters together, carrying no meaning and no semantic association with the prime words. And the pseudo words underwent a manipulation check before use. The design not only eliminated semantic priming in non-word trials but also ensured pseudo words closely resembled real Chinese words, which prevent participants from relying on superficial cues during the lexical decision task and encourage them to pay attention to the task.

Table1

Word Properties of Materials

		High Frequency		Low Frequency	
Stimulus Property	Target	Related	Unrelated	Related	Unrelated
Words	抱负	梦想	眼睛	志向	疑难
Translation	ambition	dream	eye	aspiration	difficulty
Log frequency		3.54 (0.38)	3.54 (0.38)	1.44 (0.48)	1.42 (0.45)
N strokes		16.36 (4.45)	16.36 (4.45)	16.13 (4.04)	16.16 (4.07)
Sem. rating		4.06 (0.43)	1.72 (0.48)	4.00 (0.40)	1.77 (0.48)

Note. Means (and standard deviations) of log10 prime words frequency per million, number of prime words' strokes, ratings from a 5-point scale of semantic (Sem.) relatedness between target and prime words are provided.

2.4 Apparatus

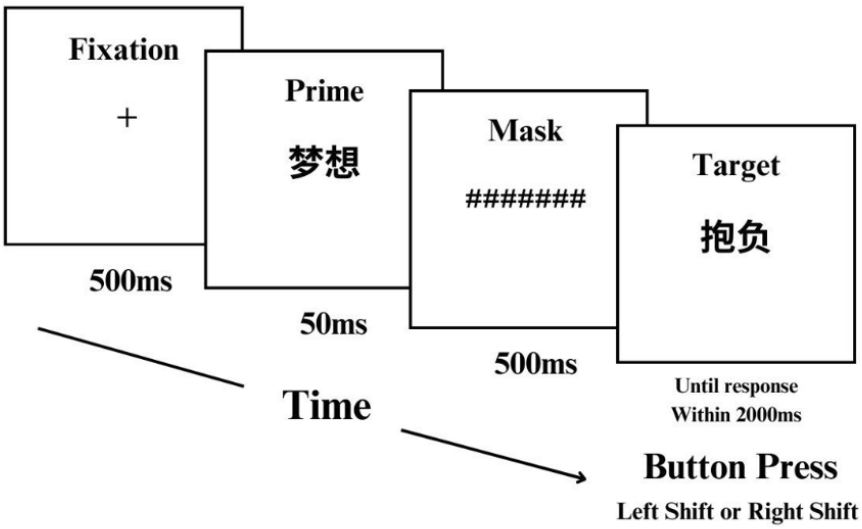
Two computers running DMDX software were used to present the stimuli and collect data. The software automatically scrambled the order of trials for each session, which minimized the order effect and the fatigue effect.

2.5 Procedures

In the lexical decision task, participants were required to read the instructions and press the space bar to continue and start an exercise before the formal experiment. The exercise contained two word trials and two non-word trials. The stimuli sequence in each trial is as shown in Figure 1. Each trial in this experiment started with a plus sign (+) presented in the centre of display for 500 ms. Then, the prime word was displayed for 50 ms, followed by a mask composed of seven hash-marks (*******) presented for 500 ms. After the mask, a target word or a pseudo word was presented until participants respond within 2000 ms. Any response after 2000 ms were recorded as errors, and the experimental program immediately proceeded to the next trial. Participants were asked to respond by pressing either the left "Shift" or right "Shift" keys whether the later stimulus was a word or a pseudo word. The different settings of correct key were used to counterbalance hand effects across participants.

Figure 1

Stimuli Sequence in the Lexical Decision Task



2.6 Data Analysis

After data collection, the mean response time for correct responses to experimental word trials was calculated separately for each participant. Then, outliers were identified based on their deviations from the means. Specifically, any response time that was more than 3 standard deviations either higher or lower than the mean was considered an outlier and removed from the dataset. This criterion aimed to eliminate extreme values and maintain the validity of the dataset.

Chapter 3

Results

All the experimental trials were analysed for accuracy, while only correct-response word trials that were not identified as outliers were analysed for response time. A 2x2 repeated measures ANOVA was conducted to compare the effect of prime word frequency and semantic relatedness on participants' accuracy and response time in the lexical decision task. The means of accuracy and response times are shown in Table 2.

Accuracy

For accuracy, there were no significant main effects of prime word frequency or semantic relatedness on accuracy, $F(1,41)= 0.85$, $p= .36$, $\eta^2_p = .020$, and $F(1,41)= 0.02$, $p= .89$, $\eta^2_p= .000$. The interaction effect was also non-significant, $F(1,41)= 0.28$, $p= .60$, $\eta^2_p= .007$. Participants demonstrated similar accuracy rates across four experimental conditions.

Response time

For response time, the results revealed that there were no main effects of prime word frequency and semantic relatedness, $F(1,41)= 0.31$, $p= .579$, $\eta^2_p = .008$, and $F(1,41)= 2.68$, $p= .11$, $\eta^2_p = .061$, respectively. But a significant interaction effect between semantic relatedness and prime word frequency was emerged, $F(1,41)= 4.76$, $p= .035$, $\eta^2_p = .104$, suggesting that the effect of semantic relatedness was significantly different for targets after high frequency prime and low frequency prime, with a moderately strong effect size.

To further explore the interaction effect, a paired-samples t-test was conducted to examine the simple effect of semantic relatedness on prime word frequency. The results showed that the effect of semantic-relatedness was significant for low prime frequency trials ($t= - 2.47$, $p= .018$), with faster response times for related targets compared to unrelated targets. In

contrast, there was no significant effect of semantic relatedness for high prime frequency trials (t= 0.46, p= .65), with similar response times for related and unrelated targets.

Table 2

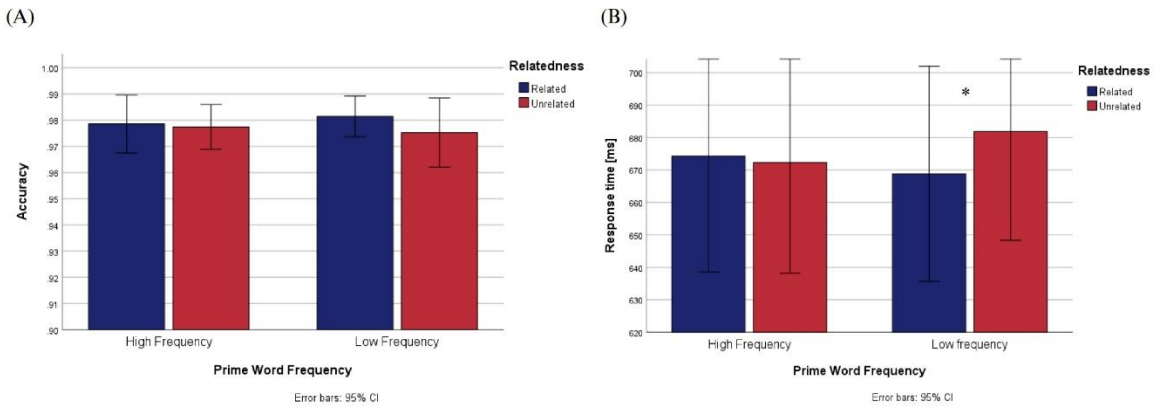
Response Times and Accuracy by Prime Word Frequency and Semantic Relatedness

	High Frequency		Low Frequency	
	Related	Unrelated	Related	Unrelated
Acc [%]	97.86 (3.55)	97.74 (2.74)	98.14 (2.50)	97.52 (4.24)
RT [ms]	674 (115)	672 (110)	669 (106)	682 (108)

Note. Means (and standard deviations in parentheses) of response time (RT) and accuracy (Acc) are provided.

Figure 2

Accuracy and Response Times for Different Prime Word Frequency and Semantic Relatedness



Note. Results for the lexical decision task according to prime word frequency and semantic relatedness. (A) Accuracy. (B) Response times. Error bars indicate standard errors. Statistical significance is indicated by asterisk (*p< .05).

CHAPTER 4
Discussion and Conclusion

4.1 Discussion

The present results demonstrated that the main effects of prime word frequency and semantic relatedness on response time were not significant while interaction effects were significant, indicating that the influence of one variable on semantic priming depends on the level of the other. Simple effects analysis indicated that semantic relatedness significantly impacted response time under low prime frequency condition, whereas no significant effect was observed under high prime frequency condition. This suggests that semantic relatedness plays a more critical role in influencing reaction times when processing targets after low frequency primes. Notably, these effects only appeared in response times, with no significant effects on accuracy rates.

Nonsignificant word frequency effect

In the current study, the response times and accuracy for high prime frequency condition and low prime frequency condition were similar. For high prime frequency condition, the mean response time was *M*= 673 ms (*SD*= 112.53). For low prime frequency condition, the mean response time was *M*= 675.5 ms (*SD*= 107).

The absence of a significant prime word frequency effect in the current study may be attributed to the linguistic background of the participants. More precisely, a substantial proportion of the participants were from the Chinese linguistics major, who likely have advanced language proficiency and extensive exposure to both high-frequency and low-frequency words. For these individuals, the lexical representations for high-frequency and low-frequency words may be equally robust, resulting similar processing efficiency for both types of words. Thereby, a non-significant word frequency emerged. These findings align

with the study of Tainturier et al. (1992), who found that individuals with higher education exhibited a reduced word frequency effects than whose who with lower education. It suggests that greater exposure to low frequency words diminished the processing advantage for high frequency words. Although all the participants in the present study were university students, the pattern observed among participants in Chinese linguistics majors is consistent with pattern among highly educated groups in previous literature.

This supports the idea that participants with rich vocabulary can process both low-frequency words and high-frequency words fluently, weakening the word frequency effects.

Moreover, the nonsignificant word frequency effect may be partially attributable to the unbalanced non-word trial ratio. In this study, there were 152 word trials and 100 non-word trials, with a non-word trial ratio of 39.7%. Low non-word trial ratio may induce participants develop a response strategy to respond "word" judgements more (Jones & Estes, 2012). Since low frequency prime words are more difficult to recognize, this response bias to "word" judgement could increase both response accuracy and reaction speed for low prime frequency trials. In contrast, high frequency prime words are easily recognized, making the response to high prime frequency trials less sensitive to the response strategy. Consequently, the response differences between high and low prime frequency conditions may decrease, possibly contributing to the nonsignificant word frequency effect in the current study.

Significant interaction effect with unexpected patterns

A significant interaction between prime word frequency and semantic relatedness was observed as expected. However, further simple effects analysis revealed that semantic priming was more pronounced under low prime word frequency conditions, which opposes the initial hypothesis. These results also diverged from prior studies demonstrating that the

morphological priming was more significant in high prime word frequency conditions (Giraudo & Grainger, 2000).

Interestingly, the results for high-frequency words not only showed nonsignificant effect of semantic relatedness but also hinted at a reverse pattern in the data. Specifically, the mean response time for high-frequency related condition (*M*= 674 ms, *SD*= 115) was slightly slower compared to high-frequency unrelated condition (*M*= 672 ms, *SD*= 110). Although this difference was subtle and not statistically significant, this trend suggests a potential negative semantic priming effect for high-frequency words, which contrasts with the typical facilitative effect for low-frequency words. This reversal can be explained through several mechanisms.

One possible explanation for the nonsignificant semantic priming effects is the overprocessing of high frequency primes. In the present study, prime was presented for 50 ms and was kept being processed in the 500 ms mask duration. For high frequency prime, its activation may peak earlier than low frequency prime and then decline before the target word was presented. This explanation aligns with findings by Pan et al. (2016), who demonstrated similar semantic preview cost in oral reading. Their study showed that long exposure to a previewed word could lead to a cost for high frequency words.

Another explanation for the potential reverse semantic priming effect for high prime frequency trials involves inhibitory attention mechanism. In this study, despite the prior exercise, several participants misunderstood the task and initially responded to primes for lexical decisions. To address this issue, they were instructed to ignore the primes and focus solely on the target words. This instruction potentially activated their inhibitory attention mechanisms and led to negative priming effects for them. Concretely, when participants were instructed to ignore the primes, their brains may engaged inhibitory processes to suppress the

processing of the prime words. This suppression could result in residual inhibition, which may interference the processing of subsequent related target, causing delayed response time. This is consistent with research of Noguera et al. (2006), who found that participants exhibited slower responses in trials where they were instructed to ignore the prime compared to trials where they were instructed to attend and remember the prime.

4.2 Limitations

Apparatus constraints

One limitation of the study is that data were collected using two computers with different display sizes. Although the refresh rates and front size was controlled and the experimental procedure was standardized, the difference in screen size may still have introduced variability in stimulus presentation. For example, the physical size of the stimuli relative to the screen could have influenced perception and visual processing, potentially affecting response times and accuracy.

Nontypical sampling

Another limitation of the study stems from the nontypical sample, particularly the inclusion of a substantial proportion of individuals from the Chinese linguistics major. While their specialized linguistic background may have influenced the results. Precisely, their robust lexical decision for both high-frequency and low-frequency words could diminish the word frequency effect, leading to the non-significant findings in this study.

Unclear Instructions

A further limitation in this study lies in the instructions. Although most participants performed the lexical decision task correctly from the start, some participants were mistakenly responded to the prime words at the beginning. To correct participants, they were

required to ignore the prime words and focus on the target words only, which might activate their inhibitory attention mechanisms and contribute to the negative priming effect. The clarity of instructions, the inconsistent instruction among participants, and correcting participants' response during the mid-experiment, all introduced variability in the data, making it difficult to interpret the results.

Single SOA setting

The current study employed a single SOA of 500ms, which also presents several limitations. First, using one timing setting between prime and target words make it difficult to compare with previous findings at various SOA settings. For example, Perfetti and Tan (1998) found semantic priming at SOA of 85 ms but not at shorter SOA of 43 ms and 57 ms. However, Chen and Shu (2001) found semantic priming effects across multiple SOA (43ms, 57ms, 85ms). These contradictory findings suggest that semantic priming effects are highly sensitive to specific time settings. Second, a single SOA make it difficult to interpret the results in this study. For high frequency primes, the lack of semantic priming can be explained by weaker priming or complete decay after peak. For low frequency primes, the significant semantic priming effect might reflect either ongoing priming before peak or attenuated priming after peak, which was relatively stronger than high frequency primes though. The single SOA setting cannot assess the time course of the semantic priming, resulting in unclear explanation of the results.

Biased Non-word Trials Ratio

Another notable limitation of this study is the biased ratio of non-word of 39.7%, which have introduced a response bias. Participants may develop a tendency to favor "word" responses due to the higher probability of encountering real words. And the bias can influence the

results, particularly increase the accuracy and response time for low prime word frequency trials.

4.3 Conclusion and Implications

Conclusion

The present study investigated how prime word frequency and semantic relatedness jointly influence semantic priming effects in lexical decision task in Chinese. While no main effects of prime word frequency or semantic relatedness were found, the interaction effects between these two variables revealed that the semantic relatedness selectively facilitated the processing of targets in low prime frequency trials only. The absence of the frequency effects may be due to individual differences in Chinese vocabulary and the biased nonword trial ratio. And the mild reverse semantic priming trend for high prime word frequency trials may stem from inhibitory attention mechanisms or overprocessing of primes. Besides, some methodological limitations, such as the different apparatus and single SOA setting may have also contributed to these unexpected findings. Overall, the results highlight the complex interplay between prime word frequency and semantic relatedness in visual semantic priming in Chinese.

Implications

The findings have both theoretical and practical implications. For the theorical implications, the findings contribute to the understanding of semantic priming in Chinese by demonstrating that the semantic priming effects are modulated by prime word frequency and semantic relatedness. The fact that semantic priming influenced response times but not accuracy suggests that it mainly influence response speed but not later decisions. The finding that low prime word frequency makes the targets benefit more from semantic relatedness raises new questions about the timing dynamics of semantic priming for high versus low frequency

primes. These findings also offer useful suggestions for teaching and learning language. The robust semantic priming effects for low prime frequency trials indicate that semantic context plays a crucial role in processing unfamiliar vocabulary. Educators might emphasize the importance of semantic context when teaching students new or difficult vocabulary. For high frequency words, which showed no semantic priming effects, teacher may focus more on fluency building, as these words appear to be processed efficiently regardless of context.

4.4 Future Research

Future research should address the limitations of the current study through several methodological improvements. Firstly, subsequent research should use standardized computer equipment with identical display settings to ensure consistent visual presentation across all the experimental sessions. Secondly, future studies should recruit typical readers who represents the general population rather than specialized groups like linguistics students to reflect the typical word processing and improve the generalizability of the findings. Thirdly, future research should use clear instruction and add corrective feedback in the exercise, to make sure participants fully understand the instructions before formal experiment. Fourthly, further studies should implement multiple SOAs to examine how the interaction effects between prime word frequency and semantic priming vary across different processing duration. Lastly, there is a need to further examine these effects across diverse linguistic systems to assess their validity and generalizability.

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Appendix A

Table A1

Word Trial used in the Lexical Decision Task

	Prime			
	High Frequency		Low Frequency	
Target	Related	Unrelated	Related	Unrelated
抱负	梦想	眼睛	志向	疑难
导致	造成	明白	引出	斗殴
追随	同意	睡觉	附和	排查
赋予	交给	受伤	交出	过往
店员	工作	病人	职工	见地
充饥	吃饭	知道	捕食	知会
启示	理解	能力	开导	意向
身世	经历	公园	来历	主见
书店	学习	保护	阅览	筛选
童话	故事	规矩	寓言	寺庙
利润	好处	范围	收成	录影
寻常	普通	慈善	通俗	高洁

Table A1 (continued)

Word Trial used in the Lexical Decision Task

	Prime			
	High frequency		Low frequency	
Target	Related	Unrelated	Related	Unrelated
管理	控制	结婚	执掌	交出
理由	原因	监狱	起因	病床
钟声	时间	好处	寺庙	山川
担架	受伤	老婆	伤员	课桌
记忆	过去	迟到	再现	湮灭
首长	军队	帮助	政委	本领
意志	坚强	漂亮	坚韧	俊俏
烈士	牺牲	说明	捐躯	领会
见面	遇到	经历	会晤	告捷
守卫	保护	停下	庇佑	梳妆
视力	眼睛	牺牲	眼目	古迹
家具	桌子	约会	木床	援军
战友	兄弟	问题	援军	眼目

Table A1 (continued)

Word Trial used in the Lexical Decision Task

	Prime			
	High frequency		Low frequency	
Target	Related	Unrelated	Related	Unrelated
清洁	收拾	犯罪	扫除	捐躯
生育	母亲	历史	子孙	囚徒
住院	病人	早晨	病床	才干
夕阳	夜晚	原因	黄昏	餐盘
树林	公园	警察	枝叶	黄昏
记叙	说明	剩下	书写	聚合
谣言	消息	文件	假话	收成
意识	想法	集中	认知	执掌
法院	犯罪	提醒	囚徒	苍穹
静止	停下	管理	暂缓	斟酌
辛苦	困难	有趣	艰巨	年少
措施	办法	申请	对策	风俗
容易	轻松	伤心	简便	洁净

Table A1 (continued)

Word Trial used in the Lexical Decision Task

	Prime			
	High frequency		Low frequency	
Target	Related	Unrelated	Related	Unrelated
实现	完成	遇到	达标	休憩
洞房	结婚	宇宙	佳偶	摊位
登记	申请	怀疑	挂号	再现
志愿	希望	消息	意向	伤员
跳跃	运动	位置	腾飞	娘子
遗址	历史	完成	古迹	假话
打架	伤害	庆祝	斗殴	希冀
媳妇	老婆	军队	娘子	权势
缺席	失踪	寻找	旷工	挂号
利益	好处	拯救	权势	西药
歌剧	表演	收拾	献艺	遗留
收拾	干净	激动	洁净	周详
认识	了解	同意	领会	站岗

Table A1 (continued)

Word Trial used in the Lexical Decision Task

	Prime			
	High frequency		Low frequency	
Target	Related	Unrelated	Related	Unrelated
出发	开始	结婚	启航	扫除
市场	客户	武器	摊位	植被
打扮	约会	关心	梳妆	训话
护士	医院	公园	西药	子孙
告诉	通知	控制	知会	补过
酒精	聚会	胜利	乙醇	协理
解除	取消	稳定	免去	庇佑
嫌犯	警察	夜晚	专案	职工
皮肤	血液	时间	体表	学问
清楚	明显	高兴	真切	欢愉
夫妻	结婚	办法	老伴	专案
挽回	拯救	训练	补过	认知
分开	失去	隐藏	离别	暂缓

Table A1 (continued)

Word Trial used in the Lexical Decision Task

	Prime			
	High frequency		Low frequency	
Target	Related	Unrelated	Related	Unrelated
难受	伤心	聪明	委屈	宏伟
血缘	家庭	玻璃	亲属	乙醇
遭遇	经历	食物	过往	体表
秀丽	漂亮	轻松	俊美	豪爽
优雅	美丽	努力	秀气	委屈
智慧	聪明	意外	灵巧	凶恶
现金	银行	失踪	纸币	章程
誓言	答应	学习	允诺	侵占
征服	胜利	选择	侵占	欢聚
哨兵	训练	回忆	站岗	延迟
意思	想法	负责	主见	条文
指示	提醒	时间	告诫	细瓷
残余	剩下	运动	遗留	起航

Table A1 (continued)

Word Trial used in the Lexical Decision Task

	Prime			
	High frequency		Low frequency	
Target	Related	Unrelated	Related	Unrelated
加入	参与	好像	进驻	隐匿
典礼	庆祝	了解	欢聚	旷工
岁月	时间	好处	年华	枝叶
串通	阴谋	考虑	勾结	恍如
指示	命令	喜欢	训话	钟情
拦截	阻止	理解	阻挠	会晤
明白	知道	取消	领悟	进驻
拘禁	监狱	拍摄	囚牢	长矛
躲避	隐藏	工作	隐匿	腾飞
地点	位置	学习	处所	职能
耽误	迟到	看法	延迟	处所
传统	历史	兄弟	风俗	囚牢
安逸	舒服	明显	闲适	真切

Table A1 (continued)

Word Trial used in the Lexical Decision Task

	Prime			
	High frequency		Low frequency	
Target	Related	Unrelated	Related	Unrelated
困扰	问题	梦想	疑难	老伴
留恋	回忆	通知	追思	政委
差距	区别	表演	有别	猜忌
似乎	好像	造成	恍如	执掌
愉悦	快乐	关键	欢愉	艰巨
迷恋	喜欢	录像	钟情	书写
本领	能力	自然	才干	佳偶
崇高	伟大	认真	宏伟	简便
仔细	认真	美丽	周详	简易
漂亮	美丽	难过	俊俏	勤劳
思索	考虑	交给	斟酌	引出
资讯	消息	历史	音信	范畴
机智	聪明	舒服	伶俐	坚韧

Table A1 (continued)

Word Trial used in the Lexical Decision Task

	Prime			
	High frequency		Low frequency	
Target	Related	Unrelated	Related	Unrelated
手段	方法	责任	举措	志向
才能	技术	家庭	本领	起因
才华	能力	谎言	学问	摄制
取舍	选择	医院	筛选	假意
懂得	明白	失去	通晓	有别
哀伤	难过	普通	悲怆	伶俐
核心	关键	能力	中枢	对策
主张	看法	聚会	见地	珍视
便利	轻松	优秀	简易	秀气
成功	胜利	想法	告捷	附和
许愿	期待	技术	希冀	离别
支持	帮助	故事	协理	亲属
统治	管理	伤害	执掌	告诫

Table A1 (continued)

Word Trial used in the Lexical Decision Task

	Prime			
	High frequency		Low frequency	
Target	Related	Unrelated	Related	Unrelated
埋没	消失	胜利	湮灭	献艺
爱护	关心	出发	珍视	通晓
领域	范围	桌子	范畴	来历
活力	年轻	正确	年少	诧异
属实	正确	聪明	真切	优异
困惑	怀疑	答应	猜忌	启航
好玩	有趣	坚强	过瘾	安闲
使命	责任	消息	职守	寓言
卓越	优秀	干净	优异	激昂
惊奇	意外	轻松	诧异	开朗
虚伪	谎言	参与	假意	领悟
无瑕	干净	危险	高洁	悲怆
乐天	高兴	标准	开朗	俊美

Table A1 (continued)

Word Trial used in the Lexical Decision Task

	Prime			
	High frequency		Low frequency	
Target	Related	Unrelated	Related	Unrelated
平静	稳定	伟大	安闲	灵巧
书本	学习	阻止	课桌	职守
牛排	食物	方法	餐盘	基准
花瓶	玻璃	血液	细瓷	勾结
歹徒	危险	美丽	凶恶	闲适
床铺	睡觉	区别	休息	阅览
搜索	寻找	想法	排查	达标
火枪	武器	开始	长矛	举措
法则	规矩	快乐	章程	追思
档案	文件	命令	条文	阻挠
河流	自然	客户	山川	中枢
树木	公园	阴谋	植被	允诺
星空	宇宙	期待	苍穹	木床

Table A1 (continued)

Word Trial used in the Lexical Decision Task

	Prime			
	High frequency		Low frequency	
Target	Related	Unrelated	Related	Unrelated
扬帆	出发	消失	起航	捕食
拍照	录像	银行	录影	纸币
照相	拍摄	希望	摄制	开导
兴奋	激动	困难	激昂	通俗
慷慨	慈善	年轻	豪爽	过瘾
规范	标准	母亲	基准	年华
权力	负责	过去	职能	早间
荟萃	集中	吃饭	聚合	免去
奋斗	努力	干净	勤劳	真切
上午	早晨	经历	早间	音信

Appendix B

Table B1

Nonword Trial used in the Lexical Decision Task

Prime	Pseudoword
上级	雨米
两岸	钟汤
主张	电旺
出席	瓶国
动作	奶购
发出	豆发
强大	鲜笔
早已	力旅
普及	桃本
毕竟	医阔
深深	宽忙
猎人	果册
眼前	步事

Table B1 (continued)

Nonword Trial used in the Lexical Decision Task

Prime	Pseudoword
著作	相灯
违法	机云
刘墉	风成
上市	阳长
千万	无苏
印象	文震
危险	齐欲
时刻	条可
照片	布天
昨天	欢经
熟悉	海年
荣誉	难孔
转业	和定
全会	玩历

Table B1 (continued)

Nonword Trial used in the Lexical Decision Task

Prime	Pseudoword
卫星	屯非
围绕	中则
将来	庄剧
小学	预资
歹徒	动料
立法	温号
简直	流关
观测	农程
评价	导造
语言	体疆
调动	乐节
飞机	感八
山区	爱比
产量	足典

Table B1 (continued)

Nonword Trial used in the Lexical Decision Task

Prime	Pseudoword
公园	子望
当代	收击
有力	入术
模式	开西
武装	率器
法人	火万
物理	近明
现有	就日
绝对	倡身
课题	舞判
趋势	韩色
配合	菜同
上升	拍装
上午	赞边

Table B1 (continued)

Nonword Trial used in the Lexical Decision Task

Prime	Pseudoword
交往	处气
作风	文饮
参观	搬潮
哈哈	考码
天下	糕话
婆婆	例伟
少年	巴严
差距	园昔
平衡	模指
年龄	邻问
想象	股领
指标	月当
改进	消千
教训	然汁

Table B1 (continued)

Nonword Trial used in the Lexical Decision Task

Prime	Pseudoword
肚子	居机
舞台	期信
车间	汗笑
进程	离球
伙伴	起格
会见	剂此
家里	空主
既然	衣营
欧洲	司至
死亡	减别
海外	沙纳
针对	街缺
不足	分绿
主持	劳电

Table B1 (continued)

Nonword Trial used in the Lexical Decision Task

Prime	Pseudoword
之前	称升
依然	书小
加以	亚理
周围	水复
国债	随总
寻找	出星
导致	队生
尤其	崇度
成熟	糖移
执法	深要
有利	品维
构成	借东
标志	凉悔
法国	看切

Table B1 (continued)

Nonword Trial used in the Lexical Decision Task

Prime	Pseudoword
状态	法春
登记	他工
石头	思林