

# Tone Sandhi in Hokkien Taiwanese

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## Abstract

This paper documents tone sandhi of Hokkien, a Southern Min language from the island of Taiwan. Data are from fieldwork with a native speaker of Hokkien (audio files and relevant identifying textgrids are included). The new data largely confirm the findings of Chung (1996), with the only slight variation in pitch frequency for elicited tones.

Chung describes tone sandhi in Hokkien as an iterative rule which applies in loosely phrasal and syntactically bounded domains (this is further elaborated on by Chen [5]). Tone sandhi is a set of phonological rules which predict replacement from one underlying tone to another in non-final syllables. This set of phonological rules is often described as a cycle and can be seen in any length of phrasally bounded entities, from two-character terms to full utterances. Tone sandhi in Hokkien can be accurately predicted with a set of three classes of phenomena: general tone sandhi, E-syllable tone sandhi, and diminutive special tone sandhi. This paper tests Chung's hypothesis in elicited speech from a native speaker. Bounding domains are in general phrasal, but there are many syntactically influenced specifications of this domain, of which a few examples of many are introduced in this paper.

General tone sandhi predicts the movement of all five tones present in Hokkien, illustrated in examples such as in underlying term  $tsin_{55} + k'wa_{31}$  changing to a surface form  $tsin_{33} + k'wa_{31}$ . The phenomena of tone sandhi is apparent as final syllables remain unchanged. Other examples include changing from 13  $\rightarrow$  33, 33  $\rightarrow$  31, 31  $\rightarrow$  53, and 53  $\rightarrow$  55. In special tone sandhi, which involves cases that include the diminutive  $-a_{53}$  suffix, a slight change to the general tone sandhi is made: 33 tones do not change, and 31 tones become 55 tones. Lastly, E-tones, which are tones that are attached to syllables beginning in voiceless stops, have an alternating tone sandhi pattern in which underlying 55 tones become 31 and 31 become 55. Examples of this include  $hap_{55} + tsok_{31}$  to  $hap_{31} + tsok_{31}$  and  $kyat_{31} + hap_{55}$  to  $kyat_{55} + hap_{55}$ . Another kind of E-tone, those that begin with glottal stops, have 31 tones becoming 53 tones instead.

My speaker's data is consistent with Chung's, so no substantial revision to Chung's analysis is needed. This paper presents and explains the applicability of Chung's analysis in elicited evidence. Modifications that preserve analogous features have been made to some examples to better suit sentences and terms the speaker is familiar with.

## 1. Introduction

Hokkien is a Southern Min language from the island of Taiwan, with about 15 million speakers residing in Taiwan as of 2000, and a total of 49 million worldwide as of 1991 [2]. The goal of this paper is to document and analyze the phenomena of tone sandhi, based on evidence elicited from a native speaker.

My consultant for this paper, Jason Yang, is a native speaker of Hokkien. He comes from Taipei, the capital of Taiwan. Though Mandarin is the standard dialect of the country, used in education and in broadcasting, Hokkien is taught at home and spoken within communities. Jason lived in Taipei for most of his childhood, up to the age of 13, at which point he completed his high school in California and studied Computer Science at UC Berkeley. He has lived in Los Angeles since graduating, and is quite fluent in English.

My project takes as its starting point the analysis of Hokkien phonology given in Chung 1996 [1]. Chung covers most of the major phonological rules of Hokkien, including tone sandhi. I will also be using Wiktionary for some source transcriptions [3].

## 2. Chung (1996)

The phonemic inventory of Hokkien Taiwanese, according to Chung 1996, is as follows:

### (1) Consonant phonemes (p. 3)

			Labial	Coronal	Velar	Glottal
Stop	voiced		b	l	g	
	voiceless	unaspirated	p	t	k	ʔ
		aspirated	p'	t'	k'	
Affricate	voiceless	unaspirated		ts		
		aspirated		ts'		
Nasal	voiced		m	n	ŋ	
Fricative	voiced			z		
	voiceless			s		h
Glide	voiced		w	y		

### (2) Vowel phonemes (oral) (p. 2)

	front	central	back
high	i		u
upper-mid	e		o
lower-mid			ɔ
low		a	

### (3) Vowel phonemes (nasal)

	front	central	back
high	ĩ		
upper-mid	ẽ		
lower-mid			õ
low		ã	

Taiwanese Hokkien tones are composed of combinations of three tone levels: a low (~137-143 Hz), medium (~170-183 Hz), and high tone (~above 183 Hz), indicated by the numbers 1, 3, and 5 respectively corresponding to musical tones do, re, and mi [4]. These frequencies can be seen to vary in the speaker, and are a slight discrepancy between my speaker and my sources. These levels are contrastive, as seen in ki<sub>13(33)</sub> and ki<sub>55</sub> (6b, 9b) which are different words but differ only in tone, and are confirmed by elicitations. Chung divides two categories of tones: E-tones (entering tones) and Non-E tones to explain two systems of tone-sandhi. As is relevant for the topic of tone sandhi, the tonemic inventory of Hokkien Taiwanese, according to Chung 1996, is also included:

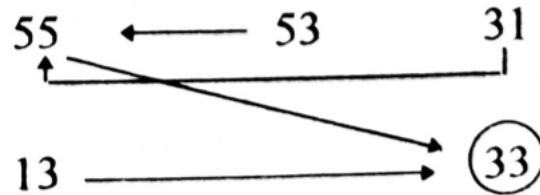
### (4) Citation tones and sandhi tones (p. 3)

	Non-E tones					E-tones	
citation tones	55	13	33	31	53	55	31
	HH	LM	MM	ML	HM	HH	ML
	33	33	31	53	55	31	55



A special case can also be seen with words ending in the -a<sub>53</sub> diminutive suffix, placed by morphological rule. The mid-level tone 33 remains unaltered while the mid-low tone 31 becomes the high level tone 55 [1]. All other tones undergo the general sandhi pattern seen in (7). The diagram for this special case is thus figure (8):

(8) Special sandhi before -a<sub>53</sub> diagram (Chung's Diagram [1] p. 7)



Below are examples of the diminutive -a<sub>53</sub> special sandhi pattern.

(9) Illustrating examples of tone sandhi (p. 7)

	without suffix	with suffix	gloss
a.	33	33	
	te <sub>33</sub>	te <sub>33</sub> a <sub>53</sub>	'bag'
	ts'i <sub>w</sub> <sub>33</sub>	ts'i <sub>w</sub> <sub>33</sub> wa <sub>53</sub>	'tree'
b.	31	55	
	ki <sub>55</sub>	ki <sub>55</sub> ya <sub>53</sub>	'sawyer'
	in <sub>31</sub>	in <sub>31</sub> nã <sub>53</sub>	'seal'
c.	13	33	
	tsim <sub>13</sub>	tsim <sub>33</sub> mã <sub>53</sub>	'crab'
	kaw <sub>13</sub>	kaw <sub>33</sub> wa <sub>53</sub>	'monkey'
d.	53	55	
	kaw <sub>53</sub>	kaw <sub>55</sub> wa <sub>53</sub>	'dog'
	i <sub>53</sub>	i <sub>55</sub> ya <sub>53</sub>	'chair'
e.	55	33	
	kam <sub>55</sub>	kam <sub>33</sub> mã <sub>53</sub>	'orange'
	kaw <sub>55</sub>	kaw <sub>33</sub> wa <sub>53</sub>	'hook'

As seen in figure 9, the suffix tone does not change and only one rule is still applied, the special sandhi rule.

### 3. Tone Sandhi in the Speech of Consultant Jason Yang

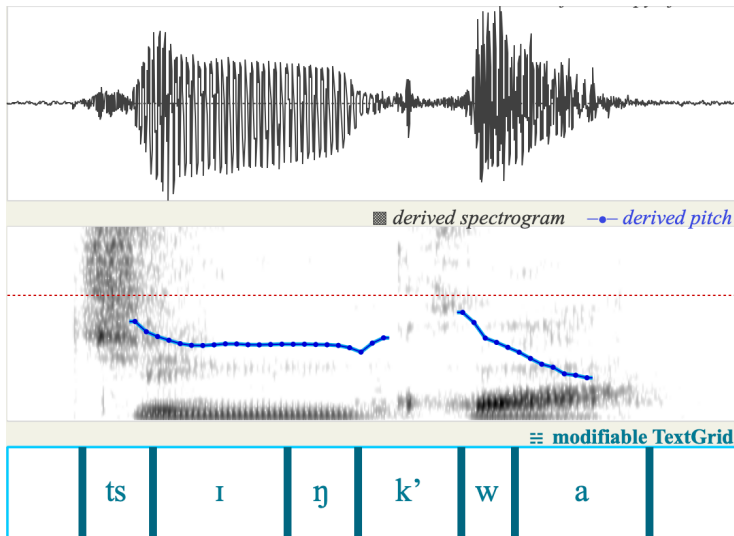
I began my session with my speaker by eliciting items to show all movements composing of general tone sandhi (10).

(10) **Examples of basic tone:** Non-E tones (all taken from [1] unless otherwise specified)

	<i>Chung's underlying form</i>	<i>Chung's surface form</i>	<i>gloss</i>	<i>Chinese Analogous Characters</i>
<b>55 -&gt; 33</b>				
1.	sim <sub>55</sub> + kyat <sub>31</sub>	sim <sub>33</sub> + kyat <sub>31</sub>	'an unforgettable feeling'	心结
2.	tsin <sub>55</sub> + ki <sub>13</sub>	tsin <sub>33</sub> + ki <sub>13</sub>	'very strange'	很奇
3.	seŋ <sub>55</sub> + waʔ <sub>55</sub>	seŋ <sub>33</sub> + waʔ <sub>55</sub>	'living'	生活
4.	tsin <sub>55</sub> + k'waʔ <sub>31</sub>	tsin <sub>33</sub> + k'waʔ <sub>31</sub>	'very wide'	很宽
<b>13 -&gt; 33</b>				
5.	ki <sub>13</sub> + kway <sub>31</sub>	ki <sub>33</sub> + kway <sub>31</sub>	'strange'	奇怪
6.	ki <sub>13</sub> + mÿãw̃ <sub>33</sub>	ki <sub>33</sub> + mÿãw̃ <sub>33</sub>	'miraculous'	奇妙
<b>33 -&gt; 31</b>				
7.	ta <sub>33</sub> + ta <sub>33</sub>	ta <sub>31</sub> + ta <sub>33</sub>	'very dry'	干干
<b>31 -&gt; 53</b>				
8.	kway <sub>31</sub> + ts'iw <sub>53</sub>	kway <sub>53</sub> + ts'iw <sub>53</sub>	'bulldozer'	怪的手
9.	kwaʔ <sub>31</sub> + ts'ay <sub>31</sub>	kwaʔ <sub>53</sub> + ts'ay <sub>31</sub>	'to cut vegetables'	切菜
<b>53 -&gt; 55</b>				
10.	ts'iw <sub>53</sub> + sim <sub>55</sub>	ts'iw <sub>55</sub> + sim <sub>55</sub>	'palm'	手心

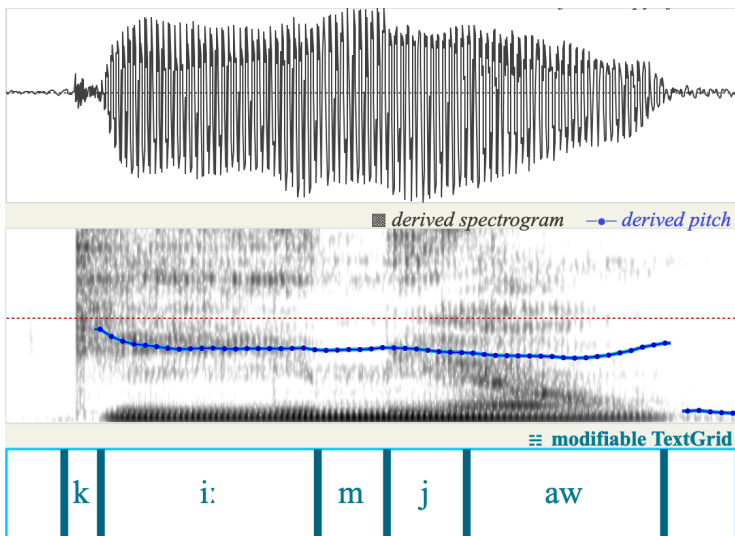
I found that the tones for 1, 3, and 5 tended to vary in terms of specific frequency ranges, but stayed in consistent relative pitch. Transitions between syllables with transitions between dramatically different tones result in phonological glide insertion that I don't include as a part of tones. With this, tone sandhi can be seen in the following pitch tracks (11).

**(11) Pitch Tracks of Elicited General Tone Sandhi:**



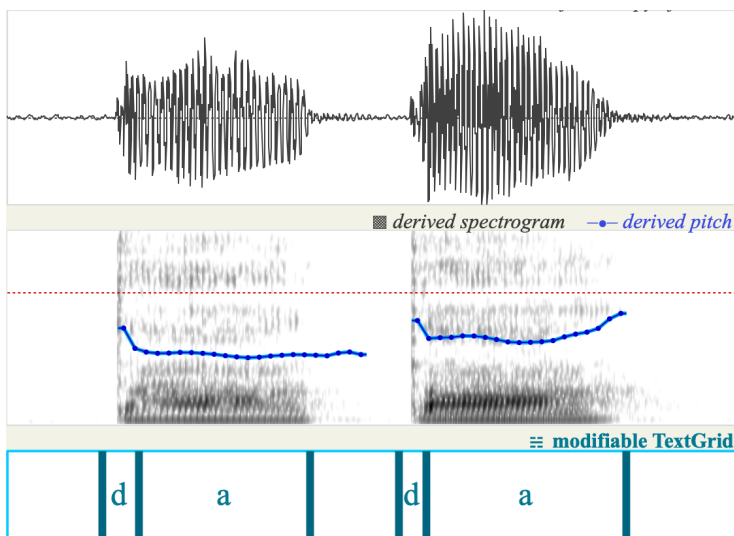
**55 -> 33** 4. tsin<sub>55</sub> + k'waʔ<sub>31</sub> -> tsin<sub>33</sub> + k'waʔ<sub>31</sub>

Since pitch is relative in Jason's speech, the first tone is identifiable as an even tone but unable to be distinguished as either 33 or 55, though the next tone, which does not undergo sandhi is a 31, so we can infer that the first even tone, which has a pitch below the starting position of the 31 tone, is a mid even tone, rather than a high one.



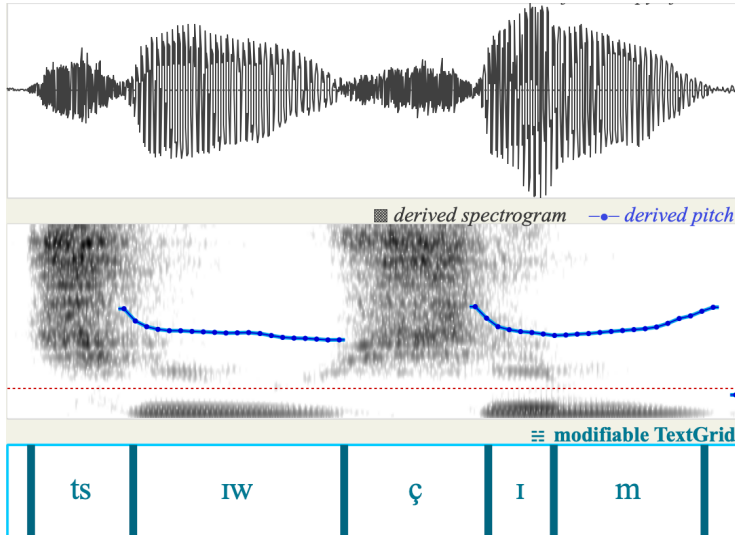
**13 -> 33** 6. ki<sub>13</sub> + mÿãw̃<sub>33</sub> -> ki<sub>33</sub> + mÿãw̃<sub>33</sub>

Here is an incredible example of even mid tone, which is kept at nearly the exact pitch across syllables due to the glide and voiced nature of the transition.



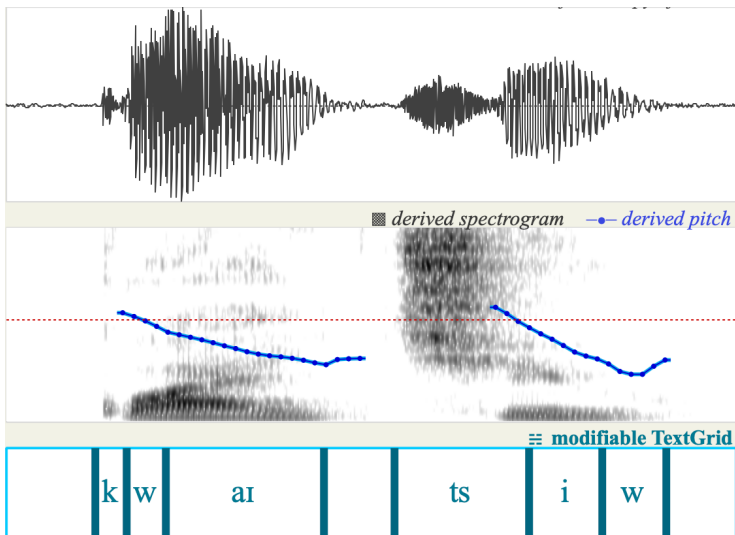
**3 -> 31** 7. ta<sub>33</sub> + ta<sub>33</sub> -> ta<sub>31</sub> + ta<sub>33</sub>

Though subtle, the second syllable's pitch track rises above the first one, and in the waveform, it is presented as louder to distinguish the syllables after emphatic-stressed reduplication.



53 -> 55 10. ts'iw<sub>53</sub> + sim<sub>55</sub> -> ts'iw<sub>55</sub> + sim<sub>55</sub>

Two high even tones can be seen in the surface elicitation.



31 -> 53 8. kway<sub>31</sub> + ts'iw<sub>53</sub> -> kway<sub>53</sub> + ts'iw<sub>53</sub>

Pitch tracks show a clear fall in both syllables, both of which begin and end in relatively the same range.

### Examples of basic tone: E-tones

E-tones are defined as entering-tones which govern E-syllables that end in a voiceless obstruent (/p/, /t/, /k/) or a glottal stop. According to Chung, they accompany E-syllables which are shorter in duration. Tone Sandhi for E-tones consists of two movements: the movement of 31 to 55 and vice versa accompanies voiceless obstruent ending E-syllables, and E-tones become non-E tones for E-syllables that end in a glottal stop. The glottal stop is removed along with the tone change. Here is the evidence supporting Chung's analysis:

(12) I present the elicited results for the specific tones which are variations from general tone sandhi:

55 -> 31				
11.	hap <sub>55</sub> + tsok <sub>31</sub>	hap <sub>31</sub> + tsok <sub>31</sub>	'cooperate'	合作
31 -> 55				
12.	kyat <sub>31</sub> + hap <sub>55</sub>	kyat <sub>55</sub> + hap <sub>55</sub>	'combine together'	结合
glottal stop tone sandhi				

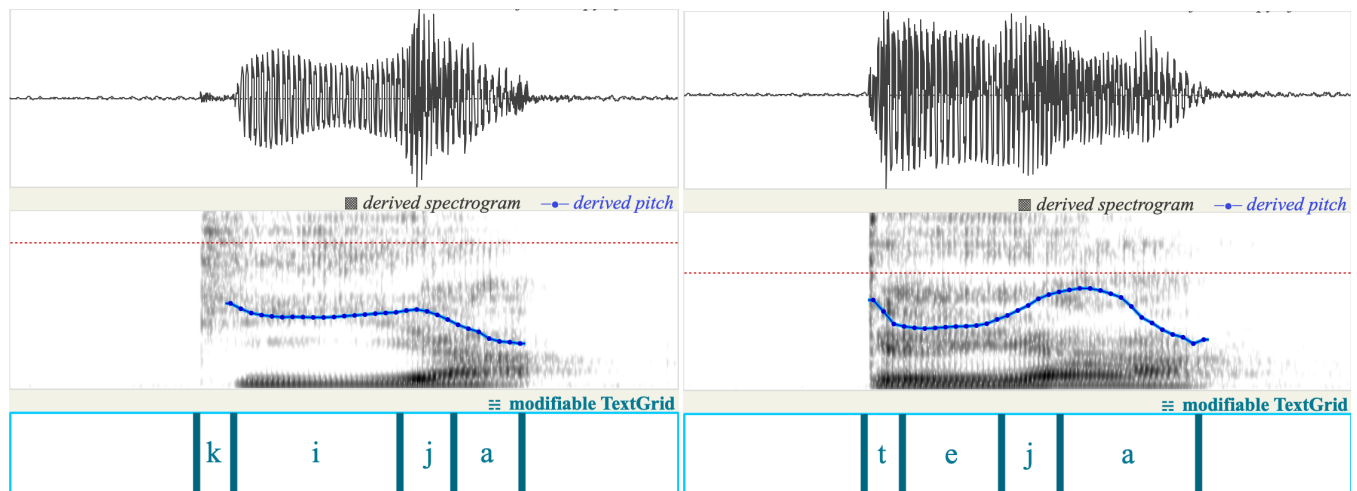
<b>55 -&gt; 31</b>				
13.	waʔ <sub>55</sub> + mÿã <sub>33</sub>	wa <sub>31</sub> + mÿã <sub>33</sub>	'to survive'	存活
<b>31 -&gt; 53</b>				
14.	k'waʔ <sub>31</sub> + tɔ <sub>33</sub>	k'waʔ <sub>53</sub> + tɔ <sub>33</sub>	'width'	宽度

**(13) Examples of Special Tone Sandhi:** Involving diminutive -a<sub>53</sub> suffix

The diminutive -a<sub>53</sub> suffix is a common case which involves a different sandhi cycle. The mid-tone 33 is unaltered while the mid-falling tone 31 becomes high level tone 55. The other tones undergo tone sandhi as per the general tone sandhi pattern. Presented are the elicited results for the specific tones which are variations from general tone sandhi.

<b>33 -&gt; 33</b>				
15.	te <sub>33</sub> + a <sub>53</sub>	te <sub>33</sub> + a <sub>53</sub>	'bag'	
16.	ts'iw <sub>33</sub> + a <sub>53</sub>	ts'iw <sub>33</sub> + wa <sub>53</sub>	'tree'	
<b>31 -&gt; 55</b>				
17.	ki <sub>31</sub> + a <sub>53</sub>	ki <sub>55</sub> + ya <sub>53</sub>	'sawyer'	
18.	in <sub>31</sub> + a <sub>53</sub>	in <sub>55</sub> + nã <sub>53</sub>	'seal'	
<b>13 -&gt; 33</b>				
19.	tsim <sub>13</sub> + a <sub>53</sub>	tsim <sub>33</sub> + mã <sub>53</sub>	'crab'	
20.	kaw <sub>13</sub> + san + a <sub>53</sub>	kaw <sub>33</sub> + san + a <sub>53</sub>	'monkey'	
<b>53 -&gt; 55</b>				
21.	kaw <sub>53</sub> + a <sub>53</sub>	kaw <sub>55</sub> + wa <sub>53</sub>	'dog'	
22.	i <sub>53</sub> + a <sub>53</sub>	i <sub>55</sub> + ya <sub>53</sub>	'chair'	
<b>55 -&gt; 33</b>				
23.	kam <sub>55</sub> + a <sub>53</sub>	kam <sub>33</sub> + mã <sub>53</sub>	'orange'	
24.	kaw <sub>55</sub> + a <sub>53</sub>	kaw <sub>33</sub> + wa <sub>53</sub>	'hook'	

**(14) Pitch Tracks of Elicited Special Sandhi Differences:**



**31 -> 55** 17. ki<sub>31</sub> + a<sub>53</sub> -> ki<sub>55</sub> + ya<sub>53</sub>

**33 -> 33** 15. te<sub>33</sub> + a<sub>53</sub> -> te<sub>33</sub> + a<sub>53</sub>



In the first syllable, we see a long syllable that shows the high even tone. The second syllable descends from that pitch to a mid level tone.

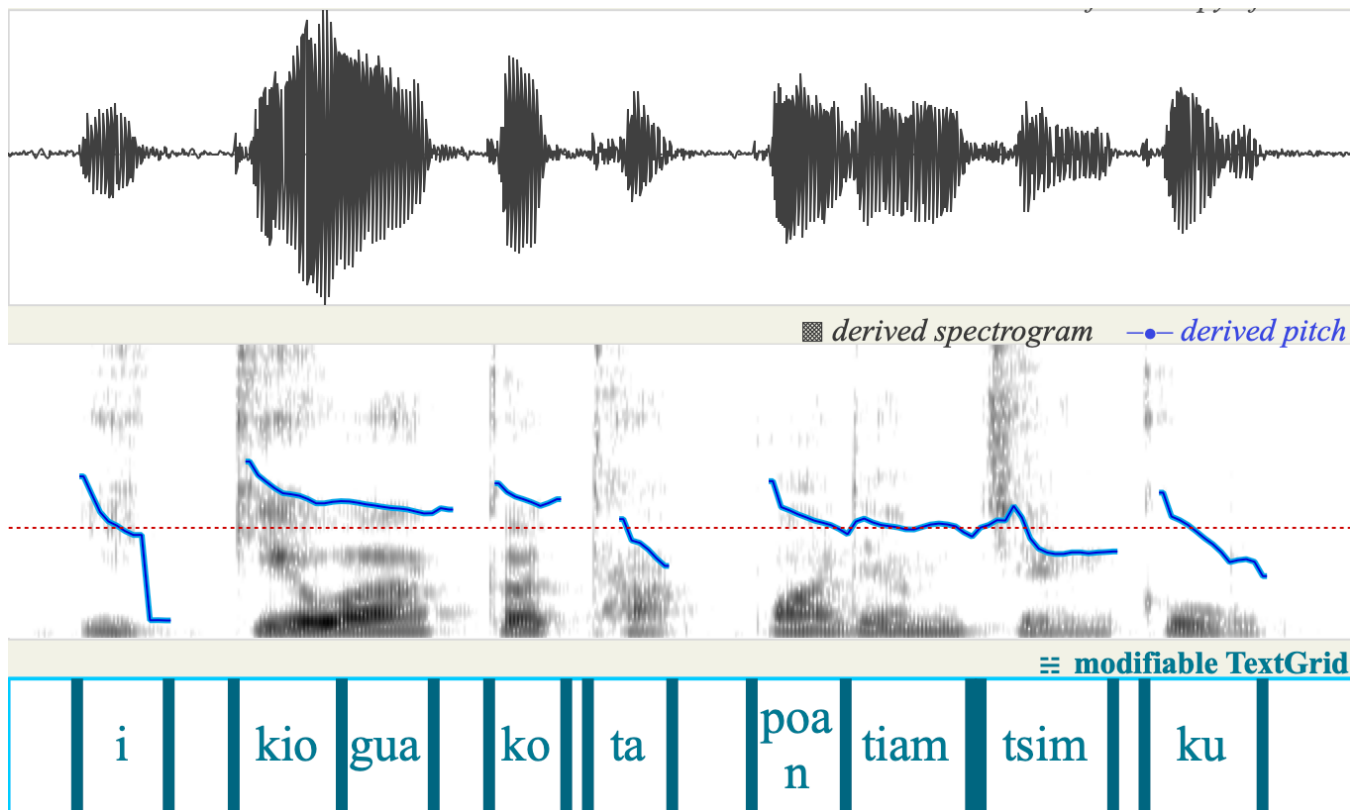
Barring the period of transition pitch marked by the glide, we can see from the pitch track that the first syllable maintains a relatively even mid tone.

### 3.1 Tone Sandhi Boundaries: based on syntactic structure

Tone sandhi in a typical prosodic structure is infinitely applicable in theory. Since tone sandhi arises so long as there is a citation tone in the position after it, only word end tones are exempt from tone sandhi. As shown in (25), tone sandhi is applied to every syllable except the last one. All examples for this section are taken from [5] unless otherwise specified. Examples in the section denoted syntax-motivated tone-sandhi boundaries, tone is not given by Chen, and thus I will be eliciting individual tones from the speaker and testing if the tone sandhi boundaries given can be replicated when each phrase is spoken. I will use the same symbolic legend Chen uses, with # denoting the right boundary of sandhi domains, and = denoting the absence of boundaries, that is, that the phrases on either side belong to the same sandhi domain.

#### (15) Motivating Examples for tone sandhi bounding domains

<i>Example of tone sandhi iterative property</i>				
25.	i <sub>55</sub> kio <sub>31</sub> gua <sub>51</sub> koh <sub>31</sub> ta <sub>51</sub> poaN <sub>31</sub> tiam <sub>51</sub> tsim <sub>55</sub> ku <sub>53</sub>	i <sub>33</sub> kio <sub>51</sub> gua <sub>55</sub> koh <sub>51</sub> ta <sub>51</sub> poaN <sub>51</sub> tiam <sub>55</sub> tsim <sub>33</sub> <b>ku</b> <sub>53</sub>	'he told me to read for half an hour.'	他叫我读书一半钟头
<i>Syntax-motivated tone-sandhi boundaries</i>				
	<i>sandhi boundaries</i>	<i>direct orthography</i>	<i>semantic translation</i>	<i>characters</i>
26.	i [sia = khah kin] <sub>VP</sub>	he write = more fast	'he write faster'	他写超快
27.	[i sia] <sub>S</sub> # khah kin	he write # more fast	'it would be faster for him to write'	他写, 超快
28.	moa-a # toa # e sio-piaN	sesame seed # big # E bun	'buns with big sesame seeds'	芝麻, 大, 的馅饼
29.	moa-a = toa # e sio-piaN	sesame seed = big # E bun	'buns as big as sesame seeds'	芝麻大, 的馅饼
30.	i loan-chu = kong	he mindlessly = talk	'he is talking mindlessly'	我乱去讲
31.	gua ka-chai # che chit pan ki	I fortunately # take this CI flight	'fortunately, I am taking this flight'	我幸运乘坐这航班

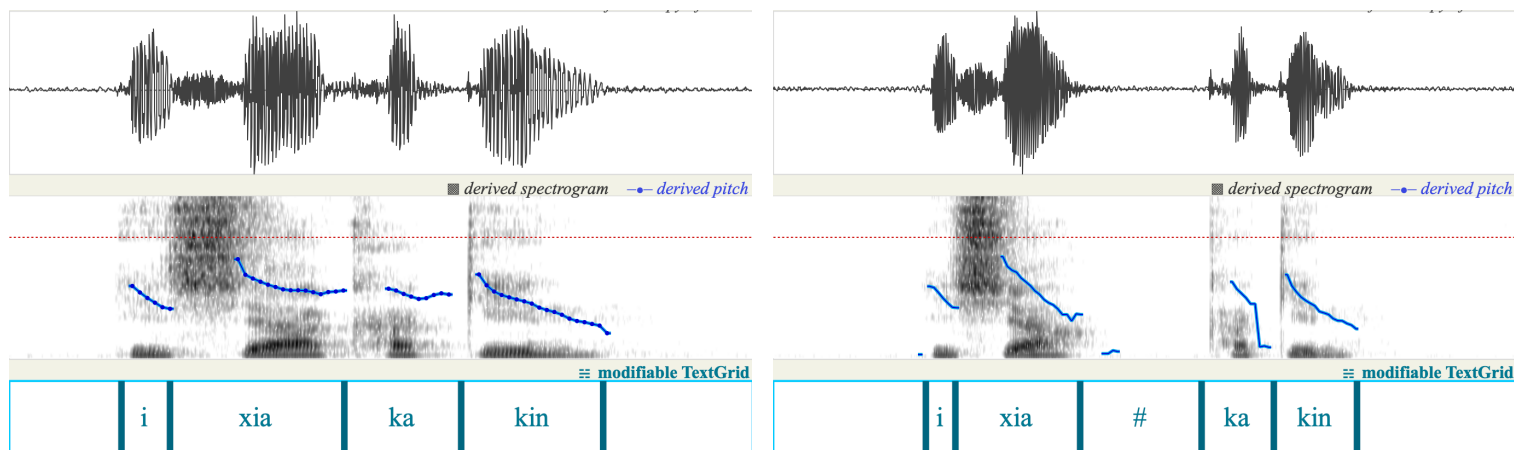


**(16) Elicitation of Iterative Property of Tone Sandhi**

*All syllables undergo tone sandhi except for at the last syllables of phrase bounding domains.*

In the above example, the predicted tone sandhi given rule applies an iteration at every syllable that isn't at the phrase end, is  $i_{33}$   $kio_{51}$   $gua_{55}$   $koh_{51}$   $ta_{51}$   $poaN_{51}$   $tiam_{55}$   $tsim_{33}$   **$ku_{51}$** . As stated before, Jason's tone sandhi differs from Chung's analysis only in pitches of 1, 3, and 5. Even within a phrase, the exact frequency ranges for these tone positions varies. Relative tone is still detectable—as seen in the pitch tracks—but variable. For example, even though *ko* and *ta* are the same tone (51) and both falling tones in the pitch tracks, the pitch positions starting and ending the tone are largely different. Vitally, we can see that the last syllable *ku*, does not undergo tone sandhi to an even high tone (55).

**(17) Evidence of Phrasal Boundaries in 26. and 27.**



In the elicited pitch tracks above, we can see that the *xia*<sub>53</sub> (write) syllable in 26. is *xia*<sub>55</sub> when it is at the end of the phrase boundary in 27. Semantically, these two sentences have different meanings and in the *xia* syllable, we can see evidence of the 55 -> 53 tone sandhi movement.

Further specifications on the phrasal domain boundaries on tone sandhi are explored in the following section.

In a phrase, Chen suggests that tone sandhi applies between adjuncts and the following constituent to which the adjunct attaches. No sandhi domain boundary occurs between the adjunct and the phrase it is modifying. Otherwise, such boundaries are found at the end of VPs, NPs, and AdjPs which are not modifying each other. Another syntactic pattern that Chen notes is that not all adjuncts behave the same. Sequential adverbs constitute their own sandhi domains but VP adverbs combine their domain with the following verb.

(18)

<b>Sequential adverbs and VP adverb distinction</b>				
32.	ki-sit # au-pai # kho-leng # i e khi Bi-kok #	actually # next time # maybe # he will go USA #	'actually, next time maybe he will go to USA'	其实, 下次, 可能, 他会去美国
33.	keh-tng-kang # chiah e tng #-lai0	the second day # just will # return	'(she) will not return until the next day'	第二天, 只是会, 来
34.	i bo [loan-chu] <sub>AdvP</sub> = kong	he not mindlessly = talk	'he didn't mindlessly talk'	我不乱去讲
35.	[ka-chai] <sub>AdvP</sub> # gua che chit pan ki	fortunately # I take this CI flight	'fortunately, I took this flight.'	幸运, 我乘坐这航班
36.	gua [ka-chai] <sub>AdvP</sub> # bo che chit pan ki	I fortunately # not take this CI flight	'fortunately, I did not take this flight.'	我幸运, 不乘坐这航班

Other cases of syntax-dictated tone sandhi boundaries are listed in the following cases:

1. In double-object construction, tone sandhi applies between verb and its following object. The boundary is located between the two objects in a verb. (37 - 39)

2. Pronouns phrase together with whatever follow them if not contrastive with the following modifier.

(40)

(19)

<b>Double-Object Verb</b>				
37.	i kai-siao chit e lau peng-iu # h0 in b0	he introduce one CI old friend # to his wife	'he introduced an old friend to his wife.'	他介绍一位老朋友, 给他的妻子
38.	i ka tang-oh # kai-siao chit e lu-peng-iu	he to schoolmate # introduce one CI girl-friend	'he introduced a girl-friend to his school-mate.'	他对同学, 介绍了一个女朋友

39.	i chiong hit pun chheh # sang hou tang-oh	he obj-marker that CI book # give to schoolmate	'he gave that book to his schoolmate.'	他把那本书, 给了他 的同学
40.	i kau-tai in nng e lang # m-thang sui-pian # ka lang khui mmg #	she urge them two # people # cannot arbi- trarily for someone open door #	'she urges them not to arbitrarily open the door for strangers'	她叮嘱他们两, 人, 不要随意给陌生人 开门,

As a rule of thumb, phrases that are about the same 'topic' share the same sandhi domain. In my recording, I'll be looking firstly for evidence of general tone sandhi with Non-E tones, general tone sandhi with E-tones, and special sandhi with diminutive suffix, and secondly, for evidence of syntactic sandhi boundary domains.

#### 4. Audio Recording

To illustrate Hokkien tone sandhi in Jason's speech, Jason and I made a recording, included in the attached wave file, giving suitable examples including all that appear in the paper, and a few extra that were recommended by Jason. The transcript of the recording is matched in the elicitation report, section 3, and includes the underlying representations, glosses, analogous Chinese characters to guide the speaker, and phonetic transcriptions for surface forms having undergone tone sandhi.

#### 5. Summary and Conclusion

My study of tone sandhi in Hokkien showed very close agreement with Chung's findings. A few phenomenon seen in common speech are notable. Tone pitches differ, but will maintain the falling, even, or rising nature of the surface tone sandhi. Tones in syllables that are uttered in quick succession, tend to even out the extreme pitches of one another. For example, a high falling tone (51) may become closer in utterance to a (53) tone if followed by a tone that begins at a mid level. The speaker seems to maintain a mental construct of the correct tone sandhi even if the utterance varies based on neighboring tones and relative pitch. This suggests that this pattern is intuitive and subconscious and applied across all utterances. The speaker also forced pauses in speech to elicit the syntactically differing meanings in phrases such as "buns with big sesame seeds" and "buns as big as sesame seeds". Further study could look into the poetic and prose elements that play a role in tone sandhi, as the speaker seems able to elicit a phrasal boundary even when not syntactically understood, simply by pausing.

#### 6. References

- [1] Chung, Raung-fu. *The Segmental Phonology of Southern Min in Taiwan*. Crane Pub. Co., 1996.
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