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Article

# A study of Cross-Language Repetition Priming on the Semantic Access of Chinese-English-Korean Trilinguals

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**Abstract:** Against the backdrop of globalization driving a growing number of trilingual speakers, understanding the mechanisms of trilingual semantic access has emerged as a pivotal research direction in cognitive linguistics. Existing studies predominantly focus on Indo-European language combinations and explicit memory paradigms, leaving gaps in the exploration of mechanisms for "cross-family + multi-script" language combinations (e.g., Chinese-English-Korean) and comparative analyses across third language (L3) proficiency levels. To address this gap, the present study employed a cross-language repetition priming paradigm—characterized by high ecological validity—using 48 sets of Chinese-English-Korean translation equivalents as stimuli. Sixty-one native Chinese speakers, with English as their second language (L2) and Korean as their third language (L3), participated in semantic categorization and lexical decision tasks. The study aimed to investigate the roles of the first language (L1, Chinese) and L2 in L3 semantic access, as well as differences in access pathways across varying L3 proficiency levels. Results revealed three key findings: (1) L1 Chinese played a dynamic mediating role in L3 Korean semantic access; (2) L2 English exerted a stable mediating role in L3 Korean semantic access; (3) High-proficiency L3 learners accessed L3 semantics directly through the connection between L2 and concepts, whereas low-proficiency learners relied on dual mediation of both L1 and L2.These findings enrich research on trilingual semantic representation, extend bilingual theories to cross-family language contexts, and provide support for differentiated pedagogical strategies in third language instruction.

**Keywords:** Trilingualism; Trilinguals; Semantic Access; Cross-Language Repetition Priming; Third Language Proficiency

## 1. Introduction

The mechanism of cross-linguistic semantic access is pivotal to unraveling how multilingual speakers efficiently retrieve and process meaning across distinct language systems. Notably, the investigation of this mechanism largely depends on understanding bilinguals' memory representation systems and semantic access pathways—two long-standing core topics in the field of bilingual cognitive research. A consistent consensus has been reached in existing studies: bilingual memory representation functions through two tightly interconnected levels, namely lexical representation (language-specific orthographic and phonological information) and conceptual representation (shared semantic knowledge and conceptual categories). Within this framework, the essence of semantic access—particularly in second language (L2) processing—lies in the establishment and activation of connections between L2 lexical representations and conceptual representations. It is only through such connections that multilingual speakers can successfully extract the intended meaning of L2 words, thereby laying the foundation for fluent cross-linguistic communication and cognitive processing.

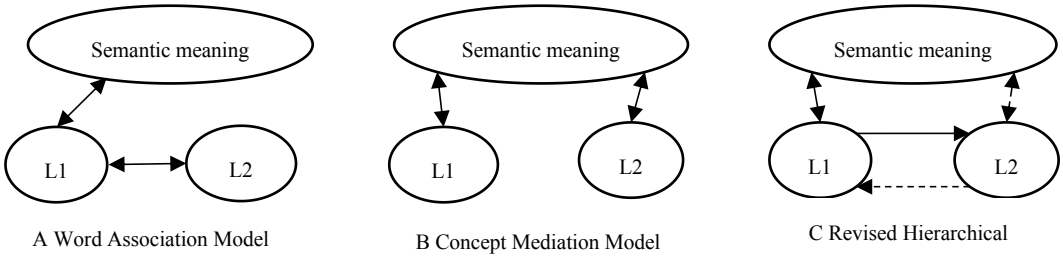


**Figure 1** Three Models of Bilingual Memory Representation

Since the 1980s, researchers have proposed three classic theoretical models to explain the structure and access mechanisms of bilingual memory representations (Figure 1). Potter et al. (1984) put forward the Word Association Model and the Concept Mediation Model. Both models assume that bilinguals share conceptual representations while maintaining independent lexical representations across languages, but they differ in their accounts of access pathways. The Word Association Model posits direct links between the lexical representations of the two languages, with L2 lexical representations unable to directly connect to shared conceptual representations—instead, they access concepts indirectly through L1 lexical mediation. In contrast, the Concept Mediation Model argues that there are no direct connections between the lexical representations of the two languages; instead, both directly link to shared conceptual representations, meaning both L1 and L2 lexica can access concepts directly.

Subsequent empirical studies revealed that L2 proficiency influences the mode of semantic access. Building on this, Kroll and Stewart (1994) integrated and revised the aforementioned models, proposing the Revised Hierarchical Model (RHM) of bilingual memory representation. This model has two key features: first, the two languages share conceptual representations, with both sets of lexical representations directly connected to these concepts; second, under specific conditions, lexical representations across languages can form direct links, enabling multi-path access. The RHM emphasizes that bilinguals' semantic access patterns evolve dynamically as their L2 proficiency develops. From a dynamic developmental perspective, the model argues that L1, as the native language, has highly consolidated connections between its lexical and conceptual representations, allowing direct access from L1 lexica to concepts. While L2 lexical representations are independent of L1 lexical representations, they share the L1 conceptual representation system. In the early stages of L2 acquisition, learners rely on L1 to acquire semantic knowledge, resulting in weaker connections between L2 lexical and conceptual representations compared to L1. At this stage, L2 access to concepts requires L1 lexical mediation, aligning with the Word Association Model's claim that L2 can only access concepts via L1. As L2 proficiency advances, connections between L2 lexical and

conceptual representations strengthen, allowing learners to bypass L1 mediation and access concepts directly from L2 lexica—a pattern consistent with the Concept Mediation Model's assertion of direct L2-to-concept access. Additionally, the model posits asymmetries in connection strength: lexical links in the L2-to-L1 direction are stronger than those in the L1-to-L2 direction, while conceptual links are stronger for L1 than for L2.

Although the Revised Hierarchical Model was originally proposed for bilinguals, De Angelis (2007) noted that it is equally applicable to explaining the memory representation and semantic access mechanisms of multilinguals. This has been validated by scholars through studies on semantic access in trilingual learners. Especially, the work of Chinese scholars provides empirical support for this view: one involves native Chinese speakers who acquire a third language (e.g., Japanese, French, German) in addition to English as their second language (Wang et al., 2010; Li et al., 2013; Chen & Wang, 2020); the other focuses on ethnic minority students, whose native language is a minority language (e.g., Tibetan, Uyghur, Mongolian), with Chinese as their second language and English as their third language (Cui & Zhang, 2009; Rebiguli et al., 2011, 2012; Wen & Rebiguli, 2009). Despite differences in research subjects, both lines of study confirm that the proficiency and linguistic distance of L2 and/or L3 are key factors influencing trilingual lexical-semantic access. This finding further supports the applicability of the Revised Hierarchical Model in research on multilingual semantic access.

However, existing research has obvious limitations. First, most studies on trilingual semantic access have focused on Indo-European languages (e.g., French, German, Russian), lacking investigation into "cross-family + multi-script combinations." Chinese belongs to the Sino-Tibetan family, English to the Indo-European family, and Korean to the Altaic family; the semantic access mechanism for this unique language combination remains unclear, and empirical testing of the applicability of relevant semantic access models to this combination is lacking. Second, studies on bilingual and multilingual semantic access have predominantly adopted explicit memory paradigms such as translation tasks and picture-naming tasks. These explicit paradigms require participants to engage in deliberate lexical retrieval or language switching, making them vulnerable to interference from irrelevant variables like "translation strategy preferences" and "differences in naming proficiency." Moreover, such task scenarios do not align with the automatic, implicit nature of daily linguistic-semantic processing, resulting in low ecological validity. They may also confound the true pathways of "lexical association" and "conceptual access" when participants rely on "surface lexical connections" to complete tasks. In contrast, the cross-language repetition priming paradigm, based on implicit memory mechanisms, effectively reduces interference from irrelevant variables during experiments, boasts higher ecological validity, and thus offers distinct advantages over other explicit memory paradigms. Finally, there are inconsistencies in the selection of participants' language proficiency across studies. While previous research has clarified that language proficiency significantly influences trilingual semantic access patterns, most studies have focused on single proficiency dimensions. Comparative research on semantic access mechanisms between high-proficiency and low-proficiency L3 learners remains scarce, which to some extent limits a comprehensive understanding of the regulatory effect of language proficiency in trilingual semantic access.

In light of these gaps, the present study adopts a cross-language repetition priming paradigm. By controlling for participants' L2 English proficiency to ensure it is roughly consistent, we divided them into two groups based on their L3 Korean proficiency to investigate the L3 semantic access patterns of Chinese-English-Korean trilinguals. The study aims to address the following questions:

a. What role does L1 Chinese play in L3 semantic access among Chinese-English-Korean trilinguals?
b. What role does L2 English play in L3 semantic access among Chinese-English-Korean trilinguals?
c. What differences exist in semantic access pathways between high-proficiency and low-proficiency L3 Korean groups among Chinese-English-Korean trilinguals?

## 2. Method

The study consisted of two experiments (Experiment 1 and Experiment 2). Participants completed identical tasks in both experiments: a semantic categorization task during the practice phase, where they judged whether words presented on the screen referred to animate entities, and a lexical decision task during the test phase, where they judged whether the displayed words were real words. Experiment 1 included two sub-experiments (1a and 1b), which examined the role of L1 Chinese in L3 Korean semantic access among proficient and non-proficient trilinguals, respectively. Experiment 2 included two sub-experiments (2a and 2b), which investigated the role of L2 English in L3 Korean semantic access among proficient and non-proficient trilinguals, respectively.

### *2.1 Participants*

Sixty-eight Korean majors from a comprehensive university in northern China participated in this study, aged between 18 and 24 years (M=22.4 years for the high-proficiency group; M=18.5 years for the low-proficiency group). All participants were native speakers of Chinese, with English as their second language (L2) and Korean as their third language (L3). Their L2 learning duration ranged from 8 to 19 years (M=11.9 years), and their L3 learning duration ranged from 1 to 7 years (M=3.3 years). To ensure the rationality of grouping, all participants completed a Korean proficiency test (referring to the standard of the Test of Proficiency in Korean, TOPIK) and a language use frequency questionnaire (adopting a 5-point Likert scale, where 1="never use" and 5="use daily"). The high-proficiency group (n=34) achieved a TOPIK Level 4 or above (score≥150) and had an average L3 use frequency of 3.82 (SD=0.65); the low-proficiency group (n=34) had a TOPIK Level 2 or below (score≤80) and an average L3 use frequency of 1.88 (SD=0.56). In terms of educational background, all participants had received 12–16 years of formal education (M=14.1 years, SD=1.12), and there was no significant difference between the two groups.

Participant screening was conducted in three sequential steps, with comprehensive details of each assessment procedure outlined as follows:

First, all 68 potential participants completed the English Proficiency Test (2021 online version) hosted on the British Council's "Learn English" platform. The assessment was administered between March 15 and 22, 2022, with a fixed testing duration of 10 minutes per participant to ensure consistency. The test consisted of 25 multiple-choice items (1 point per item), covering three core linguistic dimensions: vocabulary, grammar, and pragmatics. Raw scores were converted to levels defined by the Common European Framework of Reference for Languages (CEFR), with CEFR B1 (18–25 points) set as the eligibility threshold. This criterion was justified on two grounds: it aligns with the average English proficiency of Korean majors at universities in northern China, and it guarantees that participants possess the necessary linguistic competence to complete the academic tasks in subsequent experiments. Only 61 participants who met this standard advanced to the next stage.

Second, the 61 eligible participants completed the TOPIK Level 1 (B1 Proficiency) Test (2022 Revised Edition) offline between April 5 and 10, 2022. Developed and officially released by the National Institute for International Education of Korea (NIIED), this 20-minute assessment comprised two modules: Listening Comprehension (15 items, 50 total points) and Reading Comprehension (15 items, 50 total points), with a maximum possible score of 100. A cutoff score of ≥75 points was established to categorize participants into the high-proficiency group. This threshold was determined based on two key considerations: first, it reflects NIIED's official definition of "basic Korean communicative proficiency"; second, it maintains consistency with standards employed in prior research on East Asian trilingualism, thereby ensuring the comparability of the present study's results with existing literature.

Third, immediately following the TOPIK test, the 61 participants completed a 5-point self-rating scale designed to assess their Korean proficiency. The scale evaluated five essential language skills: listening, speaking, reading, writing, and translation, with response options ranging from 1("very unskilled") to 5("very skilled"). Pearson correlation analysis was conducted to examine the relationship between TOPIK scores and self-rated scores, revealing a significant positive correlation ($r=0.68$, $p<0.001$). This finding

confirms good convergence between objective test performance and subjective proficiency perception. Specifically, the high-proficiency group achieved a mean self-rating score of 3.16 (standard deviation, SD=0.42), while the low-proficiency group had a mean score of 1.88 (SD=0.35).

After controlling for the potential confounding effect of second language (English) proficiency, 30 participants (third-year undergraduate students and postgraduate students majoring in Korean) were ultimately assigned to the Korean high-proficiency group, and 31 participants (first- and second-year undergraduate students majoring in Korean) to the Korean low-proficiency group.

All participants were right-handed, with normal or corrected-to-normal vision, and received monetary compensation upon completion of the experiment.

*2.2 Experimental Design*

A 2×2×2 mixed-factorial design was employed, with L3 proficiency (high vs. low) as the between-subjects variable and two within-subjects variables: learning condition (learned vs. unlearned) and language condition (Chinese vs. English). Learning condition distinguished between test-phase materials: "learned" materials were words or their translation equivalents presented in the learning phase, while "unlearned" materials were those not presented in the learning phase. Language condition referred to the language of test stimuli, either Chinese (L1) or English (L2). The design measured cross-language priming effects in the L3-to-L1 and L3-to-L2 directions: Korean (L3) words (e.g., 오리 ) were presented in the learning phase, and their Chinese (e.g.,鸭子) or English (e.g., duck) translation equivalents were presented in the test phase. Dependent variables included response times and accuracy rates for Chinese and English stimuli in the test phase. The purpose of the experiment is to examine whether a priming effect occurs when the prime and target stimuli are translation equivalents.

*2.3 Experimental Materials*

In the preparation phase, 60 words were first selected from the 1,000 most frequently used English words (Nation, 2008), matched for syllable count, word length, and frequency. These words were then translated into their Chinese and Korean equivalents. Six Korean majors across different academic years rated the familiarity of all English and Korean words using a 5-point scale (1 = very unfamiliar, 5 = very familiar). Based on these ratings, 48 sets of Chinese-English-Korean translation equivalents were selected, including 24 animate words (e.g., 朋友-friend-친구 ) and 24 inanimate words (e.g., 牛奶-milk-우유 ). These 48 sets served as materials for both Experiment 1 and Experiment 2.

Prior to the formal experiment, four independent raters (all Korean-majoring undergraduates who were blind to the study's hypotheses) evaluated the readability and familiarity of 96 target stimuli (48 animate words and 48 inanimate words) using a 7-point Likert scale, where 1="extremely low readability/familiarity" and 7 = "extremely high readability/familiarity". For this evaluation, "readability" was defined as "the ease of recognizing word form and comprehending word meaning", while "familiarity" was defined as "the frequency of exposure to the word in daily study and life". Paired-samples t-tests were conducted to analyze the rating data, and the results revealed no significant differences in readability or familiarity between different stimulus subsets (e.g., learned vs. unlearned words) across all three languages (all $p > 0.05$). This confirms that the characteristics of the stimulus materials were well-balanced. Specifically, for Chinese stimuli: the learned words had a mean readability score of 5.82±0.61 and a mean familiarity score of 5.91±0.58, whereas the unlearned words had a mean readability score of 5.67 ± 0.59 and a mean familiarity score of 5.79±0.63 ($t(47)=0.83$, $p=0.412$). For English stimuli: the learned words yielded a mean readability score of 5.43±0.72 and a mean familiarity score of 5.56±0.68, while the unlearned words had a mean readability score of 5.28±0.67 and a mean familiarity score of 5.41±0.71 ($t(47)=0.91$, $p=0.367$). For Korean stimuli: the learned words had a mean readability score of 5.12±0.75 and a mean familiarity score of 5.23±0.70, in contrast to the unlearned words, which had a mean readability score of 4.98±0.73 and a mean familiarity score of 5.09±0.66 ($t(47)=0.76$, $p=0.451$).

Experiment 1 used Chinese-Korean translation equivalents. Additionally, 48 Chinese pseudowords were created as filler materials for the test phase by modifying radicals and strokes to render them meaningless. The formal experiment consisted of two phases: 24 Korean words were presented in the learning phase, and 96 Chinese stimuli were presented in the test phase (48 pseudowords and 48 experimental materials). The experimental materials included 24 Chinese equivalents of Korean words presented in the learning phase and 24 unlearned Chinese words whose Korean equivalents had not been presented in the learning phase.

Experiment 2 used English-Korean translation equivalents used in Experiment 1. Thirty-two English pseudowords were also created as fillers from the 1,000 most frequently used English words (Nation, 2008) by scrambling letters to form meaningless strings that nonetheless conformed to English orthographic rules. In Experiment 2, 24 Korean words were presented in the learning phase, and 96 English stimuli were presented in the test phase (48 pseudowords and 48 experimental materials). The experimental materials included 24 English equivalents of Korean words presented in the learning phase and 24 unlearned English words whose Korean equivalents had not been presented in the learning phase.

*2.4 Experimental Procedure*

Prior to the experiment, participants received task instructions and completed practice trials, with emphasis on responding as quickly as possible while being informed that response times would be recorded. The experiment included a learning phase and a test phase. In the learning phase, participants were presented with specific stimuli (e.g., Korean words) to trigger the activation of relevant lexical and conceptual representations—this step was designed to establish a potential priming effect for subsequent semantic processing. In the test phase, participants' response times and accuracy rates were recorded and analyzed; by comparing differences in these indicators across conditions where different materials were presented in the learning phase, this study aimed to verify whether the representations pre-activated in the learning phase would exert a cross-linguistic priming effect on the processing of target stimuli (e.g., L1 Chinese or L2 English words). In turn, this verification would reveal the mechanism of L3 (Korean) semantic access mediated by L1 or L2.

Each word was preceded by a fixation cross ("+") displayed at the center of the screen for 500ms to cue participants. Experimental words were presented for 2000ms, with the next word appearing automatically once a response was made or after 2000ms if no response was given. In the learning phase, participants performed a semantic categorization task, judging whether the presented Korean words referred to animate entities. In the test phase, they completed a lexical decision task, judging whether the presented L1 (Chinese) or L2 (English) words were real words or pseudowords. Responses were made using the keyboard: the "J" key for "yes" and the "F" key for "no."

Participants completed the experiment in a quiet environment, with each experimental session lasting approximately 10 minutes. To avoid order effects, half of the participants completed the Chinese test first, and the other half completed the English test first, with a 1-2 minute interval between the two tests. Participants were not informed in advance that the language or task would change between phases. The entire study, including all experimental sessions, was completed over one week.

*2.5 Data Collection and Analysis*

Reaction times (RTs) and accuracy rates during the test phase were automatically recorded using E-prime 2.0. Upon completion of all experiments, data from the 61 participants were merged using E-Merge software. RTs and accuracy rates for learned and unlearned words in the test phase were extracted for statistical analysis. Data preprocessing included excluding trials with incorrect or no responses, removing extreme values exceeding three standard deviations, and excluding participants with an accuracy rate below 60%. Data analyses were performed using SPSS 26.0. Paired-samples t-tests and independent-samples t-tests were conducted to compare RTs and accuracy rates across the two experiments. Comparisons of RTs and accuracy rates between proficient and non-proficient L3 Korean learners are presented in Table 1.

**Table 1.** Mean reaction times (ms) and accuracy rates (%) of Korean learners at different proficiency levels

| | Chinese | | English | |
|---|---|---|---|---|
| | RTs | ARs | RTs | ARs |
| Learned | | | | |
| High proficiency | 698.23 | 97.82 | 915.37 | 90.53 |
| Low proficiency | 721.56 | 97.15 | 1058.62 | 80.27 |
| Priming | 23.33 | 0.67 | 143.25 | 10.26 |
| Unlearned | | | | |
| High proficiency | 725.81 | 96.15 | 898.42 | 87.31 |
| Low proficiency | 750.34 | 94.52 | 1062.15 | 78.95 |
| Priming | 24.53 | 1.63 | 163.73 | 8.36 |

## 3. Results

### *3.1 Results of Experiment 1*

To examine the effects of L3 (Korean) proficiency, learning condition, and their interaction on semantic access, a three-way ANOVA was conducted on the data from Experiment 1. The analysis yielded two significant main effects: first, a significant main effect of L3 proficiency ($F=8.321$, $p=0.005<0.05$), indicating that proficiency level independently influenced task performance; second, a significant main effect of learning condition ($F=12.567$, $p=0.000$), confirming that the type of learning condition also exerted a notable impact on outcomes. Critically, a significant interaction effect was observed between L3 proficiency and learning condition ($F=6.789$, $p=0.012$), whereas all interaction effects among other factors were non-significant.

To clarify the nature of the aforementioned significant interaction, further analyses focused on reaction time (RT) data. First, comparisons of overall RTs revealed that high-proficiency L3 Korean learners responded significantly faster than low-proficiency learners, which was consistent with the main effect of L3 proficiency. RTs were then analyzed specifically under the L1 (Chinese) learning condition: the high-proficiency group exhibited significantly shorter RTs for learned words than for unlearned words ($t=2.215$, $p=0.035<0.05$), reflecting a positive cross-linguistic priming effect. In contrast, the low-proficiency group showed no significant difference in RTs between learned and unlearned words ($t=-1.892$, $p=0.068>0.05$), indicating the absence of such a priming effect. To rule out baseline processing differences between the two groups, independent-samples t-tests were conducted under the L1 condition: no significant RT differences were found between high- and low-proficiency learners for either learned words ($t=-1.123$, $p=0.267>0.05$) or unlearned words ($t=-0.985$, $p=0.330>0.05$).

These findings indicate that L1 Chinese facilitated L3 Korean semantic access for advanced learners but not for beginners, implying that the mediating role of L1 diminishes as L3 proficiency increases.

### *3.2 Results of Experiment 2*

To investigate the effects of L3 (Korean) proficiency, language condition, learning condition, and their interactions on semantic access, a three-way ANOVA was conducted on the data from Experiment 2. The analysis identified three significant main effects: first, a significant main effect of L3 proficiency ($F=9.234$, $p=0.003$), demonstrating that proficiency level independently influenced task performance; second, a highly significant main effect of language condition ($F=852.167$, $p=0.000$), indicating that the type of language used in the task exerted an extremely prominent impact on the experimental outcomes; third, a significant main effect of learning condition ($F=6.123$, $p=0.018$), confirming that learning condition also had a significant effect on the results. Additionally, a significant interaction effect was observed between learning condition and language condition ($F=7.345$, $p=0.010$), while all interaction effects among other factors were non-significant.

To further elaborate on the key findings, the study focused on overall reaction times (RTs) for in-depth analysis. First, comparisons of overall RTs revealed that proficient L3 Korean learners responded

significantly faster than non-proficient learners, which was consistent with the main effect of L3 proficiency. Subsequent analysis specifically examined RTs under the L2 (English) condition: both proficient and non-proficient Korean learner groups exhibited significantly shorter RTs for learned words compared to unlearned words, with the proficient group performing better in this comparison. When considering unlearned words alone, the proficient group also showed significantly shorter RTs than the non-proficient group. To further verify the RT differences between the two proficiency groups under the L2 condition, independent-samples t-tests were conducted. The results indicated that proficient learners responded significantly faster to learned words than non-proficient learners ($t=-3.567$, $p=0.001<0.05$), and they also had significantly shorter RTs for unlearned words ($t=-4.234$, $p=0.000<0.05$).

These findings suggest that L2 English facilitates L3 Korean semantic access for both proficient and non-proficient L3 learners, with the facilitating effect being more pronounced for proficient learners. This implies that L3 proficiency enhances the efficiency of L2-mediated L3 semantic processing—even in the processing of unlearned words.

### *3.3 Comparison of Results Between High-Proficiency and Low-Proficiency Groups*

To further unpack how language condition and learning condition jointly influence semantic processing across different L3 proficiency levels, separate two-way ANOVAs on reaction times (RTs) were conducted for high-proficiency and low-proficiency Korean learners (see Table 2 for detailed results). For the high-proficiency group, the two-way ANOVA revealed three significant effects: first, a significant main effect of language condition ($F=90.123$, $p=0.000<0.05$), indicating that the type of language used in the task strongly impacted RTs; second, a significant main effect of learning condition ($F=8.901$, $p=0.005<0.05$), confirming that whether words were learned or unlearned also affected response speed; third, a significant interaction between language condition and learning condition ($F=10.123$, $p=0.003<0.05$), suggesting that the effect of learning condition on RTs varied depending on the language condition.

For the low-proficiency group, the two-way ANOVA yielded a similar pattern of significant effects: a significant main effect of language condition ($F=75.678$, $p=0.000<0.05$), a significant main effect of learning condition ($F=7.654$, $p=0.010<0.05$), and a significant interaction between language condition and learning condition ($F=8.765$, $p=0.006<0.05$). This indicated that despite lower L3 proficiency, the two factors and their joint influence still exerted notable effects on RTs.

To specifically examine the learning condition effect under the L2 English condition (a key focus of the study), paired-samples t-tests were conducted. For high-proficiency Korean learners, the t-test showed significantly faster RTs for learned words compared to unlearned words under the L2 English condition ($t=-6.012$, $p=0.000<0.05$). Similarly, low-proficiency Korean learners also exhibited significantly shorter RTs for learned words than unlearned words under this condition ($t=-9.327$, $p=0.000<0.05$).

These findings demonstrate that both language condition and learning condition, as well as their interaction, significantly influence RTs for both high- and low-proficiency L3 Korean learners. More importantly, under the L2 English condition, the facilitative effect of prior learning (i.e., faster RTs for learned words) is evident across proficiency levels—suggesting that L2 English can serve as an effective mediating language for L3 Korean semantic access, regardless of learners' current L3 proficiency.

**Table 2.** Mean reaction times (ms) and accuracy rates (%) of Korean learners

| | High proficiency group | | Low proficiency group | |
|---|---|---|---|---|
| | RTs | ARs | RTs | ARs |
| Chinese | | | | |
| Learned | 698 | 97.8 | 726 | 96.2 |
| Unlearned | 721 | 97.2 | 750 | 94.5 |
| Priming | -23 | 0.6 | -24 | 1.7 |
| English | | | | |
| Learned | 915 | 90.5 | 898 | 87.3 |
| Unlearned | 1058 | 80.3 | 1052 | 78.9 |
| Priming | -143 | 10.2 | -164 | 8.4 |

## 4. Discussion

### *4.1 L1 and L3 Semantic Access*

Through a combined design of the cross-language repetition priming paradigm and lexical decision task, this study revealed that L1 (Chinese) exhibits a "dynamic mediating" characteristic in L3 (Korean) semantic access: low-proficiency learners rely on L1 (Chinese) mediation to achieve semantic access, whereas high-proficiency learners can bypass L1 and directly establish connections between L3 (Korean) lexical representations and concepts. This characteristic essentially reflects the developmental law of trilingual semantic networks: at the low-proficiency stage, L3 lexical representations have not yet formed independent and stable neural connections, and thus depend on the highly consolidated L1 lexical-conceptual network for semantic activation—aligning with the cognitive logic of "utilizing existing language systems to construct new linguistic pathways." At the high-proficiency stage, with increased L3 input and usage frequency, the strength of direct connections between L3 lexical representations and the conceptual system is continuously enhanced, the need for L1 mediation gradually diminishes, and "de-intermediated" access is ultimately achieved. The shift of L1's function from a "necessary mediator" to a "potential auxiliary" also embodies the flexibility and developmental nature of trilingual semantic processing.

The core findings of this study engage in effective dialogue with existing literature. On one hand, the result that low-proficiency trilinguals rely on L1 mediation is consistent with Kroll and Stewart's (1994) conclusion in the Revised Hierarchical Model (RHM)—that "low-proficiency L2 learners depend on L1 to access L2 concepts"—as well as Li et al.'s (2016) findings on Indonesian-English-Chinese trilinguals (where the accuracy of semantic access in low-proficiency L3 Chinese learners was significantly positively correlated with the activation intensity of L1 Indonesian lexical representations). This further validates the universality of L1's mediating role in low-proficiency language acquisition. On the other hand, this study extends existing research in two key aspects: first, it breaks free from the limitation that most studies focus on "L2 semantic processing" or "the mediating role of L2 in L3," and for the first time systematically uncovers the dynamic change pattern of L1 in L3 semantic access, clarifying that proficiency serves as the core variable regulating this change; second, unlike Rabigul et al. (2012), which only examined the correlation between reaction time (RT) delays and L1 familiarity, this study directly verifies the causal relationship that "the mediating role of L1 weakens as L3 proficiency improves" by comparing differences in priming effects between high- and low-proficiency groups, providing more direct empirical evidence for the development of trilingual semantic networks.

The results of this study provide robust empirical support for extending the Revised Hierarchical Model (RHM) to trilingual contexts, further verifying the model's cross-linguistic adaptability and explanatory power. The RHM proposes the core hypothesis that "bilinguals share conceptual representations while storing lexical representations in a language-specific manner, and the strength of L2-concept connections dynamically changes with L2 proficiency." This study found that this mechanism can be fully extended to trilingual scenarios: in terms of the sharing of conceptual representations, both high- and low-proficiency trilinguals were able to activate concepts shared with Korean through Chinese, indicating that the conceptual level in the trilingual system remains cross-linguistically shared and does not exhibit conceptual segmentation due to an increase in the number of languages—this supplements critical evidence for the RHM's "conceptual sharing" hypothesis at the trilingual level. In terms of the dynamism of lexical-concept connection strength, the RHM's principle that "L2 proficiency regulates the strength of lexical-concept connections" is specifically manifested in trilinguals as "L3 proficiency regulates the strength of L3-concept connections, thereby influencing the need for L1 mediation": low-proficiency learners have weak L3-concept connections and require L1 "bridging," while high-proficiency learners have strong L3-concept connections and can achieve direct access. This extension enables the RHM to explain more complex multilingual semantic processing phenomena, provides a key theoretical fulcrum for constructing a "multilingual interactive activation model," and highlights the RHM's unique advantage in "integrating lexical-concept dual-level representations and dynamically explaining proficiency effects," thus offering a more focused theoretical framework for subsequent research on trilingual semantic processing. This result not only verifies the applicability of the RHM in explaining L3 semantic access pathways in trilingual

contexts but also demonstrates that L3 proficiency moderates the choice between direct and indirect access routes, providing empirical support for understanding cross-linguistic semantic processing among trilinguals of varying proficiency.

*4.2 L2 and L3 Semantic Access*

Using a combined design of the cross-language repetition priming paradigm and lexical decision task, this study found that L2 (English) functions as a “stable mediator” in L3 (Korean) semantic access: both high- and low-proficiency L3 learners rely on L2 English to achieve L3 semantic access, with the facilitative effect of this mediation being more pronounced in high-proficiency learners.

The essence of this "stable mediating" characteristic stems from the similarities between L2 and L3 in cognitive mechanisms and acquisition patterns. Unlike L1 (Chinese)—which is naturally acquired in early childhood as implicit procedural knowledge—both L2 (English) and L3 (Korean) are typically learned in formal educational settings, dependent on explicit declarative knowledge (e.g., intentional vocabulary memorization, rule-based learning). This shared acquisition pattern enables L2 and L3 to form stronger cognitive associations, making L2 a more reliable intermediary in the process of semantic activation. For high-proficiency L3 learners, prolonged L2 use has fostered more robust "L2 lexical-concept" connections, allowing for faster and more accurate transmission of semantic information between L3 and concepts via L2—hence the stronger facilitative effect. Low-proficiency learners, while also dependent on L2 mediation, exhibit slightly lower efficiency due to relatively weaker "L2 lexical-concept" connections; crucially, however, the mediating role itself remains intact.

The core findings of this study engage in meaningful dialogue with existing literature. On one hand, the stable mediating role of L2 aligns with key conclusions from previous research: Chen et al. (2018), in their study of Tibetan-Chinese-English trilinguals, found that learners with high L2 (Chinese) proficiency prioritized L2 activation to mediate L3 (English) semantic access, with stronger cross-linguistic priming effects under mediated conditions; Rabigul et al. (2012), in research on Uyghur-Chinese-English trilinguals, observed that low-proficiency L3 (English) learners showed a positive correlation between the accuracy of their semantic processing and the activation intensity of L2 (Chinese) lexical representations. These consistencies validate the universality of L2’s mediating role in trilingual semantic access. On the other hand, this study extends existing research in two critical ways: first, it breaks the limitation of most studies focusing on single-proficiency groups, providing the first empirical evidence that L2’s mediating role remains stable across varying L3 proficiency levels—a stark contrast to the "dynamic characteristic" of L1’s mediating role, which diminishes as L3 proficiency improves; second, Alonso’s (2012) study only observed reduced reaction times (RTs) in L3 processing following L2 priming, without controlling for L2 proficiency. In contrast, this study standardized L2 proficiency across all participants, eliminating confounding variables and thus more precisely demonstrating that it is the efficiency (rather than the existence) of L2 mediation that is modulated by L3 proficiency.

The results further validate the adaptability of the Revised Hierarchical Model (Kroll & Stewart, 1994) to scenarios of "L2-mediated L3 semantic access," expanding the model’s explanatory scope from bilingualism to trilingualism. The core tenets of the RHM—cross-linguistic shared conceptual representations, language-specific lexical representations, and the dynamism of lexical-concept connection strength—are fully supported in the trilingual context of this study. First, regarding shared conceptual representations: both high- and low-proficiency learners activated shared concepts via L2 (English) when processing L3 (Korean), confirming that the conceptual layer remains cross-linguistically integrated even in trilingual systems. This supplements the RHM’s "conceptual sharing" hypothesis with evidence specific to "L2-L3 mediation." Second, regarding the dynamism of connection strength: the RHM’s proposition that "L2 proficiency modulates the strength of L2-concept connections" can be extended to trilingual contexts, manifesting as "L3 proficiency modulates the efficiency of L2-mediated L3-concept access." High-proficiency L3 learners, due to prolonged L3 exposure, have formed stronger "L3 lexical-L2 lexical" connections, allowing them to leverage L2’s robust "lexical-concept" connections for efficient semantic access. Low-proficiency learners, while relying on the same L2-mediated pathway, exhibit lower efficiency

due to weaker "L3 lexical-L2 lexical" connections. This extension enables the RHM to explain not only bilingual semantic access but also the stable mediating role of L2 in trilingualism, laying a theoretical foundation for the development of a more comprehensive multilingual semantic processing model.

*4.3 Language Proficiency and L3 Semantic Access*

By comparing cross-linguistic priming effects between high- and low-proficiency trilinguals, this study found that L3 proficiency significantly modulates semantic access pathways: high-proficiency learners achieve indirect access via L2 (English) through the route of "L3 lexicon-L2 lexicon-concepts" and do not require L1 (Chinese) mediation; in contrast, low-proficiency learners rely on dual pathways of "L1 mediation" and "L2 mediation," completing semantic activation through two parallel routes: "L3 lexicon-L1 lexicon-concepts" and "L3 lexicon-L2 lexicon-concepts."

From the perspective of trilingual semantic network development, the essence of this pathway difference lies in the dynamic change of language representation connection strength with proficiency. At the low-proficiency stage, L3 lexical representations have not yet developed independent conceptual connection capabilities, and thus need to "double-bridge" through the highly consolidated L1 network (strong connections formed via natural acquisition) and the relatively mature L2 network (connections accumulated through formal learning)—reflecting the cognitive principle that "newly learned languages rely on existing language systems to construct semantic pathways." At the high-proficiency stage, prolonged L3 input and usage significantly enhance the connection strength between "L3 lexicon and L2 lexicon"; coupled with L2's inherent stable "lexicon-concept" connections, which are sufficient to support efficient semantic transmission, the need for L1 mediation is substituted, resulting in a "single-mediation" access pattern. This transition from "dual mediation" to "single mediation" marks the maturation of the trilingual semantic network from a "dependent" to an "autonomous" state.

The core findings of this study engage in effective dialogue with existing literature. On one hand, the conclusion that "proficiency modulates semantic access pathways" aligns with the core view of Kroll and Stewart's (1994) Revised Hierarchical Model (RHM)—that "increased L2 proficiency promotes direct semantic access"—as well as Li et al.'s (2016) finding on Indonesian-English-Chinese trilinguals (i.e., higher L3 proficiency correlates with reduced reliance on L1 mediation). These consistencies further validate the universal principle that "proficiency is a core regulatory variable for multilingual semantic processing pathways." On the other hand, this study extends existing research in two key aspects: first, it breaks the limitation of most studies that only compare "the presence or absence of mediation," and for the first time explicitly identifies the "dual-mediation" pathway in low-proficiency trilinguals and the "L2 single-mediation" feature in high-proficiency trilinguals, refining the division of developmental stages for trilingual semantic pathways; second, unlike Wang et al. (2010), which only focused on the connection strength between L3 and L2, this study incorporates L1 mediation as a variable and controls for L2 proficiency to eliminate confounding factors. This enables a more systematic revelation of the dynamic relationship—"L1 mediation weakens with proficiency, while L2 mediation remains stable"—and provides a more comprehensive empirical picture of the developmental mechanism of trilingual semantic networks.

The results further expand the explanatory power of the Revised Hierarchical Model (Kroll & Stewart, 1994) in research on multilingual proficiency differences, allowing it to more fully cover the dynamic development of trilingual semantic access. The RHM proposes the core mechanism that "the strength of lexical-concept connections in bilinguals changes dynamically with proficiency"; this study extends this mechanism to scenarios involving trilingual proficiency differences, forming a more generalizable explanatory framework. In terms of shared conceptual representations: both high- and low-proficiency learners can activate concepts shared with L3 via L1 or L2, indicating that the cross-linguistic integration of the conceptual layer in the trilingual system does not change with proficiency. This supplements the RHM's "conceptual sharing" hypothesis with evidence of "consistency across proficiency levels." In terms of the dynamism of lexical-concept connection strength: the RHM's principle that "L2 proficiency modulates connection strength" is specifically manifested in trilingual contexts as "L3 proficiency modulates the difference in connection strength between 'L3-L1' and 'L3-L2'"—low-proficiency learners have similar

strength in these two types of connections, hence requiring dual mediation; high-proficiency learners have significantly stronger "L3-L2" connections than "L3-L1" connections, thus forming L2 single mediation. This extension not only enables the RHM to explain proficiency-related pathway differences in trilinguals but also constructs an "RHM-expanded model for trilingual semantic pathway development," providing clear theoretical guidance for subsequent research on the relationship between multilingual proficiency and semantic processing.

## 5. Conclusions

This study employed a cross-language repetition priming paradigm to investigate the patterns of L3 semantic access among Chinese-English-Korean trilinguals, with findings revealing three key results: (1) L1 Chinese played a dynamic mediating role in L3 Korean semantic access; (2) L2 English exerted a stable mediating role in L3 Korean semantic access; (3) High-proficiency L3 learners access Korean semantics directly via L2 English lexical links to concepts without L1 Chinese mediation, while low-proficiency L3 learners rely on both L1 and L2 English lexica for indirect semantic access. Building on existing research, this study preliminarily examined the mechanisms of semantic access in Chinese-English-Korean trilinguals.

However, this study has several limitations that should be acknowledged. First, the participant pool was restricted to Korean majors from a single university, with a relatively small sample size; future studies should expand participant recruitment to multiple institutions and increase the sample size to enhance the generalizability of the results. Second, all participants were Han Chinese with Chinese as their L1, English as their L2, and Korean as their L3, which limits the cross-group comparability of the findings. Future comparative research could explore L3 semantic access mechanisms among Chinese Korean ethnic groups (with Korean as L1, Chinese as L2, and English as L3) and native Korean speakers to capture potential differences across diverse language backgrounds. Third, the methodology was limited to behavioral measures (e.g., reaction times and accuracy rates), which cannot fully reveal the neural underpinnings of semantic access. Future studies should integrate neuroscientific tools such as event-related potentials (ERP) and functional magnetic resonance imaging (fMRI) to clarify the dynamic neural processes underlying semantic and lexical representation processing in bilinguals/multilinguals, thereby providing support for the development of a neural model of bilingual memory representation. Fourth, there is a limitation related to task modality: experimental stimuli were only presented via the visual modality (text displayed on a screen), failing to cover other common modalities in language processing. In real-world language use scenarios, modalities such as the auditory modality (e.g., speech in conversations) and audio-visual bimodal modality (e.g., reading accompanied by audio input) are more prevalent; a single visual modality may not fully reflect the semantic processing patterns of multilinguals. Future studies should expand task presentation modalities: on the one hand, add the auditory modality by playing Korean, Chinese, or English audio stimuli to examine trilingual semantic access patterns under speech input; on the other hand, introduce the audio-visual bimodal modality by presenting visual text and corresponding auditory speech simultaneously to simulate language use scenarios closer to daily life, thereby obtaining research results with higher ecological validity.

The findings also offer practical insights for L3 teaching, particularly for Korean instruction among Chinese-English bilinguals: for low-proficiency learners, instructors should emphasize explicit connections between L3 Korean vocabulary and both L1 Chinese and L2 English equivalents, using translation-based exercises to reinforce indirect semantic links (e.g., contrasting "오리" with "鸭子"and "duck" to strengthen cross-language associations); for high-proficiency learners, curricula should shift toward L2 English-mediated tasks, such as English-Korean paraphrasing or context-based comprehension activities, to foster direct L3-to-concept pathways. Additionally, educators should tailor strategies to proficiency levels—prioritizing L1-L3 and L2-L3 comparisons for beginners to build foundational links, while advanced learners benefit from immersive tasks that reduce reliance on L1 and leverage L2 as a bridge—ultimately promoting more autonomous L3 semantic processing. These pedagogical adjustments, grounded in the dynamic role of language proficiency in semantic access, may enhance the efficiency of L3 acquisition by aligning instructional methods with the cognitive mechanisms underlying trilingual semantic representation.

## DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this article. The data that support the findings of this study are available from the corresponding author upon reasonable request.

## AUTHOR CONTRIBUTIONS

You Ma is responsible for the overall topic selection, conceptualization, data collection, manuscript drafting, as well as data analysis and processing, and serves as the first author of the paper. Hui Shi is responsible for revising the manuscript and providing revision suggestions and acts as the corresponding author.

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## ETHICAL STATEMENT:

All participants provided written informed consent before participating.

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