Mid-Phon 18: Program Booklet

POSTERS

(Organized alphabetically by last name of first author)

Conjunction of markedness constraints to account for opacity in Acadian French

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Acadian French (AF), an underdescribed variety of French spoken in the maritime provinces of Canada, exhibits a case of opacity where the stress system obscures a process of high vowel laxing, presenting a problem for standard Optimality Theory. I explore the use of Local Constraint Conjunction (LCC, Smolensky 1993) to account for this opacity in the least costly way possible.

This paper stems from an initial project in which the stress system of AF is argued to include secondary stress that is weight-sensitive, much like in the case of the neighboring variety Quebec French (see Armstrong 1999). Using spoken data from three speakers of AF in New Brunswick, I show that primary stress is always word-final and secondary stress is assigned to non-penultimate heavy syllables.

To strengthen the argument for secondary stress in AF I examine a phonological process that targets stressed syllables—the laxing of high vowels [i], [y], and [u]. I use data from the interviews as well as a linguistic atlas of Acadia (Péronnet et. al 1998) to show that this process applies to both word-final syllables as well as other closed syllables, in which case secondary stress must be assigned. The process may not apply, however, in penultimate syllables. This is illustrated in the following data sets:

(1)   *Laxing in syllables with secondary stress*
[dɪfˌ.te.riˈ]   'diphtheria'
[kʏlˌ.ti.veˈ]   'cultivated'
[nʊkˌ.mɔ.vaˈ]   'bad knot' (< 'knot.bad')

(2)   *High vowels remaining tense in unstressed closed syllables*
    [pu.dœ.rid.sabˈ]   'dune' (< 'pile.of.sand')
    [kɔ̃.dyk.tœrˈ]   'conductor'
    [lud.mɛrˈ]   'seal' (< 'wolf.of.sea')

Standard OT encounters a ranking paradox when attempting to account for these facts together. A constraint *CLASH (banning adjacent stresses) prevents a penultimate syllable from being stressed, but the ranking of *iC (banning high tense vowels in a closed syllable, Poliquin 2006) over *I (banning high lax vowels) and ID[ATR] (preventing vowel laxing) forces EVAL to choose the candidate with the lax vowel, which is counter to the data shown in (2). The only current means of preventing this would be to either demote *iC, which would result in incorrect predictions for high vowels in other contexts, or to modify already-established constraints. To avoid this, another OT framework must be adopted. I thus use LCC to conjoin two markedness constraints, Weight-to-Stress Principle (requiring heavy syllables to be stressed) and *I, in order to target high lax vowels in unstressed closed syllables, which represent what Itö & Mester (1998) call "the marked in a marked position." I argue that the conjunction of markedness constraints can account for opacity resulting from a phonological process interacting with stress assignment since one of the conjoined constraints is also involved in an allophonic distribution, which is then disrupted.

Word Stress in Laotian, an OT analysis

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Metrical phonology (Hayes, 1980; 1995; Selkirk 1981) uses hierarchical structure to represent stress assignment in language. The issue of whether certain South-East languages utilize a metrical foot structure is far from decided. Because Lao lacks traditional characteristics of stress – vowel duration, pitch change, increased amplitudes, etc. – it is not immediately apparent whether metrical phonology has any explanatory power for such a language. However, Hayes (1995) argues that stress is not a specific feature of language but rather a "linguistic manifestation of rhythm." And Bennett (1995) makes a strong case that other non-canonical linguistic properties, specifically syllable weight for the languages Thai and Kayah Li, can reveal the metrical structure of a language. I use evidence from the Laotian language (Lao) to show how metrical foot structures, along with an abstract concept of stress can explain both a glottal stop alternation and vowel shortening.

Examples of the glottal stop alternation are in (1) and examples of vowel shortening are in (2).

My claim is that metrical theory along with hierarchical foot structure can explain seemingly disparate phonological alternations in a SE Asian language. Peyasantiwong (1986) gave an ordered set of linear rules for word stress in Thai, but without the benefit of metrical theory, the glottal stop alternation and vowel shortening remain unrelated processes. More recently Bennett (1995) and Tumtavitikul (1998) have shown that metrical theory can be useful in analyzing Thai word stress. I will argue that it is equally powerful at explaining related alternations in Lao. Optimality Theory (Prince and Smolensky, 1993/2004) is an ideal theoretical framework to analyze these phenomena. The focus on syllable well-formedness, rather than the ordering of linear rules, is clearly the cause of the observed alternations in Lao. Specifically, I claim that Lao has high-ranking foot well-formedness constraints that allow the attested candidates to surface. These constraints account for word-final glottal stop epenthesis as well as vowel shortening in compound words. Additionally, the constraints used in this analysis explain similar alternations in Thai (Bennett 1995) and Cupeño (Crowhurst 1994).

Examples of the crucial ranking arguments are in (3) and (4).

Finally, the interaction between syllable weight and word stress has interesting implications for the role that syllable weight plays in tone distribution in SE Asian languages and how it differs from stress distribution.

Production and Perception of Merging Tones in Dalian Mandarin

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Sound change has long been of interest to researchers in many subfields of linguistics such as phonetics, phonology and sociolinguistics. Researchers are particularly interested in the mechanisms that govern the process. For instance, Hay et al (2006) found that in New Zealand English vowel/i/ and /;/ have merged into the mid vowel /;/ and this process did not affect all speakers in the speech community, but targeted subgroups of it, young speakers and female speakers in particular.

The focus of the present study concerns one aspect of sound change: tone merger, or tone merger in progress in particular. During the early stages of an in-progress tone merger, it is often the case that, speakers make consistent difference of the merging tones in production, but have difficulties distinguishing them in perception (Mok and Wong 2010, Yiu 2009) or vice versa (Yiu2009). One case of merger proposed recently is the merger of two falling tones (i.e., Tone1 and Tone4) in Dalian Mandarin (Gao2007, Liu 2009). However, there is no consensus on which acoustic aspects do the merging tones remains different as well as the stage of the merging process, whether the merger is still in progress or completed. Previous studies of Dalian did not report the acoustic properties of the production stimuli, thus the perception cues and the relation between production and perception remain unclear. Moreover, other factors, such as word frequency, age and gender of speakers, which may have an effect on the merging process, has not been investigated. The present study intends to investigate the production and perception of the merging tones and the effects of word frequency, age and gender of speakers in the process.
A production experiment and a perception experiment (a forced-choice character identification test) were conducted. The results showed that, in production, finalf0 and contour shape have significant effects in that Tone4 has high finalf0 and a concave shape while Tone1 has low finalf0 and a convex shape. Word frequency has a significant effect in production. In terms of duration, final f0 and concave, the differences between Tone1 and Tone4 are smaller for high frequency words than that for low frequency words. Age and gender also have significant effects in that young speakers and female speakers produce less distinctive Tone1 and Tone4 tokens than old speakers and male speakers do.
In perception, the accuracy pooled across two tones is 77%, which indicates that this is not a complete merger as Liu (2010) claimed. The acoustic cues found in the production experiment (i.e., finalf0 and contour shape) are the cues employed by listeners in perception through generalized linear mixed effect model. Listeners were more accurate when listening to speakers whose productions of Tone1 and Tone4 are more separated than those whose productions are highly overlapped in the two dimensional space of finalf0 and contour shape. Word frequency has significant impact in that listeners perceived high frequency words more accurately than low frequency words. This may be due to specific speaker selection, a different type of frequency such as the frequency of syllable and tone combination, or the effect of lexical access, which may override the weakness of acoustic cues in high frequency words. There are also speaker and listener variations. The productions of Tone1 and Tone4 from some speakers are highly overlapped and some listeners have near chance accuracy regardless of speakers, which indicates that this is a merger in progress.
In sum, falling tones merger in Dalian is still an on-going process. Finalf0 and contour shape are the cues used by both speakers and listeners. Word frequency, age and gender of speakers have effects in both production and perception.

Cohesion and Autonomy: Quantifying Typological Variation of Sub-syllable Structures

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There have been everlasting debates about the sub-syllable structure or constituency. In this study, using toolkits borrowed from information theory, two novel measurements are proposed to quantitatively capture sub-syllable structures. One is cohesion score, which is based on pointwise mutual information, measuring the strength of association between segments. The other one is autonomy score, which is based on conditional entropy, measuring how varied the environment of a bi-segment sequence is. Generally, a bi-segment sequence will achieve a higher cohesion score if its two segments co-occur more than expected, and will achieve a higher autonomy score if the sequence has a more varied environment.

A four-fold[1] cross-linguistic[2] corpus analysis on monosyllabic CVC words is conducted using these two measurements. Result shows that English CVC words are largely rhyme-structured while Hungarian CVC words are only marginally rhyme-structured (see Figure.1), which confirms previous statistical studies. Also, result indicates autonomy score remains robust when sample space is extended to whole lexical items and token frequency is considered. But contrastive patterns discovered based on cohesion between segments is sensitive to corpus size and would be diluted when all lexical items are included in analysis.

Theoretical relevance to "word-likeness" and speech errors will also be discussed.

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[1] 2 x 2: Token/Type X CVC/Whole-Lexicons as sample space
[2] Other than English and Hungarian, several languages (especially Korean which is regarded as body-structured by many phonologists) are also in my plan of analysis. However, our corpora hosting server are being upgraded, so I have to wait until mid February.

Gender Effects on the Production and Perception of Vocal Fry

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The linguistic feature known as "vocal fry" (also known as "creaky voice" or "laryngealization" to linguists) has recently come into the public consciousness through the publication of a New York Times article entitled "They're, Like, Way Ahead of the Linguistic Currrve" (Quenqua 2012). The phenomenon is overwhelmingly presented in media as being associated solely with women, and previous sociophonetic research suggests that women are more likely to use vocal fry in informal contexts in some parts of the US (Podesva 2011, Yuasa 2010). In this project, I seek first to replicate this tendency for speakers in Michigan, in both formal and informal contexts. Based on the existing literature, I expect that women will use vocal fry more often. A forced-choice AXB perception experiment examines whether listeners are more likely to categorize a laryngealized gender-neutral pitch as female or male. Based on the expectations of the production experiment and the increased media attention, I predict that listeners will attend to the added vocal fry and judge speakers with the feature as female.

Is there metrical regularity in conversational speech?

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Many researchers claim that languages avoid stress clash, defined as two adjacent syllables with the same level of lexical stress within or across word boundaries, implying that strong syllables are separated by one or more weak syllables [1-3]. Yet no studies to date have measured the perceived patterning of strong and weak syllables in English speakers' spontaneous speech, despite the existence of studies that test the perceptual effects of manipulating these patterns [4,5]. This study measures the frequency of stress clash in a sample from the Buckeye Corpus of conversational American English, to test the hypothesis that an anti-stress clash constraint governs the production of stress at the phrase level against a competing hypothesis that regular patterns are instead simply a result of word order and the frequency of certain word-stress patterns. These hypotheses are tested by comparing the stress pattern of the original sample with three versions of the same utterances that manipulate word order or word stress. In this pilot study stress coding is based on listener's perception in polysyllabic words, with a default coding of mono-syllabic words distinguishing content and function words. The subsequent ongoing study relies solely on naïve listeners' perception of stress.

100 consecutive utterances from one interview from the Buckeye Corpus were perceptually coded for Strong and Weak syllables by the author (a native speaker). Polysyllabic words were labeled based on auditory perception. For mono-syllabic words, content words and contractions were coded Strong, while function words were coded Weak. The perceived stress patterns of the original utterances (AS SPOKEN) were compared to the patterns resulting from three manipulations of the words from these utterances. In the RANDOMIZED manipulation, all words in the sample were randomized and then divided into utterances of the same number of words as the original utterances. Each word retained the stress pattern as coded in the original utterance. In RANDOM CONTENTS, the content words of the original utterance were randomly reordered but function words were left in place, preserving original stress coding. In CONTENT TROCHEES each content word was replaced with the most common word type of English, a disyllabic trochee (Clopper 2002). For each manipulation, the number of clashes (SS patterns), lapses (WW), trochees (SW), iambs (WS) were counted. With no clash avoidance constraint, we predict that the occurrence of any measured pattern will be as frequent in the original utterance as in the manipulated versions. If a clash avoidance constraint does exist, we predict there will be fewer clashes in the original utterances, the only condition where this constraint would apply.

The frequency of clashes and of regular patterns in the first three versions compared did not differ significantly, ($p<.05$, fig.1). There is no need for a constraint disallowingclashes in order to accurately describe this data. However, CONTENT TROCHEES differed significantly from the AS SPOKEN because a majority of words (86%, 943) in the dataset were monosyllables. This is problematic because in the pilot study monosyllables, the majority of the corpus, were labeled categorically. This problem is remedied in the follow-up study underway, which uses only perceptual stress ratings from multiple native speakers, rather than categorical labeling.

This study concludes that regular patterns of perceived strong and weak syllables do exist, but they are equally frequent in a group of the same words randomly combined, suggesting that there is no phonological constraint of clash avoidance.

English influence as a possible source for the sound change in Korean

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Traditionally, voice onset time (VOT) has been considered as the primary acoustic dimension in distinguishing three stop categories in Korean. According to recent studies (e.g., Silva, 2006), the importance of VOT is diminishing in modern Korean, especially among Korean speakers born after the 1970s; there is a significant VOT overlap between lenis and aspirated stops, and the VOT alone cannot distinguish these two stop categories. Most studies reporting the VOT overlap, however, were conducted with Koreans living in the U.S. This raises the question whether the reported VOT overlap is due to the influence of English on the Korean subjects. To test this possibility, we collected data from Koreans living in Korea to examine the VOT of stops. We also considered whether one sociolinguitstic factor, *attitude toward English*, plays any role among native Koreans living in Korea. Two groups, each consisting of ten male native speakers of Korean undergraduate students in a Korean college located in Seoul, Korea participated in the study: one group with negative attitude and the other group with positive attitude toward English. All participants read a list consisting of frame sentences containing target words in phrase-initial position; the target words were one to four-syllable lexical items beginning with fortis, lenis, and aspirated stops in three places of articulation (i.e., bilabial, alveolar, and velar stops) followed by /a/ (e.g., /p^{h}a/ 'green onion', /tanc^{h}u/ 'button', /paŋmunca/ 'visitor', /k*amk*amhata/ '(be) dark'). When all twenty participants were examined, the VOT alone was sufficient in distinguishing the three stop categories. However, the VOT could not distinguish lenis from aspirated stops in one of the two groups—interestingly enough, it was the group with negative attitude that showed the VOT overlap. Our study suggests that English influence is a possible source for the sound change in Korean, though further research on the nature of the influence is needed.

<u>References</u>

Silva, D. J. (2006). Acoustic evidence for the emergence of tonal contrast in contemporary Korean. *Phonology*, *23*, 287-308.

Directional harmony and maximal licensing in Maasai

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Maasai is an Eastern Nilotic language with about 900,000 speakers in Kenya and Tanzania. Maasai vowels can be divided into two sets--ATR [i, e, o, u] and non-ATR [I, ɛ, ɔ, ʊ, a]. In the absence of /a/, which can block harmony, if there is an ATR vowel in a word, all vowels will be ATR. The purpose of this paper is to present a new OT analysis of Maasai vowel harmony to show that using the theoretical assumptions of Walker (2011), it is possible to account for the very complex harmony system in Maasai without resorting to more complicated alternatives seen in analyses like Baković (2000). (Data collected in the Arusha region of Tanzania).

1.
    a. /I-put-Iʃɔ/   [iputiʃo]   2nd pres intransitive "pluck"
    b. /I-nʊk-iʃe/   [inukiʃe]   2nd past intransitive "cover"
    c. /nɛ-ma-ʃol/   [nɛmaʃol]   1st sg negative future "melt"
    d. /I-puk-a/   [impuko]   2nd sg past "flee"

In (1a) the ATR root causes the affixes to harmonize, and in (1b) the ATR suffix causes the non-ATR root and prefix to harmonize. In (1c) the opaque /a/ blocks the leftward harmony, but in (1d) it harmonizes to [o] due to the preceding ATR vowel. Both Levergood (1984) and Baković (2001) assume the cycle to account for harmony with ATR spreading from the root outward, and Baković's OT account also relies on an anti-cyclic harmony process to account for an ATR suffix that causes a root to become ATR if no /a/ intervenes between the suffix and root.

Walker (2011) proposes a maximal licensing constraint which causes unbounded harmony by licensing only vowels that coincide with the dominant feature. She suggests that seemingly bidirectional harmony could be the result of the two unidirectional maximal licensing constraints. An analysis of Maasai supports this suggestion; the low vowel in Maasai demonstrates the necessity for two unidirectional harmony constraints. By ranking License$_{RIGHT}$ above ID labial and License$_{LEFT}$, the low vowel harmonizes when *preceded* by an ATR vowel, but not when *followed* by an ATR vowel. License$_{LEFT}$ penalizes every non-ATR vowel to the left of an ATR vowel, while License$_{RIGHT}$ penalizes every non-ATR vowel to the right of an ATR vowel. To prevent an input ATR vowel from being non-ATR in the output, the ID IO ATR constraint is split into an input to output constraint (IàO ATR) which is ranked above the output to input constraint (OàI ATR). Maasai also necessitates a high-ranked markedness constraint against the ATR counterpart to /a/, which never surfaces in Maasai: *ə. Finally, either ID labial, or ID low must be ranked between License$_{LEFT}$ and License$_{RIGHT}$.

In (2) the ATR feature spreads from the root to the prefix and suffix. In (3) the ATR feature cannot spread left because of the opaque low vowel. In (4) the low vowel in the suffix harmonizes. All the data can be accounted for without resorting to a more complex alternative. Although harmony in Maasai appears to be bidirectional, it is easy to account for by using two unidirectional harmony constraints.

2.

/I-put-Iʃɔ/	I→O ATR	LIC$_{RIGHT}$	LIC$_{LEFT}$	O→I ATR
a. IputIʃɔ		*!*	*	
b. ☞iputiʃo				***
c. IpʊtIʃɔ	*!			

3.

/nɛ-ma-ʃol/	*ə	LIC$_{RIGHT}$	ID Lab	LIC$_{LEFT}$	O→IATR
a. ☞nɛmaʃol				**	
b. nemaʃol	*!				**
c. nemoʃol			*!		**

4.

/I-puk-a/	LIC$_{RIGHT}$	ID Lab	LIC$_{LEFT}$	O→IATR
a. impuka	*!			*
b.☞ impuko		*		**
c. Impuka	*!		*	

The Perception of English Stops in a Coda Position by Thai Learners

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Previous studies often report that native (L1) Thai learners of English have more difficulty in perceiving English voiced stops than English voiceless stops in a coda position (Hancin-Bhatt, 2000). Most studies, however, examined Thai learners in an English-speaking country rather than in Thailand. Therefore, it is not certain whether previous findings can be generalized to a different population. We report results from a case study on the perception of English stops in the syllable coda position by L1-Thai learners of English in an English as a foreign language (EFL) setting. One goal of our study is to see whether L1-Thai learners of English in an EFL context show the similar perception pattern with those in a second-language (L2) speaking environment. Another goal is to investigate the influence of formal instruction on the perception of L2 segments. Thirty L1-Thai speakers with three levels of English language proficiency participated in the study: Low, Moderate, and High groups. Participants in the same group (N=10) were recruited from the same class in a public university in Bangkok, Thailand. Nine native speakers of American English also participated in the study as a control group. The stimulus corpus consisted of 12 CVC minimal pairs contrasting in voicing for bilabial, alveolar, and velar stops in coda (e.g., *cap* vs. *cab*, *bat* vs. *bad*, and *back* vs. *bag*), and the vowel was controlled as /æ/. The participants listened to stimuli produced by two native speakers via headphones and selected the sounds they heard (e.g., a. *cap* or b. *cab*). Our analyses of correct responses indicate that the Thai participants in an EFL setting did not necessarily have difficulty for the voiced coda segments than for the voiceless ones. For example, the performance for the coda /d/ was higher than that for /p/ and /k/. The results also show that the participants in Low group were poorer in their performance than those in Moderate and High groups, which were comparable to the performance of the control group. Thus, our study suggests that formal instruction plays a role in the perceptual learning of L2 segments, though perceptual learning of L2 segments occurs at the early stage of L2 acquisition. Our study also suggests that not all L2 segments absent in L1 are necessarily more difficult to learn to perceive.

Reference:

Hancin-Bhatt, Barbara. (2000). Optimality in second language phonology: codas in Thai ESL. *Second Language Research, 63,* 201-232.

Taiwanese Tone Sandhi in Loanwords

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This study investigates tone sandhi in loanwords in Taiwanese Southern Min (TSM), specifically, tone sandhi as it occurs in normal phrasal contexts. We know of no previous study on this topic. Unlike native words in TSM with the "one-morpheme-per-syllable" tendency, loanwords (primarily from Japanese) can consist of polysyllabic monomorphemic words. One may wonder if tone sandhi occurs in loanwords as they do in a phrase, and if so, how tone sandhi rules apply to the loanwords. TSM has seven tones, including five non-checked tones (H, M, L, L͡M, H͡L) on sonorant-ending syllables and two checked tones (H̲, M̲) on obstruent ending syllables. Tone sandhi in TSM describes a pattern of tone alternations conditioned by the boundaries of prosodic phrase built on the syntactic constituents like NP and VP (Tsay, Myers, & Chen, 1999). The tone sandhi rules for non-checked tones and checked tone are given in (1) and (2). On the other hand, Japanese has a pitch accent system, which can be superimposed on polysyllabic words to make phonemic contrasts. Japanese loanwords in TSM include polysyllabic monomorphemic words, such as /su.ɕiʔ/ / HM̲ 'sushi' and /o.tɔ.baiʔ/ MHH͡L 'motorcycle' and have a tone pattern similar to the Japanese default accent pattern (favoring a right edge pitch fall). In our study using native speaker consultants we requested the use of loanwords embedded in a sentence, where the loanwords occur both in sandhi (phrase-internal) and non-sandhi positions (phrase-final), as given in (3). The results show that in Japanese loanwords, non-final syllables in sandhi contexts do not undergo tone sandhi while the final syllables of these words generally undergo tone sandhi when they are in sandhi contexts, as exemplified in (4) (as seen by the first instance of the word 'sushi'). This is the first study showing this. That nonfinal syllables do not change in loan- words is consistent with the view of TSM tone sandhi as syntactically determined. We also relate our findings on loanword tone sandhi to those very rare cases of native polysyllabic monomorphemes which show a similar pattern; for example /pʰu.to/ L͡M.L͡M 'grape' has only the second syllable undergoing tone sandhi in the phrase /pʰu.to tsiu/ L͡M.M. H͡L These data make clear that TSM tone sandhi only occurs over a morpheme boundary and not within morphemes.

(1) Tone sandhi rules for non-checked tones
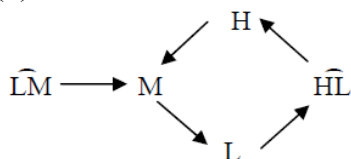
(2) Tone sandhi rules for checked tones
a. H→ M b. M→H

(3) (# indicates a syntactic boundary, citation tone is the non-sandhi tone)

	li	be	khi	su.ɕiʔ	tiam		be	su.ɕiʔ	
	you	want	go	sushi	store		buy	sushi	
Citation tone	H͡L	M	L	H.M	L	#	H͡L	H.M	#

'You are going to sushi store   to buy   sushi'

(4)	li	be	khi	su.ɕiʔ	tiam		be	su.ɕiʔ	
	you	want	go	sushi	store		buy	sushi	
Surfacing tone	H	H	H͡L	H.H	L	#	H	H.M	#
(with tone sandhi)									

'You are going to sushi store   to buy   sushi'

The Perception-Production Asymmetry in Hakka Tone Sandhi

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This study demonstrates that the application rates (productivity) of Hakka tone sandhi are inversely correlated with perceptual accuracy of the sandhi rules: the lower the perceptual accuracy is, the higher the application rate is. In examining the application rates of Mandarin and Taiwanese tone sandhi, Zhang and Lai (2010) and Zhang et al (2011) find that (i) duration-lengthening of sandhi tones enhances application rates of tone sandhi, (ii) phonological opacity of sandhi rules impedes application rates of tone sandhi, and (iii) application rates of tone sandhi are higher when stimuli are actual words than novel words, suggesting a phonetic, phonological, and lexical effect respectively. However, these previous findings were restricted to production data, and potential perceptual effects were not comparably investigated. As indicated by Moore and Jongman (1997), Huang (2004) and many others, perceptual similarity between underlying and derived tones of tone sandhi plays a crucial role in processing Mandarin T3 sandhi, so we predict perceptibility to be related to application rates of tone sandhi.

To examine the potential correlation between perceptibility and productivity of Hakka tone sandhi, three perception tasks, including discrimination, identification, and lexical formats, and one production task were conducted on 31 Hakka participants. The underlying and derived tones of rising tone sandhi, as illustrated in (1a), are phonetically similar in pitch height, while those of high checked tone sandhi, as illustrated in (1b), are phonetically similar in pitch contour. The results show that the perceptual accuracy of high checked tone sandhi (between high and low checked tones) is significantly higher than that of rising tone sandhi (between low rising and low level tones), regardless of task types, whereas the application rates of high checked tone sandhi are significantly lower than those of rising tone sandhi. Perceptibility is, therefore, found to be inversely correlated with productivity.

(1)   a. Hakka rising tone sandhi: Tone-13→ Tone-22/ ____ before any other tone
         b. Hakka high-checked tone sandhi: Tone-5→ Tone-2/ ____ before any other toned

The inverse correlation between perceptibility and productivity indicates that different types of perceptual similarity between underlying and derived tones may enhance tone sandhi application to different degrees. In this case, perceptual similarity in pitch height (rising tone sandhi) appears to enhance tone sandhi application (productivity) more than pitch contour similarity (high-checked tone sandhi). This perception-production asymmetry in Hakka tone sandhi then suggests the need to examine how perception may affect tone sandhi productivity in particular and sheds light on the interaction between perception and production processing in general.