Can a perceptual experiment reflect tonogenesis in Tai?

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A reconstruction of the tonal systems in languages within the Tai language family (Li 1977) showed that tonogenesis (termed by Matisoff 1973) in Tai languages arose from a neutralisation of a voicing contrast in prevocalic consonants: new higher tonal variants after what had been voiceless consonants and new lower tonal variants after what had been voiced consonants. The two groups are pronounced as voiceless unaspirated stops in Lungchow (a language representing the Central group of Tai) and Po-ai (a language representing the Northern group of Tai), and as voiceless aspirated stops in Siamese or Standard Thai (a language representing the South-western group of Tai). This is illustrated below:

Proto-Tai: a voiceless aspirated dental stop **th-* (from Li 1977)

	Lungchow	Po-ai	Siamese
'to pull out'	-	toon	thɔɔn

Proto-Tai: a voiceless unaspirated dental stop **t-* (from Li 1977)

	Lungchow	Po-ai	Siamese
'to castrate'	toon	toon	tɔɔn

Proto-Tai: a voiced dental stop **d-* (from Li, 1977)

	Lungchow	Po-ai	Siamese
'section'	toon	toon	thɔɔn

The cue to differentiate the two sets, namely, the Proto-Tai voiceless aspirated stops and the Proto-Tai voiced stops, is no longer the voicing but the fundamental frequency (Fo) variations of vowels following these consonants. (Abramson and Erickson 1992; Abramson 1997; Haudricourt 1956; Matisoff 1973; Ohala 1973; and

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Whalen et al. 1993) Vowels after original voiceless stops have a higher tone; whereas vowels after voiced stops have a lower tone. The development of these Fo distinctions led to the split of tones in Tai languages from three tones in Proto Tai to six tones in Lungchow and Po-ai and five tones in Siamese. The tones, and examples from each language, can be seen below (adapted from Li 1977 and Abramson and Erickson 1992):

Lungchow: six tones: 3-3, 3-1, 5-5, 1-1, 2-4, and 2-1.

Proto-Tones[1]	[voice]	Tones	Examples
A	voiceless	3-3	*pai* 'to go'
	Voiced	3-1	*taa* 'to smear'
B	voiceless	5-5	*khau* 'knee'
	Voiced	1-1	*taa* 'wharf'
C	voiceless	2-4	*khaa* 'to kill'
	Voiced	2-1	*nam?* 'water'

Po-ai: six tones: 2-4, 3-1, 5-5, 2-2, 3-3, and 4-4.

Proto-Tones	[voice]	Tones	Examples
A	voiceless	2-4	*pai* 'to go'
		or 3-1	*?au* 'to take'
	voiced	5-5	*taa* 'to smear'
B	voiceless	2-2	*hoo* 'knee'
	Voiced	3-1	*taa* 'wharf'
C	voiceless	4-4	*kaa* 'to kill'
	Voiced	3-3	*lam* 'water'

Siamese: five tones: 2-4, 3-3, 2-2, 4-1, and 4-5-3 (There is a merge between B2 and C1).

[1]Proto tones A, B, and C occur in live syllables (syllables which do not have stops as finals).

Proto-Tones	[voice]	Tones	Examples
A	voiceless	2-4	*khaai* 'to sell'
		or 3-3	*pai* 'to go'
	voiced	3-3	*thaa* 'to smear'
B	voiceless	2-2	*khau* 'knee'
	Voiced	4-1	*thaa* 'wharf'
C	voiceless	4-1	*khaa* 'to kill'
	Voiced	4-5-3	*thɔɔŋ* 'stomach'

Today, Tai languages such as Lungchow and Siamese have three sets of stops; voiceless aspirated stops (from Proto-Tai voiceless aspirated stops in Lungchow and Siamese, and Proto-Tai voiced stops in Siamese), voiceless unaspirated stops (from Proto-Tai voiceless unaspirated stops in Lungchow and Siamese, and Proto-Tai voiced stops in Lungchow), and voiced stops (from Proto glottalized voiced stops in Lungchow and Siamese). Some examples follow (from Li 1977):

Proto Tai	Siamese	Lungchow	Tone
1. Proto-Tai voiceless unaspirated stop (labial)			
**p*	p	p	
ex. 'year'	pii	pii	A1
2. Proto-Tai voiceless aspirated stop (labial)			
**ph*	ph	ph, p	
ex. 'male'	phuu	phuu	C2
3. Proto-Tai voiced stop (labial)			
**b*	ph	p	
ex. 'fat'	phii	pii	A2
4. Proto-Tai pre-glottalized stop (labial)			
**ʔb*	b	b	
ex. 'shoulder'	baa	baa	B1

It is of interest to see how important these Fo cues (or any other cues associated with the stops) are to Tai listeners and it was therefore decided to see whether an

experiment in the lab could duplicate one stage of the tonogenesis process in Tai. For this reason, a perceptual experiment was conducted.

Experiment

The Siamese (Standard Thai) language was chosen for this experiment. The goal of this experiment was to see whether Siamese (Thai) listeners could differentiate voiced-voiceless stop minimal pairs without the main cues for the voicing itself.

Procedure. Six minimal pairs of Siamese (Standard-Thai) words were chosen for this experiment:

Voiceless	meaning	voiced	meaning	tone
1) paan	'as if'	baan	'to bloom'	[mid]
2) pàa	'forests'	bàa	'shoulders'	[low]
3) pâa	'aunt'	bâa	'crazy'	[rising-falling]
4) tææŋ	'melon'	dææŋ	'red'	[mid]
5) tàp	'liver	dàp	'to extinguish'	[low]
6) tâan	'to resist'	dâan	'sides'	[rising-falling]

Each pair contained a word with a voiceless unaspirated stop and the other, a word with a voiced stop.[2] The first three pairs had initial labial stops and the other three pairs had initial dental stops. Pairs 1 and 4 had a mid tone, pairs 2 and 5 had a low tone, and pairs 3 and 6 had a rising-falling tone. All the words were read in the context, "*nii* + a targeted word" meaning "This is____," recorded on an analog tape recorder, and subsequently digitised at a sample rate of 10 kHz.

In this experiment, we prepared 13 sets of tokens. The first set contained the unprocessed tokens which were the same as what we recorded (*nîi* + a targeted word). For the following six sets which were in the context *nîi* + a targeted word, we digitally gated the initial portions of each targeted word with six 25-ms steps. For the first step,

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[2]I assume that the "voiced stops" in contemporary Central Thai (historically from the preglottalized series **ʔb* and **ʔd*) can serve to represent the "voiced stop," and the voiceless stops in contemporary Central Thai (historically from the voiceless stop series **p, *t, *k,* etc.) can represent the "voiceless unaspirated stops" for the purposes of this perceptual experiment, cf. Li 1977.