Lexical tone in word activation

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Summary

It is widely acknowledged that speakers or listeners co-activate multiple-word candidates during lexical access. While this conclusion is primarily drawn from empirical evidence in stress languages such as English, it is essential to note that the majority of the world's languages are tonal languages, utilizing lexical tones to distinguish word meanings. Consequently, the nature of lexical access in tonal languages, like Standard Chinese, remains to be fully understood. For instance, the relative weighting and timing of utilizing segments versus lexical tone and the role of lexical tone in activating lexical candidates during the process of Mandarin spoken word recognition have remained controversial.

Complicating matters, many tonal language speakers are bilinguals. Given that bilinguals have been found to activate words from both of their languages during lexical access, a crucial question arises regarding the role of lexical tone in bilingual language co-activation. For instance, for bilinguals with two tonal systems, it is unclear whether both tonal systems are co-activated or interact during lexical access, and if so, how potential lexical conflicts are resolved.

Therefore, for a more comprehensive understanding of lexical access, it is necessary to consider the role of lexical tone in both native and bilingual lexical access. This dissertation aims to address this gap by delving into the process of spoken word recognition and production. It focuses on three groups of tonal speakers: native speakers of Standard Chinese, bi-dialectal speakers of both Standard Chinese and Xi'an Mandarin, and bilingual speakers of Standard Chinese and English. Four key issues were highlighted: the role of lexical tone in Mandarin spoken word recognition; tonal interference in bi-dialectal spoken word recognition; the activation of lexical tone in bilingual spoken word production; and the influence of lexical tone on the bilingual mental lexicon.

This dissertation is composed of six chapters.

Chapter 1 introduced the research questions to be explored and offered a succinct preview of each succeeding chapter.

Chapter 2 aimed to investigate the role of lexical tone in Mandarin spoken word recognition. Specifically, we examined the role of segmental syllable and sub-syllabic constituents, as well as the time course of using segmental and suprasegmental tonal information during Mandarin lexical processing. In Experiments 1 and 2, native Standard Chinese speakers listened to monosyllabic Standard Chinese words with the presence of a phonological competitor, which overlaps with the target in either segmental syllable, onset and tone, rhyme and tone, or just tone. Experiments 1 and 2 differ in how long listeners were allowed to preview pictures on the screen before hearing the spoken target word. Eye movement results of both Experiments 1 and 2 confirmed a robust competition effect of segmental syllable overlap competitors, and null effects of onset, rhyme and tone overlap distractors. Experiment 3 investigated the time course of segmental versus tonal information utilization by manipulating their point of divergence in acoustic cues. We found that both sub-syllabic information (i.e., segment vs. tone) and cue timing (i.e., early vs. late point of divergence) affect phonological competition effects. Regardless of the nature of the cues, the point of divergence determines the size and time course of the competition effect: the earlier the point of divergence, the sooner the competition, suggesting that despite the dominant role of the segmental syllable, Mandarin listeners use both segmental and tonal information as soon as they are available to constrain lexical activation.

Chapter 3 aimed to enhance understanding of tonal interference in bi-dialectal spoken word recognition. Specifically, we investigated the process of spoken word recognition in bi-dialectal speakers of Standard Chinese and Xi'an Mandarin. Using the eye-tracking visual world paradigm, we asked Standard Chinese and Xi'an Mandarin bi-dialectals to listen to sentences in one dialect and identify the target word among four Chinese characters shown on the screen. The characters included the target, two unrelated distractors, and a phonological

competitor which shared the same segmental syllable with the target within- and across dialects. Among the phonological competitors, besides segmentally overlapping distractors which do not share lexical tone with the target within and across dialects (Segment Condition), there were also cross-dialect homophone competitors that share the same lexical tone with the target across dialects (Homophone Condition) and translation-induced cross-dialect homophones that share the same lexical tone with the targets' dialectal translation equivalent (Translation Condition). We hypothesized that, if both sets of lexical tones are activated, the Homophone and Translation Condition would elicit larger competition effects than the Segment Condition; if only one set of lexical tones is activated, the Segment Condition would elicit the largest competition effects, because the tonal contours of the target and competitor of the Segment Condition share the most acoustic similarity. Listeners' eye movements show that distractors in the Segment Condition interfere with participants' eye fixations significantly more than in Homophone and Translation Conditions, suggesting a lack of cross-dialectal interference effect. This finding marks a convergence between bi-dialectal and bilingual speech processing. Based on these findings, a preliminary model of bi-dialectal spoken word recognition which emphasizes active control of dialect activation was proposed.

Chapter 3 aimed to explore the activation of lexical tone in bilingual spoken word production by examining the role of lexical tone in non-tonal spoken word production with bilinguals of Standard Chinese and English. Specifically, we asked: if Standard Chinese and English bilinguals co-activate both Standard Chinese and English names during English word production, is lexical tone co-activated and utilized during the process? With four picture-word interference experiments, Standard Chinese and English bilingual speakers were instructed to name pictures in English (e.g., *feather*) while ignoring four types of simultaneously presented Standard Chinese distractors: 1) the translation distractor, which is the translation equivalent of the English target name (e.g., *yu3mao2* "feather"); 2) the tone-sharing distractor, which shares both tone and

segments with the Standard Chinese translation in the first syllable (e.g., *yu3zhou4* "universe"); 3) the no-tone-sharing distractor, which shares segments only with the Standard Chinese translation in the first syllable (e.g., *yu4mi3* "corn"); 4) the unrelated distractor, which shares no phonological overlap with target and its translation (e.g., *lei4shui3* "tear"). To further explore potential factors that may constrain the lexical tone effect, we also manipulated two additional factors that have been found to affect picture naming onset with the picture-word interference paradigm. One was distractor modality: the Standard Chinese distractors were presented either auditorily or visually. The other was familiarization mode: bilinguals were asked to familiarize themselves with the target pictures' English names only (i.e., English mode) or both English and Standard Chinese names (i.e., mixed mode). In Experiment 1 (with auditory distractor and English mode), translation distractors significantly facilitated bilingual English picture naming, while tone-sharing distractors significantly inhibited the process. Importantly, the tone-sharing distractors elicited significantly longer naming latency than the no-tone-sharing distractors, demonstrating the co-activation of lexical tone during English spoken word production. Overall, this study replicated previously found translation facilitation effect and observed a significant interference effect of lexical tone. These findings suggest that Standard Chinese and English bilinguals not only co-activate the Standard Chinese translation equivalents but also the lexical tones of the Standard Chinese translations during English spoken word production. Results of Experiments 2, 3 and 4 further demonstrated that the polarity and robustness of the lexical tone effect are modulated by external factors such as distractor modality and familiarization mode.

Chapter 5 aimed to explore the influence of lexical tone on the bilingual mental lexicon. Specifically, we asked whether and to what extent lexical tone modulates pitch processing in non-tonal speech production with Standard Chinese and English bilinguals. Using the picture-word interference paradigm, we asked Standard Chinese and English bilinguals and native English monolinguals to name pictures in English (e.g., *lung*) while ignoring simultaneously played

Standard Chinese cross-language homophones that either have a falling or a rising lexical tone (*lang4* with a falling tone, "wave"; *lang2* with a rising tone, "wolf"). We hypothesized that if lexical tone indeed influences bilinguals' pitch representation in non-tonal second languages, the effect of lexical tone (falling vs. rising) on English picture naming should differ between Standard Chinese and English bilingual and English monolingual speakers. Results showed that, compared with unrelated Standard Chinese distractors, both falling and rising cross-language homophones facilitated English word naming for both Standard Chinese-English bilingual and English monolingual speakers. Most importantly, Standard Chinese-English bilinguals showed significantly longer naming latencies with falling-tone in cross-language homophones than their rising-tone counterparts, whereas English monolingual speakers did not show such a pattern. This finding identified a significant difference between Standard Chinese-English bilinguals and English monolinguals in terms of how falling versus rising lexical tones affect English picture-word naming, providing evidence for the interaction between bilinguals' two languages at the suprasegmental level.

Chapter 6 reviewed the research questions and main findings of each study in this dissertation. Furthermore, implications for future research were discussed in this chapter.

In summary, this dissertation has demonstrated the significant role of lexical tone during native and bilingual lexical access. In Mandarin spoken word recognition, despite the advantageous role of the segmental syllable, lexical tone is employed as soon as it becomes available to constrain word activation. Bi-dialectal listeners of two closely related Mandarin dialects are able to control tonal-induced lexical interference, suggesting dynamic interaction between tonal systems. In bilingual spoken word production, Mandarin and English bilinguals automatically activate the lexical tones of the Standard Chinese translation equivalents during English spoken word production. Moreover, the pitch processing difference during English spoken word production between Mandarin-English bilinguals and English monolinguals suggests that lexical tone may play

an important role in the mental lexicon of bilinguals. Altogether, this dissertation enhances our understanding of lexical access by providing evidence on the role of lexical tone during spoken word recognition and production within- and across languages.