# English loanwords in Mandarin Chinese: A perception experiment approach

Mingzhe Zheng and Karthik Durvasula
*Michigan State University*

In the field of Mandarin Chinese (MC) loanword study, there is no consensus among researchers about tonal adaptation patterns. The purpose of the current study is to re-examine the syllable onset effect in MC native speakers' online adaptation of English words. We suggest that there is a difference in the patterns that are observed in established loanwords with settled orthography in MC and those that are observed in online adaptation tasks. Furthermore, we show that bilinguals are more sensitive to the phonetic characteristics of the source words than monolinguals.

## 0. Introduction

In the field of Chinese loanword phonology, studies have typically focused on segmental adaptation or phonotactic adaptation (e.g. Yip 1993 for Cantonese; Miao 2005, Lin 2008 for Mandarin). A smaller number of studies have also been conducted on suprasegmental adaptation: stress-to-tone adaptation (e.g. Kiu 1977, Silverman 1992, Yip 2006 for Cantonese, Wu C. 2006, Wu H. 2006, Chang & Bradley 2012 for Mandarin); tone-to-tone adaptation (Hsieh and Kenstowicz 2008 for Lhasa Tibetan). Several of these studies, both corpus-based (Wu H. 2006) and experimental (Wu H. 2006, Chang & Bradley 2012) have reported an effect of syllable onset in the source word on the adaptation to a Mandarin Chinese (MC) tone produced in the borrowing.

The goal of the current study was to test for this syllable onset effect in MC native speakers' online adaptation of English words into MC. Participants were presented with disyllabic English nonce words, and required to select the tones they felt would most naturally be used if the words were borrowed into MC. The results of the experiment contradict those of the earlier studies, insofar as the syllable onset in the source word is not as much of a predictor of adaptation as has been claimed. Furthermore, MC tone selection was found to be strongly biased among bilingual participants towards High-level tone, while monolingual MC participants exhibited a wider range of tone selections. The possible motivations for these results are discussed in the paper.

Following the above brief introduction, Section 1 introduces MC tone system; Section 2 provides a literature review of syllable-to-tone adaptation; Section 3 describes the experiment design; Section 4 provides the results of our experiment and discussion. A general discussion and a conclusion comprise the last two sections of this paper.

## 1. Basics of MC phonology

The maximum syllable structure of MC is CGVX, where C = consonant, G = glide, V = vowel or syllabic consonant, X = V or C. The minimum syllable is V (Lin 2008). As we can see from Table 1, MC is a tone language. Each MC syllable must bear one tone. As a result, tonal adaptation is needed for MC loanwords borrowed from English, which is not a tone language. In order to sound like a MC word, each loanword from English has to be assigned a tone for each syllable, as will be shown in Table 2.

In Table 1, each of the columns is one of the four tones in MC. The first column is High-level tone, the second column is Rising tone, the third column is Low tone, and the fourth column is a Falling tone. (a) gives one example of each tone in MC *Pinyin* with tone feature[1]. (b) is MC *Pinyin* with Chao digits (1930), where 5 represents the highest pitch and 1 the lowest. (c) is MC *Pinyin* with a tonal diacritic marked above the main vowel to indicate the pitch movement; this diacritic also called a 'tone marker'. (d) provides one example of each tone represented by its MC character with an English gloss. I will use convention (a) for convenience of discussion in this paper, although we used those tone markers in (c) as response options for participants in the experiments, since it is the most familiar convention for the MC-speaking layman.

Table 1.Tone system of MC

| | Tone-1(High-level) | Tone-2(Rising) | Tone-3(Low) | Tone-4(Falling) |
|---|---|---|---|---|
| a. | maHH | maMH | maL | maHL |
| b. | ma55 | ma35 | ma214 | ma51 |
| c. | mā | má | mǎ | mà |
| d. | 妈*'mum'* | 麻*'hemp'* | 马*'horse'* | 骂*'to scold'* |

In Table 2, the bolded tone in each MC syllable is the tone of MC loanword used to adapt English stressed syllables. For the rest of this paper, we will focus on the adaptation of English stressed syllables, which is also all the previous literatures have concentrated on. We will leave the analysis of unstressed syllables for future studies.

Table 2. Examples of tonal adaptation of English loanwords in MC

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| a. | bandage | pəŋ**HH** | taiHL | *绷带* | b. | Maryland | ma**L** | lɪL | lanMH | *马里兰* |
| c. | radar | lei**MH** | taMH | *雷达* | d. | hertz | xɤ**HL** | | tsɿHH | *赫兹* |

(Source: Hanyu Wailaici Cidian, [A dictionary of loan words and hybrid words in Chinese]. 1984)

The next section will provide a literature review of loanword tonal adaptation studies.

[1] Following Yip (1980) and many other works in Chinese phonology, I represent tones with the features H (high), M (middle) and L (low). Contour tones are represented as feature combinations.

## 2. Previous studies of loanword tonal adaptation

In the current study, we restrict our discussion of tonal adaptation of loanwords into MC to (i) loanwords from English and (ii) stressed syllables. The tonal adaptation pattern in MC loanwords from English is more complicated than it is for Cantonese loanwords from English (Silverman 1992, Yip 2006). Any of the four tones in MC can be used in adaptation and there is no consensus among researchers about what the expected tonal adaptation pattern is, or what accounts for the various patterns.

For example, two corpus studies both find that HH is the most frequently used tone for English stressed syllable adaptation (Wu H. 2006, Wu C. 2006). One discrepancy between the two studies is that, in Wu H. (2006), for initial stressed syllable of English disyllabic words, MH is the next most frequent choice for adaptation; while in Wu C. (2006), it is HL that is the second most frequent tone after HH

The contradiction in the generalizations made by Wu C. and Wu H. might stem from their different data collection methods, different sources for loanword examples, and different operationalization of 'loanword'.

### 2.1 My corpus study

Given the discrepancy of the Wu C. and Wu H. corpus studies, we decided to conduct our own corpus analysis. Person name was included in our corpus, to see what kind of tone patterns this category of words would have, assuming it is true that it was greatly influenced by orthography and semantics compared with other categories of loanwords (Wu H. 2006). And in order to see if the difference in word category has different tonal adaptation pattern, the loanwords we collected are listed separately by category.

As shown in Table 3, categories B and D are common nouns and place names that we collected from *汉语外来词辞典* ([A dictionary of Chinese loanwords], 1990), and *外国地名译名手册* ([A handbook to foreign geographical names], 1993). Category E, comprises personal names collected from *A list of Common British and American Names* (*New English Chinese Dictionary* 1988).

What we can find in Table 3 is that: (i) Despite the shortcomings of Wu H's study, overall the likelihood of each MC tone being used to adapt an English stressed syllable is the same in both her corpus and ours (A & B). (ii) Though the word categories of Wu C's corpus are unknown, it appears to pattern with our place name corpus (C & D). (iii) Personal names and place names do indeed have a different likelihood ranking than common nouns (D & E), suggesting that Wu H. might have been right to exclude them from her corpus. Existing loans, especially place names and personal names can have been shaped based on authorities' advice. For example, one of the responsibilities of the Ministry of Civil Affairs is to "formulate plans for translating place names in foreign

countries into Chinese script"[2]; the Chinese state press agency, Xinhua News Agency, publishes official translation of foreign personal names to regulate it[3].

Table 3. Category of words and tonal adaptation pattern

| | | Type of loanword | Number of loanword | Tonal adaptation pattern |
|---|---|---|---|---|
| **A.** | **Wu H. (2006)** | Common nouns | 102 | MH > HH > L > HL |
| **B.** | **Our own corpus** | | 52 | |
| **C.** | **Wu C. (2006)** | Unknown | 502 | HH > HL > MH > L |
| **D.** | **Our own corpus** | Place name | 25 | |
| **E.** | | Personal name | 1931 | HL(35%) > HH(30%) > MH(23%) > L(12%) |

Overall the rankings in Table 3 support Kang's (2010) claim that tone languages prefer some variant of a high tone in adapting stressed syllables, and Low tone is clearly dispreferred. However, tone preference is at least partially conditioned by the word category: common nouns or proper name. But other claims have been made about the constraints on tone preference, principally the effect of syllable onset, which will be discussed in the following section.

**2.2 Onsets' influence on tonal adaptation**

Despite the different perspective on MC loanword tonal adaptation pattern, however, as with LT loanword adaptation (Hsien and Kenstowicz 2008), MC loanword adaptation has been reported to exhibit a similar pattern insofar as the onset has an influence on tonal preference: a MH tone tends to be realized if the loanword has a sonorant and aspirated onset; while a loanword with an unaspirated obstruent onset tends to have a HH tone (Wu H. 2006). Wu H. suggests that aspirated onsets might have a "lowering effect" on tones while the unaspirated ones do not. So if consonant aspiration, like voicing does in other languages (Beach 1924 in Xhosa, Bradshaw 1999 in Siswati), affects and lowers the F0 of the following vowel, it functions as a tonal depressor in MC as well. Though there is no consensus on the effect of aspiration on the fundamental frequency of adjacent vowels yet. Evidence from Germanic languages (Iverson and Salmons 1995), Korean (Han and Weitzman 1970), Thai and Japanese (Ewan 1976) tell

[2] Retrieved from: http://wiki.china.org.cn/wiki/index.php/Ministry_of_Civil_Affairs on 10/21/2014.

[3] The website where Xinhua News Agency regularly update its official translation for personal names: http://news.xinhuanet.com/ziliao/2007-07/26/content_6432574.htm.

us that an aspirated consonant raised the F0 of the adjacent vowel. In MC, experimental study of consonant aspiration on Mandarin tones found that the F0 of a tone is higher following unaspirated consonants than following aspirated consonants (Xu and Xu 2003).

Cross-linguistic corpus studies of loanword tonal adaptation including Hsieh and Kenstowicz (2008) for LT and Wu H. (2006) for MC tell us that the onset type has an impact on loanword tonal adaptation pattern, as shown in Table 4.

Table 4. Source language onset type and loanword tonal adaptation

| | | **MC** | **LT** |
|---|---|---|---|
| **obstruent** | [-asp] | HH | High tone |
| | [+asp] | MH | |
| **sonorant** | [son] | MH | Low tone |

(Derived from Wu H. 2006 for MC, and Hsieh & Kenstowicz (2008) for LT)

In our own corpus study of personal names, we also found the influence of onset type on tonal adaptation (as shown in Table 5), which is consistent with Wu H. (2006).

Table 5. Onsets' influence in 1203 MC Loanwords of English personal names[4]

| | HH | MH | L | HL |
|---|---|---|---|---|
| [-asp] | **70%**(413) | 18%(78) | 57%(136) | (54%)357 |
| [+asp] | 26%(152) | **37%(163)** | 22%(53) | 15%(101) |
| [son] | 4%(23) | **45%(198)** | 21%(50) | 31%(207) |
| Total | 588 | 439 | 239 | 665 |

**2.3 Experimental Research**

To confirm the connection between onset consonant and tonal assignment, besides a corpus study, Wu H. (2006) conducted a forced-choice experiment in which 15 native Mandarin-speaking participants from Taiwan[5] were asked to listen to English nonsense words, and then instructed to choose the closest adaptation of it between two choices different in tones written in the form of Chinese characters. The overall results of the onset type's influence on tonal adaptation are presented in Table 6.

[4] Only 1203 out of the 1931 personal name loanwords (Table 5) were included for this analysis since the rest of loanwords of this type were onsetless syllables. Only personal names are analyzed here due to the small amount of data we have for common nouns and place names.

[5] Though some studies have found that Taiwan Mandarin tones are produced in a lower register than those produced in mainland China (Fon & Chiang 1999, Richard 2005): represented by Chao digits from tone 1 to tone 4 as 44, 323, 312, and 42, it is relatively the same pattern as MC tone register which are 55, 35, 214, 51, for tone 1 to tone 4 respectively. The dialect difference between Taiwan Mandarin and mainland China Mandarin will not be considered here.

Table 6. Onsets' influence on MC tonal adaptation in Wu (2006)

| | | **HH** | **MH** |
|---|---|---|---|
| **A.** | **[-asp]** | **63%** (150) | 37%(90) |
| **B.** | **[+asp]** | 46% (165) | **54%** (195) |
| **C.** | **[son]** | 37.5% (135) | **62.5%** (225) |

(Adapted from Wu H. 2006: 243)

In Table 6, participants showed an obvious preference for MH and HH with sonorant and [-asp] onsets respectively, though the inclination towards MH for words with [+asp] onsets was not so conspicuous at only 54%. Wu H. (2006: 243) reports that the distribution of tone choices across onset types was unlikely to have arisen by chance, as shown by Fisher's Exact Test. However, if we look at the table it appears that the preference for MH in [+asp] syllable is weak, suggesting that listeners had no significant preference for either HH or MH. It is the [-asp] and sonorant onsets that appear to trigger tone selection preferences.

The interaction between obstruent aspiration and the following F0 that was discussed in Xu and Xu (2003) shows that the onset F0 of a MC tone is lowered when following a [+asp] obstruent, while it is comparatively higher when following a [-asp] obstruent. Wu H. claims that MC participants can perceive this difference in stressed syllables and adapt them into MH and HH tones accordingly. Participants' responses replicate the tonal assignment tendency found in the loans in her corpus study (Table 5).

Chang and Bradley (2012) also conducted an experiment to elicit MC speakers' spontaneous and "immediate adaptations" of English nonsense words, rather than presenting them with forced choices. The results of Chang and Bradley's experiment are: (i) in "live" adaptation data, unlike in previous corpus studies, HL was favored above HH (cf. Wu H. 2006). (ii) The preference for HL increases when it is the second syllable in a disyllabic word bears the primary stress, σ'σ, cf. 'σσ. (iii) The preference for MH rises if the onset is [+asp] consonant and [son].

### 2.4 Limitations of prior experimental studies

Our concerns for the previous two experiments are as follow. For Wu H. (2006): (i) only two possible Chinese loans for each stimulus were provided in the experiment options (loans with HH and MH tones), which narrowed participants' choices. (ii) Chinese characters were used for the forced-choice adapted forms, which might bring about participants' preference for a particular character based on semantic and/or orthography considerations, e.g. to adapt the stressed syllable for English word *radar*, if two MC characters were given as option: (a).勒'strangle', which is the only character with [lei] segmental combination and HH tone; (b).雷'thunder', which has MH and is the only commonly used character with [leiMH]. The choice of (b) might just due to semantic reason rather than the impact of onset type: (a) has a more negative connotation

than (b). Therefore, to provide MC character as options for participants in experiments could increase semantic influence on tonal choice.

As for Chang and Bradley (2012), though the detailed demographic information is not available, participants in this experiment had lived in the U.S. for 1-4 years. They all had either experience of learning English as an L2 or indirect influence from English through living in an English-speaking environment. In Wu H.'s (2006) study, participants' language background was unknown. This leads to a question that if participants with and without English background both participated in a tonal adaptation experiment, will they have the same tonal adaptation pattern?

One similarity between the above-mentioned experiments is that what participants listened to and were asked to adapt is isolated word stimuli. This might have directed listeners to focus on the acoustic properties of the English words, rather than on their native MC phonological knowledge. Based on this, an experiment asking to adapt a stimulus embedded in MC sentence would elicit more of their native language knowledge.

In this study, we conducted experiments which could minimize the influence from MC orthography and semantics. And by recruiting two groups of participants with and without L2 experience, we will reexamine MC loanword tonal adaptation pattern.

The experiment tries to answer the following questions: (i) Is the assignment of an English loan syllable to a Mandarin tone subject to a probabilistic distribution, as reported in the literature? (ia) If there is a probabilistic distribution, is it constrained by syllable onset type, as claimed in the literature? (ib) Does the syllable onset constraint produce the same distribution as those seen in prior studies? (ii) Does the degree of English-language background of the native MC-speaking adapter have an influence on their tonal perception of loans? (iii) Will the result of a task in which participant was asked to adapt single stimuli be different from a task that asked participants to adapt a stimuli embedded in a MC sentence?

Our hypotheses for this experiment are: Hypo 1. The effect of syllable onset type will produce a probabilistic distribution of MC tones in loanwords that is the same as that reported in Wu H. (2006) and Chang and Bradley (2012). Specifically, syllables with English [-asp] onsets will most frequently be adapted with HH tone; with [+asp] onsets will be more adapted with MH tone and [son] onsets also more with MH tone; Hypo 2. Monolingual MC speakers and bilingual MC/English speakers will exhibit no differences in their assignment preferences for tonal adaptation of English loanwords; Hypo 3. In the two experiments that were conducted, the results will be different between one experiment in which single-word stimuli were presented and in the other experiment in which MC sentences embedded with target stimuli were presented to participants.

In the next section, we will introduce our experiment design.

## 3. Experiment

This study re-examined MC loanword tonal adaptation pattern in two perception experiments. Mandarin Chinese speakers were recruited to listen to disyllabic English nonsense words recorded by an American English/Mandarin Chinese bilingual speaker[6], and then they were asked to choose the most natural tone they would use for the target syllable. A bilingual speaker was chosen as the speaker because both nonsense English words and MC carrier sentences were included in the experiment recordings. All four MC tones were provided in the form of MC tone markers as options for participants. In this way, the influence of MC semantics and orthography could be minimized.

### 3.1 Participants

Two groups of participants that were classified according to their L2 background were recruited. In the Bilingual group, there were 10 MC native speakers (6 female, 4 male, age range 18-30) who had received more than 10 years of English education in China[7]. In the Monolingual group, there were likewise 10 MC native speakers (5 female, 5 male, age range 42-65) with no L2 knowledge of English. Participants in the Bilingual group were randomly recruited in a university library in China. Participants in the Monolingual group were recruited by our personal contact: 5 of them were recruited in China and the other 5 in the US. The latter were parents of MSU students who were visiting in the US. The age difference between the Bilingual group and the Monolingual group is due to the requirement of participants' language background. Given the changes to the Chinese education system in the last 30+ years, it is hard to find people with no English learning experience in China who are aged fewer than 35 and vice versa.

### 3.2 Stimuli

24 disyllabic English nonsense words with initial stressed syllable were constructed for this experiment. Recall that the stressed syllable is what the previous studies discussed; it is also the target syllable of this investigation, to see which tone MC speakers will adopt for nativization.

Three types of consonant were chosen as target onsets: voiceless obstruent [p]/[t][8],voiced obstruent [b]/[d]/[g][9] and sonorant [m]/[n]/[l]; they are the three types of

[6] Influence of different dialects of source language will not be considered in this study.

[7] Participants were from different parts of mainland China. Dialect background was not controlled.

[8] MC obstruent does not have voice/voiceless contrast as English does, instead, a [asp]/[-asp] contrast is realized for MC loanwords from English. Based on Miao (2005: 52), about 97% of the English bilabial voiced obstruent in onset position were adapted to the MC bilabial unaspirated obstruent; about 66% of the English bilabial voiceless obstruent in onset position was adapted to the MC bilabial aspirated obstruent.

[9] Iverson & Salmons (1995) and Beckman et al. (2013) propose that English is also an aspiration language. Under this view, the features of contrast should be [sg], not [voice]. We will not include their argument here since it is not the concentration of this study.

consonants discussed by previous studies on tonal adaptations in MC (Wu H. 2006). In this experiment, vowel quality was not controlled since no literature to date has discussed correlations of vowel feature and tonal assignment of MC native language. Each of the eight consonants was randomly paired with a vowel to form a $C_1V_1$ target syllable. Twelve existing English loanwords in MC were used as fillers so as to try to activate participants' MC phonological knowledge during the perception experiment (cf. the experiments conducted in Wu H. 2006, Chang & Bradley 2010). All the syllables that were incorporated in the stimuli have possible segmental combinations compatible with all the four MC tones.

### 3.3 Procedure

A series of two experiments were conducted using Praat (Boersma and Weenink 2014). In both experiments, participants received oral instructions in MC from the experimenter, recapitulated by detailed written instructions on the computer screen. Participants were asked to listen to 36 disyllabic nonsense word, and then choose the most natural tone (which were shown on the computer screen in the form of tone markers) they would use for the first syllable of each token if they were to borrow them into MC.

In Experiment 1, participants listened to 6 repetitions of each of the 36 stimuli (36 stimuli×6 times = 216 tokens) in random sequence. Experiment 2 expanded Experiment 1 by embedding the same stimuli in 6 carrier sentences with different positions: at the beginning or in the middle of each carrier sentence (see Appendix 2. for a list of carrier sentence). These carrier sentences were designed in a way that those stimuli would be inferred to be some product name by participants, since products and brand names (such as Nike, Lego, etc.) are a rich source of English loanwords for MC. Additionally, comparing the other types of loanwords, such as place name and person name, product names are less influenced by semantics/orthography (see section 2.1 for discussion). Finally, leading respondents to infer that the nonsense words were product names also ensured that all the stimuli were inferred to be nouns.

With different positions of stimuli in each sentence, it was expected that when making their tone selections, participants could consult more of their native language knowledge, rather than acoustic features of the stimuli. In Experiment 2, 36 stimuli were paired with 6 carrier sentences. A total number of 216 stimuli (36 stimuli × 6 carrier sentences) were played to participants in a random sequence. One practice phase was conducted prior to each experiment to get participant familiar with the experiment procedure and interface. The same participants that took part in Experiment 1 also participated in Experiment 2.

## 4. Result and discussion

This section talks about the result of the two experiments conducted for the current study. The overall result of tonal assignment will be shown first, then the

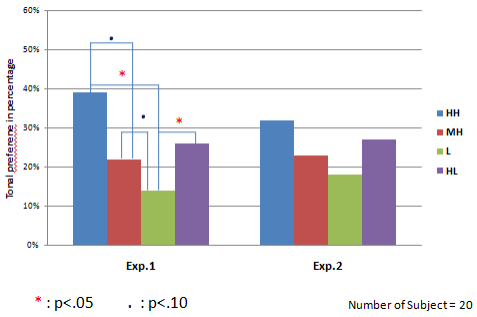
influence of stimuli onset type and participants' English background, followed by a discussion for each section.

### 4.1 Overall tonal assignment

The results of both experiments confirm Wu C. (2006) and our own corpus study's tonal adaptation pattern, in that HH and HL are overall the most preferred tones, followed by MH. Low tone is the least preferred (See Table 3. for detail).

As shown in Figure 1, for the results of Experiment 1, by conducting a One-Way Within-Subjects ANOVA[10], we found that there was a significant tone effect ($F(3, 57) = 5.55$, $p<.05$). A follow up Pairwise t-tests with adjusted p-values indicate that HH and HL were more preferable than L tone ($p<.05$). A marginal difference was also found, with HH more preferable than MH ($p<.10$), and MH more preferable than L ($p<.10$). As for experiment 2, however, there was no main effect for tone ($F(3, 57) = 1.51$, $p>.05$), nor was any tone significantly more frequently selected than any other tone by paired t-test. That is, the relative preference for each of the four tones was the same in both Experiment 1 and Experiment 2; but in Experiment 1, the preference for HH above the other three tones was significantly stronger.

Fig 1. Overall results of Experiment 1 and Experiment 2




This tonal adaptation pattern was also found in Wu C. (2006)'s corpus study and in the findings of my own corpus study for place names (see Table 6 c &d): that is, both corpus studies determined that HH was the MC tone most frequently used for adapting English stressed syllables, followed by HL tone. This may suggest that the type of word actually might not matter all that much after all, since loanwords of place names, nonsense words and a corpus with word types unknown all exhibit the HH > HL preference ranking[11].

[10] Since we are focusing on each participant's preference for tones, One-way within-subjects ANOVA was conducted.

[11] It is unclear that why we do not get a HH > HL ranking for personal names and common nouns.

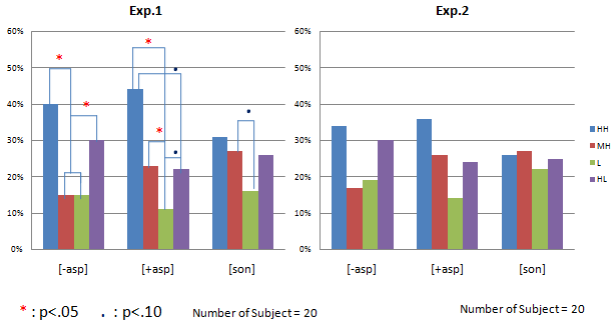
**4.2 Onset type influence**

Surprisingly, although the overall preference pattern for tones matched that of prior studies, the pattern of onsets' influence on loanwords tonal adaptation found in previous literature was not confirmed in this study. Hypothesis 1 was therefore rejected. For all three types of onsets, [-asp], [+asp] and [son], HH was the most preferred tone in the present experiment (Figure 2).

In Experiment 1, One-Way Within-Subjects ANOVA was carried out to test if there is a main tone effect. The results are as follows: (i) There was a significant tone effect for [-asp] onset ($F(3, 57) = 5.94$, $p<.05$). A follow up Pairwise t-test with adjusted p-values indicates that HH and HL are more preferable than MH and L ($p<.05$); (ii) For [+asp] onset, there was a significant tone effect ($F(3, 57) = 7.94$, $p<.05$). A follow up Pairwise t-test with adjusted p-values tells us that both HH and MH are significantly different from L tone ($p<.05$); there was a marginal difference between HH and HL, HL and L ($p<.10$); (iii) In [son] onset, there was a significant tone effect ($F(3, 57) = 7.94$, $p<.05$). A follow up Pairwise t-test tells us that only a marginal difference was found between MH and L ($p<.10$).

In Experiment 2, Figure 2 shows that HH is the most preferred tone for stimuli with [-asp] and [+asp] onset. One-Way Within-Subjects ANOVA was carried out as for Experiment 1. The result are as follows: (i) For stimuli with [-asp], none of the tones is significantly preferred to each other ($F(3, 57) = 2.37$, $p >.05$); (ii) For stimuli with [+asp] onset there is likewise no significant difference in the preference for tones ($F(3, 57) = 2.96$, $p >.05$); (iii) Those stimuli with [son] onset in Experiment 2 did show the highest adaptation with MH tone, but again, a statistically significant difference was not found between MH and the other tones ($F(3, 57) = 1.51$, $p >.05$).

Fig 2. Onsets' influence on tonal adaptation




Our explanation for the distinction between previous and current studies on onsets' influence is that: (i) the distinction between established loanwords, which have undergone a long period of nativization, and online adaptations of nonsense foreign

words (Kang 2003) and (ii) a different experiment design in the present study, which leads to different results.

First, in previous corpus studies, established loanwords from dictionaries were collected. In the current experimental study, participants took foreign nonsense words as inputs and made perceptual judgment on tones. The difference between the tonal adaptation patterns found in the corpus studies and the present experimental study follows Silverman (1992) and Yip (1993)'s model of loanword phonology[12], which is a two-stage process: (i) a perception scansion stage, in which the phonetic information of the source language is scanned by the adapter/borrower, and then mapped to the according native language forms; (ii) a phonological operation stage, in which the recipient language phonotactics reform the foreign sound sequence into a legitimate native phonological form.

Applied to the current experimental study, the online adaptation of foreign nonsense words is in the first perception scansion stage, in which acoustic information in the stimuli is the most salient cue for subjects to make tonal adaptations. English stress and HH both share high pitch, which may lead the participant to frequently choose HH to mimic English stress when adapting stressed syllables of stimuli. On the other hand, established loanwords are the output of the second, phonological operation stage: the recipient language's phonotactics transform those sound sequences perceived in the first stage to a form that is legitimate in the recipient language. Thus some established MC borrowings from English that might originally have been assigned HH due to acoustic similarity between HH tone with stress are later assigned another tone that better fits MC phonotactics. For example, tonotactic gaps that occur in MC phonology could contribute to this further adaptation. Tonotactic gaps are segmental combinations that are not compatible with all four tones (Wu H. 2006), e.g. no CVN syllable with an [-asp] obstruent onset could occur with MH. So if a CVN unstressed English syllable was initially adapted to a CVN syllable in MC with MH tone, which is a tonotactic gap in MC lexicon, it would need further adaptation in the second phonological operation stage, re-assigned with either a HH, L or HL tone. For the current experiment, all the stimuli were designed in a way that the combination with all the four tones was possible in MC lexicon. In the future study, if we include some stimuli, the adaptations of which have potential tonotactic gaps in MC, then we could tell in the perception scansion stage, if participants would still made adaptation based on just acoustic similarity regardless of whether it is possible in MC lexicon.

As for the current experiment, since the forms perceived by participants were legitimate in MC phonology, we need to propose another factor that needs to be taken into consideration in the adaptation process, which is the unique MC writing system. Almost every Chinese character corresponds to a syllable with a specific meaning. No

[12] Here we ignore the different opinions among scholars on whether there is separate loanword phonology independent from native phonology.

matter what types of loanwords were collected for a corpus, either common nouns, place names or personal names, loanword convention based on semantics unavoidably also plays a role in the adaptation process. This could be one more step of reformation following perception scansion stage and phonological operation stage.

Secondly, the inconsistency in findings of experimental studies, namely Wu H. (2006), Chang and Bradley (2012) and the current study may be attributed to different experimental designs. In Wu H. (2006), participants were forced to choose between two adapted forms for each stimulus: HH and MH. The other two tones, L and HL tone were not provided as adaptation options. In addition to that, Chinese characters were used for adapted forms for subject, which might brings about participants' preference for a particular character based on semantic and/or orthography reasons rather than phonological considerations. In comparison, the current experiment provided subject with all the four tones as adaptation options in the form of tone marker, which minimized the influence from semantics and provided them with all possible selections in MC tone inventory. This could be another explanation for the different results from Wu H. (2006) and this study.

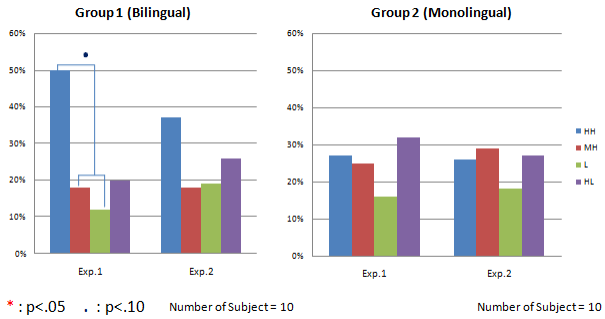
In Chang and Bradley (2012), participants who took part in their experiment had lived in the U.S. for 1-4 years. They presumably either had direct English knowledge and/or indirect exposure in an English speaking environment. The question of whether there is an influence from participant's foreign language knowledge motivated the analysis in the following section.

**4.3 English L2 influence**

As explained in an earlier section, two groups of participants were classified according to their language background. Participants in the Bilingual group are bilinguals in MC and English; participants in the Monolingual group are monolinguals whose only language knowledge is MC. The results are shown in Figure 3.

For the Bilingual group in Experiment 1, the overall result was that HH was still the primary choice among the four tone options. A One-Way Within-Subjects ANOVA tells that there was a tone effect ($F(3, 27) = 6.91$, $p<.05$). A follow up Pairwise t-test with adjusted p-value just showed a marginal difference from MH and Low tone ($p<.10$). In the Bilingual group, Exp 2, a One-Way Within-Subjects ANOVA shows us that there was no significant tone main effect ($F(3, 27) = 1.57$, $p>.05$). This result is not consistent with Chang and Bradley (2012)'s finding that HL was favored above HH (cf. Wu H. 2006), despite the fact that participants in both the current experiment of Bilingual group and Chang and Bradley (2012) have English background. Rather, participants exhibited a strong preference for HH when presented with isolated words.

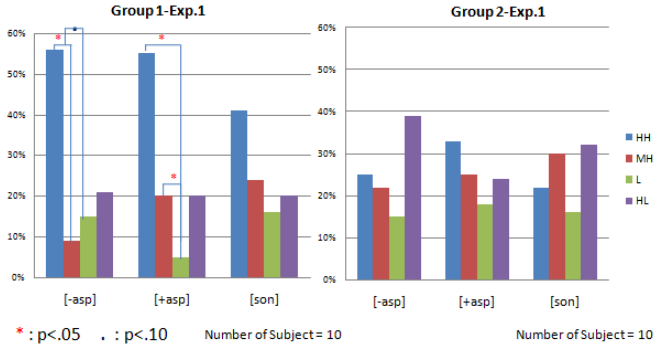
Fig 3. Language background influence on tonal adaptation.




In comparison with results from the Bilingual group, the Monolingual group subjects' tonal choices were variably distributed. HL and MH tone had slightly higher preference in Experiment 1 and Experiment. 2 respectively, but none of the tone differences was statistically different ($F(3, 27) = 1.83$, $p>.05$).

In Fig 4, for the Bilingual group subjects, HH tone was still the most preferred tone for all types of syllable onset: (i) For stimuli with [-asp] onset, HH tone had statistically significant higher preference than MH ($F(3, 27) = 8.64$, $p<.05$), and a marginal difference than Low tone ($F(3, 27) = 8.64$, $p<.10$). (ii) For stimuli with [+asp] onset, the selection of HH was significantly different from L tone ($F(3, 27) = 8.86$, $p<.05$). MH also had statistically significant higher preference than Low tone ($F(3, 27) = 8.86$, $p<.05$), but MH was not the primary preference as previous study showed for words with [+asp] onset. (iii) For stimuli with [son] onset, HH was still the most preferred tone, but no statistically significant difference among tones was found for this onset type ($F(3, 27) = 2.12$, $p>.05$).

Fig 4. Onsets' influence on tonal adaptation. A comparison of two groups of participants in Experiment 1[13].




[13] The result of Experiment 2 was not discussed here, since it highly resembles the result of Experiment 1.

In the Monolingual group, once again, no statistically significant effect of tone was found for any of the three onset types. For [son] onsets, MH was more chosen than in [-asp] and [+asp]. But the difference was not as prominent as in Chang and Bradley (2012)'s finding that "stimuli with sonorant onsets has 71% realization of Rising [MH] tone of this type". Unexpectedly too, the participants appeared to favor HL for [-asp] onsets, but this preference was not statistically significant.

In this section, when we compared tonal adaptation preference for two groups of participants, bilinguals and monolinguals, we found that bilinguals tended to adopt HH tone to adapt English stressed syllable; however, those monolinguals did not present us with a clear picture on which tone(s) they would use for adaptation. Thus Hypothesis 2 was also rejected.

Combining the information from Experiment 1 and Experiment 2, we have the following results: (i) A probabilistic distribution for the assignment of an English loan syllable to a Mandarin tone was found. The tonal adaptation pattern found in both experiments is HH>HL>MH>L, which conforms to the pattern found in Wu C. (2006) and one of my own corpus which consists of loanwords of place name. The tone distribution is not constrained by syllable onset type as the literature claimed; (ii) Hypothesis 2 was not confirmed: monolingual and bilingual speakers do exhibit differences in their assignment preferences for tonal adaptation of English loanwords. Bilinguals prefer HH tone the most for adaptation; monolinguals do not have a predominant tone(s) used for adaptation; (iii) Hypothesis 3 was proved that, although the pattern is similar in both experiments, a much stronger preference for HH was found in Experiment 1.

## 5. General discussion

The variation in tonal adaptation pattern in previous corpus studies might be attributed to different sources that each researcher uses for data collection and the categories of loanwords that were included in the corpus. For future corpus studies, one factor that should be considered for data collection is whether the loanword is still in use in the community. When comparing corpus study generalizations with perception/production experiment results, the distinction between established loanwords and online adaptation should be noted, especially for established MC loanwords, the formation of which were inevitably affected by orthography and semantics of Chinese characters. An extension of the current study is to conduct a production experiment to ask subjects to write down their adaptation in Chinese character. If different patterns are found, we would have more evidence on the influence of orthography and semantics in the process of MC loanword adaptation.

Our explanation for the less obvious tonal pattern found in Experiment 2 is that when the input for subject was a MC sentence embedded with one foreign word, subjects might focus more on their native language, rather than on the stimulus, which was a foreign word. The result was that subjects paid less attention to the acoustic feature of the

stimulus, so the pitch information of the stimulus became less prominent for subjects in Experiment 2. But in Experiment 1, it was an important cue that subject relied on to make tonal judgment.

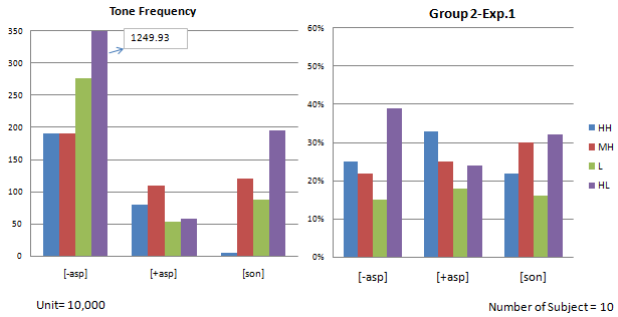
The influence on MC loanword tonal adaptation pattern by onset type was not found in this study. The previous finding was based on either established loanword corpus (Wu H. 2006, my own study) or experiment that used Chinese character as adaptation options (Wu H. 2006). Since it was based on selection options in the form of Chinese characters that the influence was found, it will be more confident to say that the onsets' influence is the consequence of MC orthography and semantics when we have results for a production experiment.

The subject's language background influence on tonal adaptation shows that monolinguals have more variation in their tonal preference, while bilinguals are more likely to choose HH. One potential explanation for this pattern is that bilinguals are more sensitive to English stress. The acoustic similarity between stress and High tone brings about the preference for HH. This resembles the adaptation of Cantonese loanwords from English, in which stressed syllables in English are adapted to high tone to mimic English stress (Kiu 1977, Yip 2006). It is reasonable to speculate that due to the long relationship between Hong Kong and Britain, compared to people of Mainland China and Taiwan, the Hong Kong population has had a longer exposure to English, which may have led to the result that HK Cantonese speakers are more sensitive to English stress than MC speakers. Consequently, stressed syllables in English are adapted to high tone. Whereas in mainland China, historically speaking, the lack of constant contact with English has lead to more variation in loanword tonal adaptation. And this is where the second adaptation step, phonological operation, plays a part (Silverman 1992).

On the contrary, for those monolinguals who have no L2 background, when listening to a foreign word, they ignore the stress information and would seek cues from their native language, Mandarin Chinese, to make a tonal choice. My hypothesis is that monolinguals employ tone frequency in making their judgments on which tone to use for adaptation. On the left hand of Figure 5, there is a histogram of the tone frequency in MC lexicon for three types of onsets based on the possible adaptation form(s) for the stimuli tested in this experiment[14].

Fig 5. The histogram on the left is tone frequency of possible adapted form(s) for the stimuli tested in this experiment; comparing it with the right hand side histogram of tonal choices by monolinguals.

[14] The tone frequency was calculated this way: take segment combination [ni] as an example, all the commonly used possible characters for each of the four tones [niHH]/[niMH]/[niL]/[niHL] were consult in CCL corpus (2009), which collected more than 72 million words from Modern Chinese literature, newspaper, magazine, etc. And then the frequency for each of the characters with the same tone was added to get a tone frequency of a particular tone.




The comparison of tone frequency and results from Experiment 1 presents us with a rather consistent tone ranking: (i) HL is the most frequent choice for words with [-asp] onset, and it is also the primary choice in Experiment 1; (ii) For words with [+asp] onset, the pattern for tone frequency and Experiment 1 is highly congruent with each other except that the ranking for MH and HH switched in tone frequency and Experiment 1; (iii) The most frequent two tones, HL and MH are also the first two choices in Experiment 1 for words with [son] onset.

The above consistency on tone rankings suggests that when making tonal adaptation by listening to foreign language stimuli, monolinguals are not sensitive to stress feature of a stimulus, tone frequency of native language is the cue they employed.

## 6. Conclusion

To sum up, we re-examined MC loanword tonal adaptation in a perception experiment. The overall adaptation pattern conforms to Wu C. (2006) and my own corpus study. We have seen in this paper that different sources of loanword corpus collection may lead to distinct tone pattern, though the explanation for this is not the concentration for this paper. The previous finding of onsets' influence on tonal adaptation is not confirmed in this study. One possible reason is the difference on experiment design. The different tonal adaptation pattern between bilinguals and monolinguals indicates that MC monolinguals employ tone frequency as an important cue to make tonal judgment, while the bilinguals, are more sensitive to stress feature of English words. For further research, a production experiment may be needed.

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