

An Empirical Study on Trilingual Semantic Access via Different Paths in Chinese-English-Korean Trilinguals

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Abstract: To explore the mediating mechanism and pathway effect of trilingual semantic access under a cross-linguistic family background, this study adopted a cross-linguistic repetition priming paradigm with 60 Chinese-English-Korean trilinguals as participants, and set three presentation conditions: visual, auditory, and audio-visual. The purpose was to empirically examine the mediating role and its intensity of the first language (L1, Chinese) and the second language (L2, English) in the process of semantic information retrieval of the third language (L3, Korean). The results showed that: 1) L1 Chinese exerted a stable mediating effect on L3 Korean semantic access under all three pathway conditions, with no significant difference in priming effect among different pathways; 2) The mediating effect of L2 English was pathway-restricted, being significant only under the visual pathway, and the priming effect under this pathway was significantly stronger than that of L1 Chinese; 3) Under the visual pathway condition, there was a significant difference in priming effect between L1 Chinese and L2 English, with L2 English showing a stronger priming effect; under the auditory and audio-visual dual-pathway conditions, there was no significant difference in priming effect between the two languages. The study indicates that the trilingual semantic access of Chinese-English-Korean trilinguals is jointly regulated by language proficiency, language distance, and task presentation pathway, and follows the principle of cognitive economy. This study provides empirical support for the mechanism of cross-linguistic family trilingual semantic access, and also offers references for pathway-adapted training and the optimization of mediating language strategies in trilingual teaching.

Keywords: Trilinguals; Visual Pathway; Auditory Pathway; Semantic Access; Cross-Linguistic Repetition Priming

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1. Introduction

In the field of bilingual cognitive research, the memory representation system and semantic access pathways of bilinguals have long been central issues of academic concern. A consensus has been reached in existing studies: the memory representation of bilinguals consists of two interconnected levels—lexical representation and conceptual representation—and the essence of semantic access is essentially the process in which connections are established between L2 lexical representations and shared conceptual representations to achieve meaning retrieval.

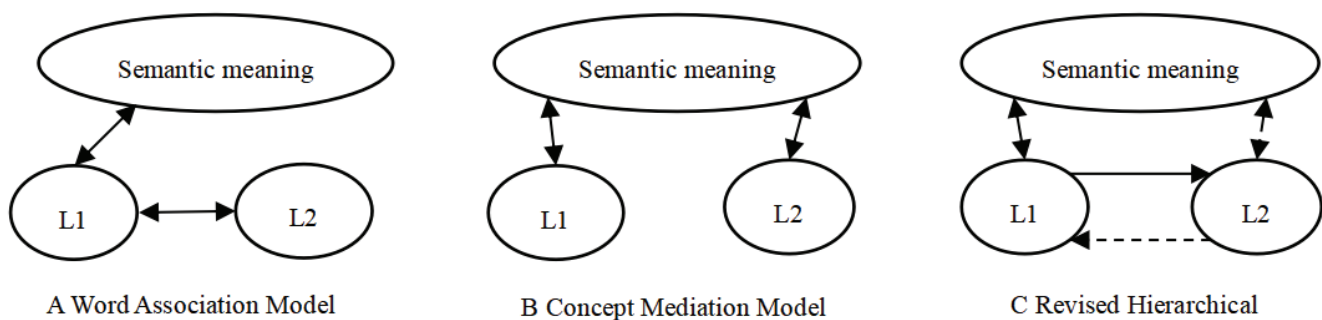
Since the 1980s, researchers have proposed three classic theoretical models regarding the structure and access mechanisms of bilingual memory representations (Figure 1). Potter et al. (1984) put forward the Word Association Model and the Concept Mediation Model. Both models assume that bilinguals share a single conceptual representation system while maintaining

separate lexical representations for each language, but they differ in terms of access pathways. The Word Association Model posits that lexical representations of the two languages are directly linked at the lexical level, and L2 lexical representations cannot access the shared conceptual representations directly; instead, they rely on L1 lexical items as mediators to achieve conceptual access indirectly. In contrast, the Concept Mediation Model argues that there are no direct connections between the lexical representations of the two languages, and both are directly linked to the shared conceptual representations—meaning that both L1 and L2 words can access concepts directly.

Subsequent empirical studies revealed that L2 proficiency modulates the mode of semantic access. On this basis, Kroll and Stewart integrated and revised the two aforementioned models and proposed the Revised Hierarchical Model of bilingual memory representation. This model has two core features: first, the two languages share conceptual representations, and their lexical representations are both directly connected to the conceptual system; second, lexical representations of the two languages may be directly linked under specific conditions, forming a multi-path access pattern. The model emphasizes that the semantic access mode of bilinguals undergoes dynamic evolution as their L2 proficiency develops.

From a developmental perspective, the Revised Hierarchical Model holds that, as the native language, L1 has highly stabilized connections between lexical and conceptual representations, allowing L1 words to access concepts directly. Although L2 lexical representations are independent of L1 lexical forms, they share the L1 conceptual system. In the initial stage of L2 acquisition, because learners depend on L1 to acquire semantic knowledge, the connection strength between L2 lexical and conceptual representations is weaker than that of L1. At this stage, L2 words must be mediated by L1 to access concepts, consistent with the assumption of the Word Association Model: L2 can only reach concepts through L1. As L2 proficiency reaches a certain level, the connection between L2 lexical and conceptual representations gradually strengthens, and learners can bypass L1 mediation and access concepts directly from L2 lexical forms, aligning with the claim of the Concept Mediation Model: L2 words can access concepts directly. In addition, the model maintains that connection strengths vary across different pathways: lexical associations are stronger in the L2-to-L1 direction than in the L1-to-L2 direction, whereas conceptual connection strength is stronger for L1 than for L2.

Figure 1: Three Models of Bilingual Memory Representation



Although the Revised Hierarchical Model was originally proposed for bilinguals, De Angelis (2007) argued that it is equally applicable to accounting for the memory representation and semantic access mechanisms of multilinguals. Some scholars have verified this model by investigating semantic access among trilingual learners. Against the backdrop of globalization, as the number of trilingual and multilingual individuals continues to rise, academic attention to lexical representation and semantic access in multilinguals has gradually increased.

In China, research on semantic access in trilinguals is generally divided into two categories based on language relationships. One category focuses on Han Chinese native speakers who acquire a third language (e.g., Japanese, French, German) in addition to L1 Chinese and L2 English (Wang et al., 2010; Li et al., 2013; Chen & Wang, 2020). The other category centers on ethnic minority students who speak a minority language as L1 (e.g., Tibetan, Uyghur, Mongolian), use Chinese as L2, and learn English as L3 (Cui & Zhang, 2009; Rebigul et al., 2011, 2012; Wen & Rebigul, 2009). Despite the different participant groups, both lines of research confirm that language proficiency and language distance in L2 and/or L3 are key factors influencing trilingual lexical-semantic access.

However, existing studies suffer from notable limitations. First, most investigations of trilingual semantic access focus on Indo-European languages (e.g., French, German, Russian), with insufficient attention to combinations involving cross-family and multi-script languages. Chinese belongs to the Sino-Tibetan language family, English to the Indo-European family, and Korean (tentatively) to the Altaic family. The semantic access mechanisms underlying this unique language combination remain unclear, and empirical evidence regarding the applicability of current theoretical models to this combination is lacking. Second, most studies of bilingual and multilingual semantic access adopt explicit memory paradigms such as translation tasks and picture-naming tasks. Explicit paradigms require participants to engage in deliberate lexical retrieval or language switching, which are susceptible to confounding variables such as translation strategy preferences and differential naming proficiency. Moreover, such tasks diverge from the automatic and implicit nature of everyday semantic processing, resulting in relatively low ecological validity. In addition, reliance on superficial lexical associations may obscure the true pathways of lexical connection versus conceptual access. In contrast, the cross-linguistic repetition priming paradigm is grounded in implicit memory mechanisms, effectively reduces extraneous interference, and yields higher ecological validity, thus offering clear advantages over explicit paradigms. Third, the modal presentation of stimuli in most studies is relatively uniform. Existing research is largely restricted to the visual modality, with only a few studies incorporating the auditory modality (e.g., Li et al., 2016; Chen & Wang, 2020; Ma & Shi, 2025). However, Taft (1986) pointed out that visual word recognition begins with orthographic activation, whereas auditory recognition centers on phonological activation, and such perceptual differences directly influence the efficiency and pathways of lexical access. The uniformity of modality design not only limits current research but may also lead to biased conclusions due to the absence of cross-modality comparisons.

In summary, the trilingual semantic access process is jointly constrained by multiple variables, including language distance, L2 and L3 proficiency, and stimulus presentation modality. Nevertheless, the academic community has not yet reached a consensus regarding the specific mechanisms and pathways through which these factors modulate trilingual semantic activation.

To ensure comparability with previous research, this study adopts the classic cross-linguistic repetition priming paradigm. From a novel research perspective, it extends and complements existing literature by establishing three experimental conditions: unimodal visual, unimodal auditory, and bimodal audio-visual presentation. It systematically examines the mediating effects of L1 Chinese and L2 English during L3 Korean processing among Chinese-English-Korean trilinguals.

Accordingly, this study aims to address the following three core research questions:

- (1) Does L1 Chinese exert a mediating effect during trilingual semantic access in Chinese-English-Korean trilinguals under visual, auditory, and audio-visual bimodal conditions?
- (2) Does L2 English exert a mediating effect during trilingual semantic access in Chinese-English-Korean trilinguals under visual, auditory, and audio-visual bimodal conditions?
- (3) Are there significant differences between the mediating effects of L1 Chinese and L2 English in trilingual semantic access?

2. Methods

The cross-linguistic repetition priming paradigm is an implicit memory paradigm that investigates semantic representational connections across languages via a two-phase design comprising a study phase and a test phase. In the study phase, participants are presented with target Korean (L3) words and instructed to perform a semantic categorization task (judging whether the referent is animate or inanimate), which activates the semantic representations of the Korean words as well as those of their translation equivalents in L1 Chinese and L2 English. After a brief interval, the test phase follows, in which participants are presented with L1 or L2 words—including translation equivalents of studied Korean words, translation equivalents of unstudied Korean words, and nonwords—and complete a lexical decision task (judging whether the stimulus is a real word). Cross-linguistic semantic priming is established by comparing response latencies between translation equivalents of studied and unstudied L3 words; significantly shorter responses to the former indicate that L3 processing in the study phase activated semantic representations in L1 or L2, demonstrating a mediating role of L1 or L2 in L3 semantic

access. By employing implicit tasks, this paradigm avoids interference from explicit translation strategies, enables precise detection of automatic cross-linguistic semantic associations, and thus possesses high ecological validity.

The present study consists of two sections: Experiment 1 and Experiment 2, in which participants completed identical core tasks: a semantic categorization task in the study phase and a lexical decision task in the test phase. Experiment 1 comprised three sub-experiments (1a, 1b, 1c) designed to examine the mediating effect of L1 Chinese under visual, auditory, and audio-visual bimodal conditions. Correspondingly, Experiment 2 also included three sub-experiments (2a, 2b, 2c) to explore the mediating effect of L2 English across the same three presentation modalities.

2.1 Experiment 1a

2.1.1 Participants

Thirty students majoring in Korean from a comprehensive university in northern China were recruited as participants for this experiment, with an age range of 18 to 24 years and a mean age of 19.8 ($M=19.8$). All participants were native speakers of Chinese (L1), with English as their second language (L2) and Korean as their third language (L3). The duration of their English learning ranged from 12 to 16 years, with an average of 12.9 years ($M=12.9$), while their Korean learning duration ranged from 2 to 5 years, with an average of 3.5 years ($M=3.5$). Prior to the formal experiment, all participants completed a language background questionnaire and self-rated their proficiency in Chinese, English, and Korean using a 7-point Likert scale (1=very unskilled, 7=very skilled). Statistical results showed that the average self-rated proficiency was 6.82 for Chinese, 4.69 for English, and 4.87 for Korean. All participants met the basic experimental requirements, with normal visual acuity (either uncorrected or corrected) and normal auditory function, without any visual or auditory disorders that could affect the experimental results. In addition, the language background survey indicated that both L2 English and L3 Korean of the participants were acquired through classroom teaching, and the learning process relied on declarative knowledge learning methods such as bilingual annotations in textbooks, vocabulary translation memory, and grammatical rule explanation. Supplementary results from the language use frequency questionnaire showed that the use scenarios of English and Korean among participants were highly overlapping (82% for classroom learning and 75% for after-class assignments), mainly for academic and task-oriented purposes, with no significant difference in scenarios ($t=0.89$, $p=0.37$). Meanwhile, an independent samples t-test indicated that there were no significant differences between the participants of this experiment and those of Experiment 2 in self-rated English proficiency ($t=0.32$, $p=0.75$), Common European Framework of Reference for Languages (CEFR) level distribution ($\chi^2=1.21$, $p=0.55$), and Korean learning methods ($\chi^2=0.98$, $p=0.61$), ensuring the consistency of characteristics between the two groups of participants.

In terms of L2 English proficiency, all 30 participants completed the English Level Test from the British Council and reached CEFR Level B1 (intermediate). For L3 Korean proficiency, all participants passed Level 4 of the Test of Proficiency in Korean (TOPIK, $\text{score} \geq 150$), with no significant difference in the average score between the two groups ($M=155$, $SD=8.9$). In addition, the 30 participants completed a language use frequency questionnaire using a 5-point Likert scale (1=never use, 5=use daily), and the results showed no significant difference in the average use frequency of L3 between the two groups ($M=2.78$, $SD=0.59$). Finally, one participant was excluded because their accuracy in the lexical decision task during the test phase did not meet the standard, resulting in 29 valid participants for Experiment 1.

2.1.2 Experimental Materials

In the preparation phase, 60 words were first selected from the 1,000 most frequently used English words (Nation, 2008), with strict matching in syllable count, word length, and usage frequency. These words were then translated into their corresponding Chinese and Korean equivalents. Six Korean majors from different grades were invited to rate the familiarity of all English and Korean words using a 5-point Likert scale (1=very unfamiliar, 5=very familiar). Finally, 48 sets of Chinese-English-Korean translation equivalents were selected, including 24 animate words (e.g., "医生 -doctor- 의사") and 24 inanimate words (e.g., "市场 -market- 시장"), which served as the common materials for both Experiment 1 and Experiment 2. Examples of the stimulus materials are shown in Table 1.

Table 1. Examples of Stimulus Materials

Vocabulary Type	Chinese	English	Korean
Animate Words	歌手	singer	가수
	医生	doctor	의사
	教授	professor	교수
Inanimate Words	照片	photo	사진
	学校	school	학교
	市场	market	시장

Prior to the formal experiment, four undergraduate Korean majors who were naive to the research hypotheses acted as independent raters to evaluate the readability and familiarity of 96 target stimuli (48 animate words and 48 inanimate words) using a 7-point Likert scale (1=extremely low readability/familiarity, 7=extremely high readability/familiarity). “Readability” was defined as “the ease of recognizing word form and understanding word meaning”, while “familiarity” was defined as “the frequency of encountering the word in daily study and life”. Paired-samples t-tests were conducted on the rating data, and the results revealed no significant differences in readability and familiarity across different stimulus subsets (e.g., studied vs. unstudied words) in the three languages (all $p>0.05$), indicating that the stimulus materials were well-balanced in their characteristics. Detailed data are presented in Table 2.

Table 2. Readability and Familiarity Ratings of Stimulus Materials in Three Languages ($M\pm SD$)

Language type	Stimulus Category	Readability ($M\pm SD$)	Familiarity ($M\pm SD$)	t-value	p-value
Chinese	Studied Words	5.82±0.61	5.91±0.58	0.83	0.412
	Unstudied Words	5.67±0.59	5.79±0.63		
English	Studied Words	5.43±0.72	5.56±0.68	0.91	0.367
	Unstudied Words	5.28±0.67	5.41±0.71		
Korean	Studied Words	5.12±0.75	5.23±0.70	0.76	0.451
	Unstudied Words	4.98±0.73	5.09±0.66		

For Experiment 1, Chinese-Korean translation equivalents were used as core materials. Additionally, 48 meaningless Chinese nonwords were constructed by modifying the radicals and strokes of real Chinese characters to serve as filler items in the test phase. The formal experiment was divided into two phases: in the study phase, 24 Korean words were presented; in the test phase, 96 Chinese stimuli were presented, including 48 nonwords and 48 experimental items. The experimental items consisted of 24 Chinese translation equivalents of the Korean words presented in the study phase and 24 Chinese translation equivalents of Korean words that did not appear in the study phase.

2.1.3 Experimental Procedure

Before the experiment, the researcher explained the task requirements to the participants and administered practice trials, emphasizing that they should respond as quickly as possible while ensuring accuracy, and that response times would be recorded. The experiment consisted of a study phase and a test phase: In the study phase, specific stimuli (e.g., Korean words) were presented to activate relevant lexical and conceptual representations—this step aimed to establish a potential priming effect for subsequent semantic processing. In the test phase, participants’ response times and accuracy were recorded and analyzed. By comparing the differences in these indicators under conditions where different materials were presented during the study phase, we verified whether the pre-activated representations in the study phase would produce cross-linguistic priming effects on the processing of target stimuli (e.g., L1 Chinese or L2 English words), thereby revealing the mechanism of L3 (Korean) semantic access mediated by L1 or L2.

Before each word presentation, a fixation cross “+” was displayed at the center of the screen for 500 ms to alert participants.

Each experimental word was presented for 2000 ms, and the trial advanced automatically after a response was made; if no response was given within 2000 ms, the trial proceeded automatically. In the study phase, participants completed a semantic categorization task, judging whether the presented Korean word referred to an animate entity. In the test phase, participants completed a lexical decision task, judging whether the presented L1 (Chinese) or L2 (English) stimulus was a real word or a nonword. The key assignment was as follows: the “J” key represented “yes” and the “F” key represented “no”.

Participants completed the experiment in a quiet environment, with each 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 2-minute interval between the two tests. Participants were not informed in advance that the language or task would change between phases.

2.2 Experiment 1b

The 30 participants who completed Experiment 1a took part in Experiment 1b one month later. During stimulus preparation, a Korean instructor recorded all auditory materials for Experiment 1b. The recordings were edited on a laptop using Cool Edit Pro 2.0 to ensure no background noise, identical left and right audio channels, and standardized acoustic parameters: 44,000 Hz sampling rate and 16-bit resolution. The experimental materials and procedure were largely identical to those in Experiment 1a, except that all stimuli were presented auditorily.

2.3 Experiment 1c

The same 30 participants who completed Experiment 1b participated in Experiment 1c one month afterward. Unlike Experiment 1b, stimuli in Experiment 1c were presented in the audio-visual bimodal condition. All other materials and procedures remained identical to those in Experiment 1b.

2.4 Experiment 2a

A separate group of 30 Korean majors from the same comprehensive university in northern China participated in Experiment 2a. Their ages ranged from 18 to 24 years, with a mean age of 19.9 ($M=19.9$). All participants were native speakers of Chinese (L1), with English as their second language (L2) and Korean as their third language (L3). Their length of English learning ranged from 12 to 16 years ($M=13.1$), and Korean learning duration ranged from 2 to 5 years ($M=3.6$).

Before the experiment, all participants completed a language background questionnaire and rated their proficiency in Chinese, English, and Korean on a 7-point Likert scale (1=very unskilled, 7=very skilled). Mean self-rated proficiency scores were 6.78 for Chinese, 4.73 for English, and 4.81 for Korean. All participants had normal or corrected-to-normal vision and normal hearing, with no sensory impairments that could affect performance. Both L2 English and L3 Korean were acquired through classroom instruction relying on declarative knowledge, and 65% of participants reported learning Korean vocabulary via English annotations. English and Korean were used in highly similar contexts, and no significant differences were found between this group and the Experiment 1 group in core variables including English proficiency and Korean learning methods, ensuring group comparability.

For L2 English proficiency, all 30 participants completed the English Level Test from the British Council and achieved CEFR Level B1 (intermediate). For L3 Korean proficiency, all passed TOPIK Level 4 (score ≥ 150), with a mean score of 153 ($SD=8.5$), showing no significant difference from the Experiment 1 group. Participants also completed a 5-point language use frequency questionnaire (1=never use, 5=daily use), revealing no significant between-group difference in L3 use frequency ($M=2.75$, $SD=0.56$).

Experiment 2 used the same English-Korean translation equivalents as Experiment 1. Additionally, 48 English nonwords that conformed to English orthographic rules were created by rearranging letter strings from the 1,000 most frequent English words (Nation, 2008) and served as filler items. The procedure mirrored that of Experiment 1: 24 Korean words were presented in the study phase, and 96 English stimuli (48 nonwords and 48 experimental items) in the test phase. The experimental items consisted of 24 English translation equivalents of studied Korean words and 24 equivalents of unstudied Korean words. The experimental procedure was identical to Experiment 1a, except that participants performed lexical decision on English targets in the test phase.

One participant was excluded due to outlying average response times, leaving 29 valid participants for Experiment 2.

2.5 Experiment 2b

The 30 participants who completed Experiment 2a took part in Experiment 2b one month later. A Korean instructor recorded all auditory stimuli, which were then edited using Cool Edit Pro 2.0 to eliminate noise, equalize left and right channels, and standardize parameters to 44,000 Hz and 16 bits. Materials and procedures were identical to Experiment 2a except for auditory presentation of all stimuli.

2.6 Experiment 2c

The same 30 participants who completed Experiment 2b participated in Experiment 2c one month later. Stimuli were presented in the audio-visual bimodal condition; all other materials and procedures were identical to Experiment 2b.

3. Results and Analyses

Prior to data analysis, participant exclusion criteria were established to ensure data validity: (1) Participants who failed to complete the entire experimental procedure or provided incomplete language background information were excluded; (2) Participants with accuracy lower than 85% in the lexical decision task during the test phase or lower than 70% in the semantic categorization task during the study phase were regarded as not having effectively completed the tasks and excluded; (3) For correct response latencies in the test phase, trials with RTs shorter than 200 ms or longer than 2000 ms were discarded, and participants whose mean RTs fell outside ± 2 standard deviations of the overall valid data were excluded; (4) Data from participants with logical inconsistencies in the language background questionnaire were excluded.

Based on the above criteria, one participant was excluded from Experiment 1 and one from Experiment 2, leaving valid complete data from 58 participants (29 in Experiment 1 and 29 in Experiment 2), ensuring the reliability and validity of the data. All statistical analyses were performed using SPSS 22.0.

3.1 Results of Experiment 1

Table 1 presents the mediating effect of L1 Chinese on L3 Korean semantic access under the visual, auditory, and audio-visual bimodal conditions. Paired-samples t-tests revealed significant differences in response latencies between Chinese translation equivalents of studied Korean words and unstudied Korean words across all three conditions (visual: $t(422)=-2.172$, $p=0.03 < 0.05$, Cohen's $d=0.21$; auditory: $t(393)=-2.222$, $p=0.027 < 0.05$, Cohen's $d=0.22$; audio-visual: $t(436)=-2.252$, $p=0.025 < 0.05$, Cohen's $d=0.21$). No significant differences in accuracy were observed under any condition (visual: $t(438)=0.543$, $p=0.76 > 0.05$; auditory: $t(409)=0.279$, $p=0.59 > 0.05$; audio-visual: $t(452)=0.247$, $p=0.56 > 0.05$).

Cross-linguistic repetition priming effects emerged in all three conditions, indicating that participants automatically activated the corresponding Chinese translation equivalents when performing semantic judgments on Korean words in the study phase. This activation facilitated faster responses during the lexical decision task for Chinese targets in the test phase. These results suggest that L1 Chinese exerts a facilitative effect on L3 Korean semantic access.

Table 3. Reaction Times and Accuracy for L1 Chinese Lexical Decision Under Three Modality Conditions

Experiment	Modality Type	Condition	Reaction Time(ms)	Accuracy(%)
1a	Visual Modality	Studied	546.28	98.6
		Unstudied	581.73	98.3
		Priming Effect	35.45	0.3
1b	Auditory Modality	Studied	382.65	97.5
		Unstudied	429.31	97.0
		Priming Effect	46.66	0.5
1c	Audio-Visual Bimodal Modality	Studied	298.41	99.5
		Unstudied	336.85	99.2
		Priming Effect	38.44	0.3

A one-way analysis of variance (ANOVA) conducted on the priming effects revealed no significant difference across the three modality conditions ($F=0.022$, $p=0.979$, $\eta^2=0.001$). Furthermore, post-hoc comparisons indicated no significant differences in priming effects between any pair of modalities (Visual vs. Auditory: $F=-3.39$, $p=0.987$; Visual vs. Audio-Visual: $F=-4.17$, $p=0.979$; Auditory vs. Audio-Visual: $F=-0.78$, $p=0.999$). Collectively, these results demonstrate that the mediating role of L1 Chinese in L3 (Korean) semantic access remains consistent across the visual, auditory, and audio-visual bimodal presentation conditions.

3.2 Results of Experiment 2

Table 2 presents the mediating effect of L2 English on L3 Korean semantic access under the visual, auditory, and audio-visual bimodal conditions. Paired-samples t-tests revealed a significant difference in response latencies between English translation equivalents of studied Korean words and unstudied Korean words only under the visual modality ($t(405)=-4.418$, $p < 0.001$, Cohen's $d = 0.43$), indicating a clear cross-linguistic repetition priming effect. In contrast, no significant differences in response latencies were observed under the auditory modality ($t(392)=-1.562$, $p=0.120$, Cohen's $d=0.15$) or the audio-visual bimodal modality ($t(416)=-1.437$, $p=0.151$, Cohen's $d=0.14$), and no reliable priming effects emerged in these two conditions. Accuracy rates did not differ significantly across any of the three modalities (visual: $t(421)=0.001$, $p=0.999$; auditory: $t(408)=0.698$, $p=0.486$; audio-visual: $t(432)=0.002$, $p=0.998$).

A one-way ANOVA conducted on the priming effects revealed a significant difference across the three modality conditions ($F=4.216$, $p=0.016$, $\eta^2=0.02$). Post-hoc comparisons showed that the priming effect in the visual modality was significantly stronger than that in the auditory modality ($p=0.012$) and the audio-visual bimodal modality ($p=0.009$), while no significant difference was found between the latter two modalities ($p=0.783$). These results indicate that the mediating role of L2 English in L3 Korean semantic access is only significant under the visual modality, and is negligible under the auditory and audio-visual bimodal modalities.

Table 4. Reaction Times and Accuracy for L2 English Lexical Decision Under Three Modality Conditions

Experiment	Modality Type	Condition	Reaction Time(ms)	Accuracy(%)
1a	Visual Modality	Studied	722.58	96.3
		Unstudied	830.14	95.7
		Priming Effect	107.56	0.6
1b	Auditory Modality	Studied	415.37	93.5
		Unstudied	438.62	92.9
		Priming Effect	23.25	0.6
1c	Audio-Visual Bimodal Modality	Studied	310.84	99.2
		Unstudied	329.59	98.6
		Priming Effect	18.75	0.6

3.3 Further Analyses

A subsequent one-way ANOVA revealed a significant difference in priming effects between L1 Chinese and L2 English only under the visual modality ($F=9.617$, $p=0.002$, $\eta^2=0.04$), with L2 English showing a stronger priming effect. In contrast, no significant differences were observed in the auditory modality ($F=1.124$, $p=0.291$) or the audio-visual bimodal modality ($F=0.048$, $p=0.826$). These results indicate that the advantage of L2 English mediation is specific to the visual modality, while L1 Chinese mediation remains more stable in the auditory and audio-visual modalities.

To rule out potential confounding variables, Pearson correlation analyses were conducted between visual modality priming effects and two covariates: English proficiency (CEFR level) and self-reported frequency of exposure to English-Korean loanwords (rated on a 5-point scale, $M=3.12$, $SD=0.68$). The results showed no significant correlation between English proficiency and priming effects ($r=0.18$, $p=0.31$), nor between loanword exposure frequency and priming effects ($r=0.22$, $p=0.24$). This suggests that the observed advantage of L2 mediation is not attributable to differences in proficiency or

loanword exposure, but primarily stems from similarities in learning contexts.

4. Discussion

4.1 L1 Semantic Mediation in L3 Access

Experiment 1 was designed to examine whether L1 Chinese serves as a mediator during the semantic access of L3 Korean. The results revealed significant response time differences between Chinese translation equivalents of studied Korean words and those of unstudied Korean words in the lexical decision task. This pattern indicates that participants relied on L1 Chinese mediation when accessing the meanings of L3 Korean words.

The present findings are consistent with previous trilingual processing research. Li et al. (2008) observed L1 Chinese mediation in L3 access among Chinese–English–Japanese and Chinese–English–French trilinguals. Rebiguli Baikeli et al. (2012) found that L1 Uyghur mediated L2 English lexical comprehension in Uyghur–Chinese–English trilinguals. Using a masked translation priming paradigm, Aparicio & Lavour (2015) reported L1 French priming effects on L3 Spanish lexical selection. Li et al. (2016) detected facilitative effects of L1 Indonesian on L3 Chinese semantic access in Indonesian–English–Chinese trilinguals under both visual and auditory modalities. Chen et al. (2018) demonstrated that even with high L2 Chinese proficiency, L3 English semantic access still depended on L1 Tibetan mediation. Similarly, Chen & Wang (2020) found stable L1 Chinese mediation for L3 German across visual, auditory, and bimodal conditions, with no significant modality differences in priming effects.

The mediating role of L1 in L3 semantic access can be attributed to the consolidation effect of native language status. According to the Critical Period Hypothesis, there exists an optimal sensitive period for language acquisition, during which learning is most effective before cerebral functional lateralization is complete. Second language learning initiated after age 6–7 is strongly constrained by L1 consolidation, such that learners typically access L2 meaning via an L2–L1 translation route. Only as L2 proficiency increases does L1 reliance weaken, allowing direct L2 semantic access to develop gradually. This mechanism extends to L3 acquisition: when L3 proficiency remains at an intermediate level, L1 consolidation remains dominant, forcing L3 semantic access to proceed through L1 mediation.

4.2 L2 Semantic Mediation in L3 Access

Experiment 2 was designed to investigate whether L2 English mediates the semantic access of L3 Korean. The results showed significant response time differences between English translation equivalents of studied Korean words and unstudied Korean words in the lexical decision task, indicating that participants also relied on L2 English mediation when accessing the meanings of L3 Korean vocabulary.

The present findings are partly consistent with previous research. Wang et al. (2010) examined the role of L2 English in L3 semantic access among late proficient Chinese–English bilinguals, with Japanese and French as the target L3s. Their results revealed no L2 mediation for L3 Japanese, but clear L2 mediation for L3 French. Based on this pattern, the researchers proposed that L2 serves as a mediator in L3 semantic access when L2 and L3 are genetically related. Li et al. (2016) focused on the modulating role of presentation modality and found significant facilitative effects of L2 English on L3 Chinese semantic access in the visual modality, but not in the auditory modality, suggesting that presentation modality regulates L2 mediation in trilingual processing. In addition, Chen et al. (2018) found that highly proficient Tibetan–Chinese bilinguals relied on L2 Chinese rather than L1 Tibetan to access L3 English semantics. Chen & Wang (2020) further observed L2 English mediation for L3 German across three modalities, with the strongest priming effect in the visual modality.

This pattern can be interpreted within the framework of the Second Language Dominance Model (Bardel & Falk, 2012). According to this model, L1 acquisition is essentially procedural, occurring spontaneously in naturalistic contexts. In contrast, both L2 and L3 acquisition are declarative, typically acquired through formal classroom instruction, resulting in higher similarity in learning contexts and knowledge types. Due to this similarity, learners tend to use L2 as a mediating device for activating and retrieving L3 semantics.

The present study further revealed that the mediating effect of L2 English was stronger than that of L1 Chinese. This suggests that the similarity between L2 and L3 acquisition outweighs the native language status of L1. Although English and Korean belong to different language families, English functions as a global lingua franca and has developed stronger automatic

activation and associative strength in learners' cognitive processing. In contrast, Chinese and Korean are typologically distant and differ substantially in linguistic features. These differences in language typology and learning experience jointly contribute to the significantly stronger mediation effect of L2 English.

4.3 Modality Effects in Trilingual Semantic Access

Vision and audition are the primary modalities through which humans acquire external information. Previous research indicates that 77% of information is received via the visual modality, 14% via the auditory modality, and the remaining 9% through other perceptual channels (Wu & Zhu, 1997). This clearly demonstrates that vision is the dominant input modality, followed by audition.

Results from Experiment 1 of the present study showed that L1 Chinese mediated L3 Korean semantic access consistently across the visual, auditory, and audio-visual bimodal conditions, with no significant differences in priming effects among the three modalities. This pattern aligns with findings from Li et al. (2016) and Chen & Wang (2020), both of whom reported that L1 mediation remains stable regardless of presentation modality. The robust lexical-conceptual connections of the native language can be activated reliably across perceptual formats, providing consistent support for L3 semantic access. This further confirms the unique advantage of L1: as participants' most proficient language, Chinese had achieved balanced development in both auditory and visual processing, such that modality differences exerted no significant influence on its mediating role.

In contrast, results from Experiment 2 revealed a clear modality-specific constraint on L2 English mediation. Significant cross-linguistic repetition priming emerged only in the visual modality, with the strongest priming effect observed in this condition. No reliable priming effects were found in either the auditory or audio-visual bimodal conditions. This pattern is consistent with Li et al. (2016) but diverges from Chen & Wang (2020), who reported significant L2 English priming for L3 Korean even in the auditory modality.

The discrepancy may be attributed to differences in language distance, phonological relatedness, and L2 proficiency across studies. In Chen & Wang (2020), L2 English and L3 German are both Indo-European languages with close genetic proximity, sharing considerable similarities in morphology and phonology, allowing phonological activation to facilitate semantic access in the auditory modality. In the present study, however, English and Korean belong to distinct language families with distant typological distance and highly divergent phonological systems, resulting in weak auditory associations between L2 and L3. Li et al. (2016) similarly noted that English and Chinese are genetically unrelated, and when L2 proficiency is not sufficiently high, L2 English fails to produce significant cross-linguistic priming for L3 Chinese in the auditory modality. Accordingly, no auditory L2 mediation effect was observed in the present study. Furthermore, participants in Chen & Wang (2020) possessed higher L2 English proficiency and greater automaticity in phonological processing, which also supported observable priming in the auditory modality.

5. Conclusion

The present study recruited 60 Chinese–English–Korean trilinguals and adopted a cross-linguistic repetition priming paradigm under visual, auditory, and audio-visual bimodal conditions to investigate the mediating roles of L1 Chinese and L2 English in L3 Korean semantic access and related modality effects. The results revealed the following: L1 Chinese exerted a stable mediating effect on L3 Korean semantic access across all three modalities, with no significant differences in priming effects among conditions; The mediating effect of L2 English was modality-specific, emerging significantly only in the visual modality, where its priming effect was significantly stronger than that of L1 Chinese; Under the visual modality, priming effects differed significantly between L1 Chinese and L2 English, with a stronger effect for L2 English, whereas no significant difference was observed in either the auditory or audio-visual bimodal conditions.

This study has several limitations, and future research can be expanded in three directions. First, the participant pool can be enlarged to include ethnic Korean trilinguals in China to explore the moderating boundaries of language acquisition order on modality effects and verify the generalizability of the present findings across different populations. Second, a wider range of stimulus materials can be adopted, including native Korean words, low-frequency words, and technical vocabulary, to reduce interference from English loanwords and further clarify the effect of language distance. Third, neurolinguistic techniques such

as ERP and fMRI can be integrated to reveal modality differences in trilingual semantic access at the neural level, providing more in-depth physiological evidence for multilingual cognitive research and promoting the study of cross-family trilingual semantic mechanisms toward greater precision and multidimensionality.

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