

Central Thai Phonology

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1. Overview

Thai (ISO-639-3: tha), the national language of Thailand, is one of two national languages in the Tai-Kadai family. Of the Tai-Kadai languages, it is also the best-described and is the macrolanguage with the most speakers (Diller 2008:4). In this paper, we examine the ‘Central’ or ‘Central Plains’ dialect and survey several outstanding accounts of Thai phonology. We compare seminal original work such as Abramson (1962) and Noss (1964) with excellent contemporary accounts such as Iwasaki (2005), Diller (2008:32-34), and others.

2. Geographical Distribution

Central Thai use is prevalent within a radius of about 200 miles of the capital city, Bangkok, and extends throughout the Chao Phraya river delta (Noss 1964:2, Diller 2002:77). Within the capital city itself, there is characteristic allophonic variation. We adopt Diller’s view that this variation is subsumed by the Central Thai phonology we describe. Our text will point out those instances of allophonic variation which are particularly characteristic of the Bangkok sub-dialect.

3. Speaker Population

About 80% of Thailand’s 68 million (United Nations 2008) inhabitants speak one of four Thai dialects, which are broadly characterized as Central, Northern, Southern, and Isaan (Northeastern). Estimating the proportion of these that are Central Thai speakers is difficult, in part because urban migration is underway (*ibid.*), which introduces regional dialects into the heart of the Central dialect region, affecting population distribution as well as dialect stability. Taking urban

population at 32%, we estimate 16 million speakers of Central Thai within Thailand. This estimate is consistent with estimates of Ethnologue (Lewis 2009) and Iwasaki (after Smalley) (Iwasaki and Ingkaphirom 2005:xxvii) of 20-25 million speakers worldwide.

4. Phoneme Inventory

The consonant and vowel phonemes of Central Thai are described below; Appendices A and B present feature charts for the consonants and vowels, and Appendix C is an illustrative wordlist organized according to minimal or near-minimal sets.

4.1. Consonant Phonemes

Central Thai has twenty contrastive consonant phonemes (Diller 2008:32). Adopting the view of Abramson (1962), Harris (2001:7), and others, we exclude glottal stop on the basis that it is predicted by stress environment (Noss 1964:9) (see Sections 8.3 and 8.4).

4.1.1. Syllable-Initial

All consonant phonemes (and zero) contrast in syllable-initial position. A notable feature of Thai is the three-way voicing/aspiration contrast in bilabial /p p^h b/ and alveolar oral stops /t t^h d/; only the voiced-aspirated combination is absent (Harris 2001:4). Aspiration alone is contrastive in voiceless velar /k k^h/ and post-alveolar, affricated /tʃ tʃ^h/ oral stops [wordlist sets 1 and 2].

	Bilabial	Labiodental	Alveolar	Post-Alveolar	Palatal	Velar	Glottal
Plosive	p p ^h b		t t ^h d			k k ^h	
Nasal	m		n			ŋ	
Trill			r				
Fricative		f	s				h
Affricate				tʃ tʃ ^h			
Approximant					j		
Lateral Approximant			l				

w	Voiced labial-velar approximant
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Table 1. Syllable-Initial Consonant Phonemes

Voiced nasal stops occur at the bilabial /m/, alveolar /n/, and velar places /ŋ/ (Diller 2008:32). Three fricatives occur at the labiodental /f/, alveolar /s/, and glottal /h/ places, all voiceless. Alveolar articulations also include trill /r/ and lateral approximant /l/; we thus observe seven phonemes at the alveolar place: three oral stops, voiced nasal stop, voiced trill, voiceless fricative, and voiced lateral approximant. Completing the consonant inventory are palatal /j/ and labial-velar /w/ approximants.

4.1.2. Syllable-Final

A proper subset of ten of the consonant phonemes, plus zero, is permitted in syllable-final position. This includes the unvoiced oral stops /p t k/ and the voiced nasal stops /m n ŋ/ (Iwasaki 2005:4) [wordlist sets 6-8]. Final /s/ and /f/ are attested in loanwords such as ก๊าซ /kɛːs/ “gas” and กอล์ฟ /kɔːf/ “golf.”

Our treatment of labial-velar approximant /w/ and voiced palatal approximant /j/ as glide finals (as opposed to diphthong segments) is confirmed by the prohibition of final consonant clustering in syllable phonotactics (see Section 5) (ibid., Tingsabadh 1993:26).

4.1.3. Consonant Clusters

/l/ and /r/ form contrastive initial clusters with initials /p p^h k k^h/; the trill also clusters with /t/ [wordlist set 21]. The aspirated alveolar cluster /t^hr/ is rare and may invoke epenthesis /t^hər/. Labial-velar clusters /kw/ /k^hw/ are also attested (Iwasaki 2005:5).

4.2. Vowel Phonemes

Each of the nine vowel phonemes has a long variant, giving a total of eighteen monophthongal phonemes. Although Brown (1979) suggests that, for the mid- and high vowels, the geminate distinction may be disappearing, Abramson (2001) confirms the contrast experimentally. Front phonemes are high /i iː/, mid /e eː/, and mid-low /ɛ ɛː/, all unrounded. We discuss quality differences within front pairs in Section 8.1. Low central /a aː/ are unround. Back phonemes include high /u uː/, mid /o oː/, and mid-low /ɔ ɔː/, all rounded.

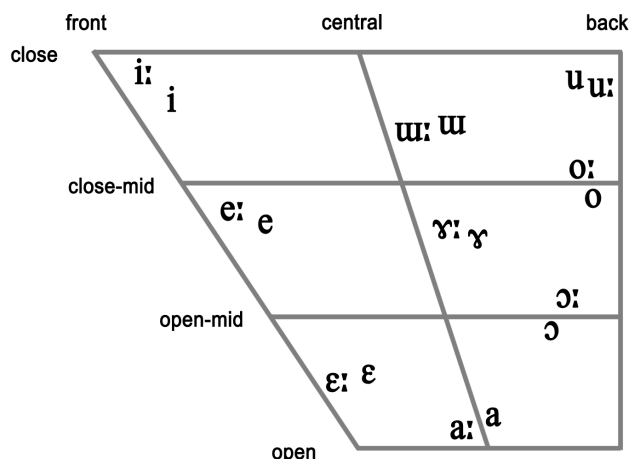


Figure 1. Vowel Monophthong Phonemes

i	high	front	unround
ɯ	high	near-back	unround
u	high	back	round
e	mid	front	unround
ɤ	mid	near-back	unround
o	mid	back	round
ɛ	mid-low	front	unround
ɔ	mid-low	back	round
a	low	central	

Table 2. Vowel Monophthong IPA

As with other Tai languages, the high near-back /u ɯ:/ and mid near-back /ɤ ɤ:/ unround vowels are a characteristic feature (Henderson 1975:260). We concur with Henderson's (1975:261) IPA selections, including her considered use of back symbols for these two near-back phonemes (Abramson 1962).

4.3. Compound Vowel Phonemes

Each long high monophthong forms an *opening* diphthong with /a/ in open and closed syllables: /i:a u:a ɯ:a/ [wordlist sets 18 and 19]. Short variants are unattested for /u:a/; for /i:a/ and /u:a/ the short variant is rare and found in open syllables only (Diller 2008:33) [wordlist set 20].

Syllable-final appearance of glides /j/ and /w/ is alternatively treated as a *closing* diphthong or triphthong sequence in some analyses (M-H. Brown 1993:22). In this view, the number of diphthongs increases considerably, to include: /iu/, /eu/, /ɛu/, /au/, /iau/, /ai/, /ɔi/, /ui/, /ɤi/, /uai/, /ɯau/, and certain respective long variants (Tingsabadh et al. 1993:25). Because stop finals are not attested with the putative diphthongs, this analysis is less predictive.

5. Phonotactics

The structure of a maximal syllable is given by the following (Iwasaki 2005:3):

$$(C_1) (C_2) V^T (/a/) (C_3)$$

$C_1 = \text{any consonant}$
 $C_2 = /w/, /l/, /r/$
 $V = \text{any monophthong}$
 $T = \text{Tone}$
 $C_3 = /p/, /t/, /k/, /m/, /n/, /ŋ/, /j/, /w/$

Initial consonants are optional. When both are present, clustering constraints given in Section 4.1.3 are in effect. Diphthongs from Section 4.3 are activated by the inclusion of the low central vowel /a/. Constraints on the optional syllable-final consonant are given in section 4.1.2.

6. Tones

Most studies of Thai characterize five contrastive tones (Tingsabadh 2001), although some early accounts, such as McFarland (1944:x) and Noss (1964:17) posit a sixth, glottally-constricted high tone. There is agreement on the phonemic labels *Low*, *Mid*, *High*, *Rising*, and *Falling*. Tone sandhi is minimal but we review one author's observations on allotones in section 9. Tone does not contrast with zero; every syllable uses exactly one toneme [wordlist set 17].

Thai phonology classifies syllables into two types, *live* and *dead*. Live syllables include those ending with an open long vowel, nasal stop, or glide. Dead syllables end in an open short vowel or a stop. We adopt this terminology for describing tonotactic constraints in the following paragraphs (Tingsabadh 2001:214).

The mid tone ม้า /māj/ “mule” is pitched at the normal speaking range and does not exhibit contour. The rising tone ไหม /mǎj/ “silk” swoops up through the pitch of the mid tone. These two tones are only attested in live syllables.

The low tone ใหม่ /màj/ “new” is pitched approximately one whole step below this pitch and may dip very slightly. It is attested in both live and dead syllables.

The falling tone ไหม้ /mâj/ “burn” begins quite high and swoops down below the pitch of the mid tone.

The high tone มั้ย /máj/ [particle] begins about one third of an octave above the mid tone, and may rise upwards. (McFarland 1944:x, Haas 1956:x, Abramson 1962:112-141, Abramson 1979:3,5,6).

7. Stress and Prosody

Abramson (1962:17) describes two stress environments, *emphatic* and *contrastive*, which can support allophonic variation. Noss (1964:21) proposes a set of three stress phonemes, *loud onset*, *normal onset*, and *sustained contour*, which combine to create six possible stress contours, and supplies examples for each. Both of these accounts also propose frameworks for the study of Thai intonation and prosody. Finally, Noss elaborates a system for notation of rhythmic phonemes.

A full analysis of these systems is beyond the scope of this summary, but we note the following generalization: Monosyllabic words are stressed; in polysyllabic words, stress falls on the last syllable, and the unstressed syllables (especially if epenthetic), are reduced:

/má hǎ: wít t ^h á ja: laj/	[mǎ hǎ: wít t ^h ǎ ja: 'laj]	มหาวิทยาลัย	“university”
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8. Allophonic Variation

Tables 3 and 4 summarize some notable vowel and consonant allophones of Central Thai. Phonological rules governing the appearance of some of these are included in subsections which follow.

	front	central	near-back	back
high	[i] [i:]		[ɯ] [ɯ:]	[u] [u:]
mid	[e] [e:]		[ɤ] [ɤ:]	[o] [o:]
mid-low	[ɛ] [ɛ:]	[ə]		[ɔ] [ɔ:]
low		[a] [a:]		

Table 3. Summary of vowel allophones

	Bilabial	Labiodental	Alveolar	Post-Alveolar	Palatal	Velar	Glottal
Plosive	p p ^s	b b _~ β	t t ^s	d d _~ d ^h d ^h		k k ^s k ^h k ^x	ʔ
Nasal		m		n		ŋ	
Trill				r			
Tap				ɾ			
Fricative		f	s				h
Affricate				tʃ tʃ ^h			
Approximant					j		
Lateral Approximant			l				

w	Voiced labial-velar approximant
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Table 4. Summary of consonant allophones

8.1. Quality Distinction in Front Vowel Geminate Pairs

Abramson's (1962:76) pioneering spectrographic study of Thai vowels established quality differences within the front geminate pairs. Appendix D presents new plots of Abramson's data for two native speakers which illustrate these shifts.

In (2002:362), Roengpitya concludes that these distinctions are a secondary perceptual cue for phonemic vowel length. Briefly, [i:] and [e:] are higher and more advanced than [i] and [e], respectively, and [ɛ:] may be more advanced than [ɛ]. Geminate pairs for central and back vowels do not appear to manifest significant quality shift.

8.2. Diphthong Allophones

In long diphthongs, /a/ may undergo reduction (Abramson 1962:76).

/nî:a/	[ni:ə]	นี่	“this”
/k ^h ù:at/	[k ^h ù:ət]	ขวด	“bottle”
/rū:a/	[rū:ə]	เรือ	“boat”

8.3. Glottal Stop Initial

[+stress]_{syllable} → ? [] / __ [+syllabic]

Glottal stop may freely alternate before stressed syllables with vocalic onset. (Noss 1964:9)

/ʰòk/	['ʔòk]	อก	“chest”
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8.4. Glottal Stop Final

$$\left[\begin{array}{l} +open \\ +short \end{array} \right]_{\text{syllable}} \rightarrow [\quad] \text{ʔ} / [+stress] _$$

Glottal stop may freely alternate after open, short syllables in the stress environment. (Noss 1964:9)

/'tó/	['tóʔ]	โต๊ะ	“table”
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8.5. Final Consonant Voicing

There is no aspiration or voicing contrast in syllable-final consonants and some researchers assert that this may permit variation (Haas 1956, Abramson 1962, Noss 1964). Haas’ influential account left a legacy of /g/-final transcription in the pedagogical literature.

$$\left[\begin{array}{l} +stop \\ -voice \end{array} \right] \rightarrow [+voice] / _]_{\text{syllable}}$$

Syllable-final stops may exhibit free variation in phonation.

/pà:k/	['pà:g]	ปาก	“mouth”
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8.6. Fricativization

$$/k^h/ \rightarrow [k^x] / [_]_{\text{syllable}}$$

In some speakers there is fricativization in the velar initial (Abramson 1962:4).

/k ^h ù:at/	[k ^x ù:at]	ขวด	“bottle”
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8.7. Cluster Simplification

Velar- and bilabial-initial clusters may be dentalized or simplified. Iwasaki (2005:4), Diller (2008:33), and others note that initial consonant clusters may be reduced in colloquial speech. This is a particular feature of the sub-dialect of capital city, sometimes referred to as “Bangkok Thai” (Brown 1967:xi).

$$/k^hw/ \rightarrow [f] / [_]_{\text{syllable}}$$

$$/kw/ \rightarrow [f] / [_]_{\text{syllable}}$$

Velar-initial clusters may be dentalized, especially in the Bangkok sub-dialect.

/k^hl, k^hr/ → [k^h] / [syllable____]

/kl, kr/ → [k] / [syllable____]

/p^hl, p^hr/ → [p^h] / [syllable____]

/pl, pr/ → [p] / [syllable____]

Velar- and bilabial-initial clusters may be simplified, especially in the Bangkok sub-dialect.

/k ^h wǎ:/	[fǎ:]	ขวา	“right (direction)”
/k ^h ráp/	[k ^h áp]	ครับ	[polite particle]
/plā:/	[pā:]	ปลา	“fish”

8.8. /r/ Tapping and [l] Substitution

Although /r/ and /l/ are orthographically distinguished (by ร and ล, respectively), some sub-dialects of Central Thai allow the substitution of the alveolar lateral approximant [l] for its homorganic trill /r/. Retroflex /r/ is not attested. Such substitution is particularly characteristic of the Bangkok sub-dialect (Brown 1967:xi), and Diller (2008) notes that sociolinguistic conditioning may be involved as native speakers seek a precarious balance between the pretension of prestige speech and the stigma of colloquialism.

/r/ → [l]

[l] is in free variation with [r] for some speakers (Diller 2002:77)

/r/ → [ɾ]

/r/ may be tapped. (Iwasaki 2005:4)

/rū:a/	[lū:a]	เรือ	“boat”
/rū:a/	[ɾū:a]	เรือ	“boat”

8.9. Sonorant Contraction after /ŋ/

Also prominent in the Bangkok sub-dialect of Central Thai is the contraction of sonorants after /ŋ/ (Diller 2002:77).

/jāŋ ŋāj/	[jāŋ āj]	ยั้งเง	“how”
/jà:ŋ rāj /	[jà:ŋ āj]	อย่างไร	“like what”

8.10. Pharyngealization

/+stop/ → [+low] / ___[+vowel]

Syllable-initial stops before a vowel are pharyngealized. (Abramson 1962:4).

/+vowel/ → $\begin{bmatrix} +\text{low} \\ -\text{back} \end{bmatrix}$ / [+stop]___

Vowels following an initial stop are centralized and lowered (Abramson 1962:4).

/p̣à:k/	[p̣̆à:k]	ปาก	“mouth”
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8.11. Creaky or Stiff Onset and Implosion

/b, d/ → [ḅ, ḍ]

Closure onset of voiced stops often carries stiff or creaky voice. (Ladefoged et al. 1996:55)

/b, d/ → [ɓ, ɗ]

Voiced stops may invoke an implosive gesture of the larynx. (Ladefoged et al. 1996:78)

/bāj/	[ḅāj]	ใบ	“leaf”
/bāj/	[ɓāj]	ใบ	“leaf”

8.12. Vowel Nasalization

Vowels appearing after nasals and the glottal fricative may be nasalized (Abramson 1962:4).

9. Tone Sandhi

Abramson (1979:7) establishes the stability of all five tonemes in dynamic, non-citation speech. Importantly, he also discovers that they cannot be decomposed into more fundamental elements, and characterizes allotones for running speech versus citation form, discovering that laryngeal coarticulation of tones is in free variation. Haas (1956:x) also notes prosodic variation (tone contour numbers in this section are based on the following nominal values—low¹¹ mid³³ high⁴⁵ rising²⁴ falling⁵²):

/tone-33/syllable → [tone-32] / ___]phrase

At the end of a phrase, the mid tone is dropped very slightly.

/set ¹¹ lɛ:w ⁴⁵ ru:r ²⁴ jaŋ ³³ /	[... jaŋ ³²]	เสร็จแล้วหรือยัง	“Are you finished?”
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$$[\text{tone-45}]_{\text{syllable}} \rightarrow \left[\begin{array}{c} \text{tone-454} \\ +\text{low} \end{array} \right] / \text{---}]_{\text{phrase}}$$

At the end of a phrase, the high tone has glottal stricture and drops quickly.

$$[\text{tone-52}]_{\text{syllable}} \rightarrow [+low] / \text{---}]_{\text{phrase}}$$

At the end of a phrase, the falling tone has glottal stricture.

/tɕ ^h an ²⁴ tɔŋ ⁵² ka:n ³³ ma ⁴⁵ la ⁴⁵ kɔ̄: jaŋ ¹¹ nuŋ ¹¹ lu:k ⁵² /	[...lu:kʔ]	ฉันต้องการมะละกอ ใหญ่หนึ่งลูก	“I want one large papaya”
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10. Conclusion

Though Central Thai is well-described, it is not without opportunities for further study. In particular, there is little consensus on the treatment of prosodic elements: stress, rhythm, and intonation. Abramson’s (1964:20) proposals in this area are only now beginning to pique the interest of contemporary researchers.

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Appendix A - Consonant Features of Central Thai

features from Hayes (2008:95-97)

	Nucleus features		Manner features							Laryngeal features			Place features														
	syllabic	long	consonantal	sonorant	continuant	delayed release	approximant	tap	trill	nasal	voice	spread glottis	constr glottis	LABIAL	round	labiodental	CORONAL	anterior	distributed	strident	lateral	DORSAL	high	low	front	back	tense
ŋ	-	-	+	+	-	0	-	-	-	+	+	-	-	-	-	-	0	0	0	-	+	+	-	0	0	0	0
r	-	-	+	+	+	0	+	-	+	-	-	-	-	-	-	-	+	+	-	-	-	-	0	0	0	0	0
n	-	-	+	+	-	0	-	-	-	+	+	-	-	-	-	-	+	+	-	-	-	-	0	0	0	0	0
m	-	-	+	+	-	0	-	-	-	+	+	-	-	+	-	-	-	0	0	0	-	-	0	0	0	0	0
l	-	-	+	+	+	0	+	-	-	-	+	-	-	-	-	-	+	+	-	-	+	-	0	0	0	0	0
tɕ	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	+	+	+	+	-	+	+	-	+	-	0
tɕ ^h	-	-	+	-	-	+	-	-	-	-	-	+	-	-	-	-	+	+	+	+	-	+	+	-	+	-	0
k	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	-	+	+	-	0	0	0
k ^h	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	0	0	0	-	+	+	-	0	0	0
t	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	0	0	0	0	0
t ^h	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	+	+	-	-	-	-	0	0	0	0	0
s	-	-	+	-	+	+	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-	0	0	0	0	0
p	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	0	0	0	-	-	0	0	0	0	0
p ^h	-	-	+	-	-	-	-	-	-	-	-	+	-	+	-	-	-	0	0	0	-	-	0	0	0	0	0
f	-	-	+	-	+	+	-	-	-	-	-	-	-	+	-	+	-	0	0	0	-	-	0	0	0	0	0
d	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	+	+	-	-	-	-	0	0	0	0	0
b	-	-	+	-	-	-	-	-	-	-	+	-	-	+	-	-	-	0	0	0	-	-	0	0	0	0	0
w	-	-	-	+	+	0	+	-	-	-	+	-	-	+	+	-	-	0	0	0	-	+	+	-	-	+	+
j	-	-	-	+	+	0	+	-	-	-	+	-	-	-	-	-	-	0	0	0	-	+	+	-	+	-	+
h	-	-	-	-	+	+	-	-	-	-	-	+	-	-	-	-	-	0	0	0	-	-	0	0	0	0	0

Appendix B - Vowel Features of Central Thai

features from Hayes (2008:95-97)

	Nucleus features		Manner features							Laryngeal features			Place features														
	syllabic	long	consonantal	sonorant	continuant	delayed release	approximant	tap	trill	nasal	voice	spread glottis	const. glottis	LABIAL	round	labiodental	CORONAL	anterior	distributed	strident	lateral	DORSAL	high	low	front	back	tense
a	+	-	-	+	+	0	+	-	-	-	+	-	-	-	-	-	0	0	0	-	+	-	+	-	-	-	0
a:	+	+	-	+	+	0	+	-	-	-	+	-	-	-	-	-	0	0	0	-	+	-	+	-	-	-	0
ɔ	+	-	-	+	+	0	+	-	-	-	+	-	-	+	+	-	0	0	0	-	+	-	-	-	-	+	-
ɔ:	+	+	-	+	+	0	+	-	-	-	+	-	-	+	+	-	0	0	0	-	+	-	-	-	-	+	-
o	+	-	-	+	+	0	+	-	-	-	+	-	-	+	+	-	0	0	0	-	+	-	-	-	-	+	+
o:	+	+	-	+	+	0	+	-	-	-	+	-	-	+	+	-	0	0	0	-	+	-	-	-	-	+	+
ɤ	+	-	-	+	+	0	+	-	-	-	+	-	-	-	-	-	0	0	0	-	+	-	-	-	-	+	+
ɤ:	+	+	-	+	+	0	+	-	-	-	+	-	-	-	-	-	0	0	0	-	+	-	-	-	-	+	+
e	+	-	-	+	+	0	+	-	-	-	+	-	-	-	-	-	0	0	0	-	+	-	-	-	+	-	+
e:	+	+	-	+	+	0	+	-	-	-	+	-	-	-	-	-	0	0	0	-	+	-	-	-	+	-	+
ɛ	+	-	-	+	+	0	+	-	-	-	+	-	-	-	-	-	0	0	0	-	+	-	-	-	+	-	-
ɛ:	+	+	-	+	+	0	+	-	-	-	+	-	-	-	-	-	0	0	0	-	+	-	-	-	+	-	-
ɯ	+	-	-	+	+	0	+	-	-	-	+	-	-	-	-	-	0	0	0	-	+	+	-	-	-	+	+
ɯ:	+	+	-	+	+	0	+	-	-	-	+	-	-	-	-	-	0	0	0	-	+	+	-	-	-	+	+
u	+	-	-	+	+	0	+	-	-	-	+	-	-	+	+	-	0	0	0	-	+	+	-	-	-	+	+
u:	+	+	-	+	+	0	+	-	-	-	+	-	-	+	+	-	0	0	0	-	+	+	-	-	-	+	+
i	+	-	-	+	+	0	+	-	-	-	+	-	-	-	-	-	0	0	0	-	+	+	-	+	-	-	+
i:	+	+	-	+	+	0	+	-	-	-	+	-	-	-	-	-	0	0	0	-	+	+	-	+	-	-	+

Appendix C: Word List

Set 1.

Place contrasts:

alveolar

bilabial

Manner contrasts:

all voicing contrasts in oral stops

all nasal stops

all Approximants

affricate

(including zero initial)

id	broad	orthography	gloss
1	āj	ไอ	"vapor"
2	pāj	ไป	"to go"
3	p ^h āj	ภัย	"peril"
4	bāj	ใบ	"leaf"
5	tāj	ไต	"kidney"
6	t ^h āj	ไทย	"Thai"
7	dāj	ใด	"any"
8	kāj	ไก	"trigger"
9	māj	มัย	"mule"
10	nāj	ใน	"within"
11	ṇāj	ไง	"how, what"
12	rāj	ไร	"where, which"
13	fāj	ไฟ	"fire, flame"
14	sāj	ไทร	"banyan"
15	tɕāj	ใจ	"heart"
16	tɕ ^h āj	ชัย	"to win"
17	jāj	ใย	"filament"
18	lāj	ลัย	"rhythm"
19	wāj	วัย	"swift"

Set 2.**Place contrasts:**

alveolar

velar

Manner contrasts:

all aspiration contrasts (oral stops and the affricate)

all approximants

(including zero initial)

id	broad	orthography	gloss
20	ā:	อา	"paternal uncle"
21	pā:	ปา	"to fling; to hurl"
22	p ^h ā:	พา	"to lead along"
23	tā:	ตา	"eye"
24	t ^h ā:	ทา	"to apply, to paint"
25	dā:	ดา	"abundant, plentiful"
26	kā:	กา	"check-mark"
27	k ^h ā:	คา	"pillory"
28	mā:	มา	"to come"
29	nā:	นา	"rice paddy"
30	ŋā:	งา	"tusk, ivory"
31	rā:	รา	"fungus, mold"
32	sā:	ซา	"to abate"
33	tɕā:	จา	"to speak"
34	tɕ ^h ā:	ชา	"tea"
35	jā:	ยา	"drug"
36	lā:	ลา	"to bid farewell"
37	wā:	วา	"[unit of measure]"

Set 3.**Manner contrasts:**

All fricatives

All nasal stops

id	broad	orthography	gloss
38	pàk	ปัก	"to braid"
39	tàk	ตัก	"to ladle out"
40	dàk	ดัก	"to entrap"
41	kàk	กัก	"to hinder"
42	màk	หมัก	"to leaven"
43	nàk	หนัก	"laden"
44	ŋàk	งัก	"very old"
45	fàk	ฝัก	"hull; sheath"
46	sàk	สัก	"tattoo"
47	hàk	หัก	"to break off"
48	tɕàk	จักร	"wheel"
49	jàk	หยัก	"serrated"
50	làk	หลัก	"pillar"

Set 4.**Place contrasts:**

velar

labiodental/labial-velar

Manner contrasts:

all approximants

all nasal stops

id	broad	orthography	gloss
51	p ^h ว̄:น	พร	"blessing"
52	b̄ว̄:น	บอน	[type of plant]
53	t̄ว̄:น	ตอน	"during"
54	t ^h ว̄:น	ทอน	"returned money"
55	d̄ว̄:น	ดอน	"knoll"
56	k̄ว̄:น	กร	"worker"
57	k ^h ว̄:น	คอน	"to carry"
58	m̄ว̄:น	มอญ	"Mon, Pegu"
59	n̄ว̄:น	นอน	"to sleep"
60	ɲ̄ว̄:น	งอน	"petulant"
61	r̄ว̄:น	รอน	"to cut back"
62	f̄ว̄:น	ฟอน	"to gnaw away"
63	s̄ว̄:น	ชอน	"to work inside"
64	t̄ɕ̄ว̄:น	จร	"to wander"
65	t̄ɕ̄ ^h ว̄:น	ชอน	"to penetrate into"
66	j̄ว̄:น	ยอน	"to insert"
67	l̄ว̄:น	ลอน	"curl, wave"
68	w̄ว̄:น	วอน	"to beg, plead"

Set 5.			
Place contrast:			
bilabial			
(including zero initial)			
id	broad	orthography	gloss
69	๖:k	ออก	"to exit"
70	p๖:k	ปอก	"to pare"
71	p ^h ๖:k	พอก	"sheath"
72	b๖:k	บอก	"to say"
73	t๖:k	ตอก	"a strip of bamboo"
74	t ^h ๖:k	ถอก	"to peel back"
75	d๖:k	ดอก	"flower"
76	k๖:k	กอก	"olive, fig"
77	m๖:k	หมอก	"fog, mist"
78	ŋ๖:k	หงอก	"silver-gray"
79	r๖:k	หรรอก	"surely not"
80	s๖:k	ศอก	"elbow"
81	h๖:k	หอก	"lance, spear"
82	tɕ๖:k	จอก	"water cabbage"
83	j๖:k	หยอก	"to tease, to joke"

Set 6.**Place contrasts:**

bilabial

velar

Manner contrasts:

all oral stop finals

all approximant finals

(including zero final)

id	broad	orthography	gloss
84	tà	ตะ	"to encrust"
85	tàp	ด้บ	"skewer"
86	tàt	ตัด	"to cut"
87	tàk	ตัก	"to ladle"
88	tàm	ต่ำ	"short; low"
89	tàŋ	ตั้ง	"foot stool"
90	tàj	ไต่	"to climb"
91	tàw	เต่า	"turtle"

Set 7.**Place contrasts:**

alveolar

velar

Manner contrasts:

all oral stop finals

all approximant finals

(including zero final)

id	broad	orthography	gloss
92	wâ:	ว่า	"that..."
93	wâ:p	วาบ	"to flash"
94	wâ:t	วาด	"to sketch"
95	wâ:k	วากย์	"utterance"
96	wâ:n	ว่าน	"herbs"
97	wâ:ŋ	ว่าง	"vacant"
98	wâ:j	ว่าย	"to swim"
99	wâ:w	ว่าว	"kite"

Set 8.**Place contrasts:**

bilabial
alveolar
velar

Manner contrasts:

all nasal stop finals
(including zero final)

id	broad	orthography	gloss
100	hà:	हां	"cholera"
101	hà:p	หาบ	"to carry"
102	hà:t	หาด	"beach"
103	hà:k	หาก	"allowing that..."
104	hà:m	ห้าม	"unripe"
105	hà:n	ห่าน	"goose"
106	hà:ŋ	ห่าง	"distant from"

Set 9.**All Low Vowels****Front Vowels, set F-1**

Length Contrast: /u o ε ɔ a/

id	broad	orthography	gloss
107	lí:	ลี	"to flee"
108	lú:	ลือ	"Lue (ethnic minority)"
109	lú	ลู	"to reach the end"
110	lú:	ลุ	"flute"
111	lɔ́	เลอะ	"soiled, stained"
112	ló tʰɨŋ	โละทิ้ง	"to discard"
113	ló:	โล้	"to paddle"
114	lé	และ	"and"
115	lé:	แล้	"sagging from burden"
116	ló	เลาะ	"to skirt around"
117	ló:	ล้อ	"wheel"
118	lá	ละ	"to forsake"
119	lá:	ล้า	"exhausted"

Set 10.			
High Vowels, set H-1			
Length Contrast: /u u a/			
id	broad	orthography	gloss
120	rí	ริ	"to originate"
121	rú	รี	"or"
122	rú:	รี้อ	"to raze"
123	rú	รุ	"to purge"
124	rú:	รู้อ	"to know"
125	ré	แระะ	"pigeon pea"
126	ró	เระะ	"to break off"
127	rá	ระ	"to hit, strike"
128	rá:	ร้า	"pickled fish"
Set 11.			
High Vowels, set H-2			
Length Contrast: /u e o a/			
id	broad	orthography	gloss
129	kì:	กี	"how many"
130	kù	กู	"to deceive"
131	kù:	กู้อ	"to holler"
132	kè	แกะะ	"sheep"
133	kè:	แก๋	"old"
134	kò	เกาะะ	"island"
135	kò:	ก่อ	"to construct"
136	kà	กะ	"an estimate"
137	kà:	ก่า	"a duck"

Set 12.			
Near-back and Back Vowels, set B-1			
Length Contrast: /ɾ ɔ a/			
id	broad	orthography	gloss
138	tɔ̀i:	ชั	"to broil"
139	tɔ̀u	จ	"is able to hold"
140	tɔ̀u:	จู่	"to rush in"
141	tɔ̀ɿ	เจอ	"to meet someone"
142	tɔ̀ɿ:	เจอ	"swollen"
143	tɔ̀ɔ̀	เจาะ	"to pierce"
144	tɔ̀ɔ̀:	จ่อ	"to touch against"
145	tɔ̀à	จะ	"will"
146	tɔ̀à:	จ่า	"to address (a crowd)"
Set 13.			
Front Vowels, set F-2			
Length Contrast: /i u o a/			
id	broad	orthography	gloss
147	kìt	กิจ	"errand"
148	kì:t	กีด	"to obstruct"
149	kùt	กุด	"severed"
150	kù:t	กูด	"fern"
151	kè:t	เกตุ	"Neptune"
152	kɿ:t	เกิด	"to be born"
153	kòt	กฎ	"rule"
154	kò:t	โกศ	"cocoon"
155	kɔ̀:t	กอด	"to hug"
156	kàt	กัด	"to bite, nip at"
157	kà:t	กาด	"cabbages"

Set 14.			
Front Vowels, set F-3			
Length Contrast: /e o a/			
id	broad	orthography	gloss
158	hìt	ทิด	"scabies"
159	hù:t	หืด	"asthma"
160	hù:t	หูด	"wart"
161	hèt	เห็ด	"mushroom"
162	hèt	เหตุ	"situation"
163	hòt	หด	"to retract"
164	hò:t	โหด	"ruthless"
165	hàt	หัด	"to train at"
166	hà:t	หาด	"beach"
Set 15.			
High Vowels, set H-3			
Length Contrast: /ɯ a/			
id	broad	orthography	gloss
167	ìt	อิฐ	"brick"
168	ùt	อืด	"to endure"
169	ù:t	อืด	"distended"
170	ùt	อุด	"to plug up"
171	ù:t	อูฐ	"camel"
172	èt	เอ็ด	"[one's digit]"
173	òt	อด	"to fast"
174	ò:t	ออด	"a peep"
175	àt	อัด	"to compress"
176	à:t	อาจ	"might, may"

Set 16.			
Near-back and Back Vowels, set B-2			
Length Contrast: /u o a/			
id	broad	orthography	gloss
177	kīn	กิน	"to eat"
178	kūn	กุล	"caste"
179	kū:n	กุล	"embankment"
180	kē:n	เกณฑ์	"criterion"
181	kī:n	เกิน	"to exceed"
182	kōn	กล	"stratagem"
183	kō:n	โกน	"to shave"
184	kē:n	แกน	"axle"
185	kō:n	กร	"worker"
186	kān	กัน	"together with"
187	kā:n	การ	"work"

Set 17.			
Tone contrasts			
id	broad	orthography	gloss
188	k ^h à:w	ข่าว	"news"
189	k ^h ā:w	คาว	"stench"
190	k ^h á:w	เค้า	"gist"
191	k ^h ǎ:w	ขาว	"white"
192	k ^h â:w	ข้าว	"rice"
Set 18.			
Diphthong-Monophthong contrasts			
id	broad	orthography	gloss
193	k ^h ù:at	ขวด	"bottle"
194	k ^h ù:t	ขูด	"grate against"
195	rū:a	เรือ	"boat"
196	rū:	ฤ	[interrogatory]
197	nî:a	เนีย	[emphatics]
198	nî:	นี่	"this"
Set 19.			
Inter-diphthong Contrast for /r ~ an/, mid tone			
id	broad	orthography	gloss
199	rū:an	รวน	"belligerent"
200	rū:an	เรือน	"household"
201	rī:an	เรียน	"to study"
Set 20.			
Length contrast in diphthong /ia/			
id	broad	orthography	gloss
202	mī:a	ขวด	"wife"
203	día	ขูด	"straight"

Set 21.			
/r l w ø/ initial consonant clusters			
id	broad	orthography	gloss
204	kàk	กัก	"small box"
205	kràk	กรัก	"jackfruit heartwood"
206	klàk	กลัก	"small box"
207	kwàk	กวัก	"to call, beckon"
208	k ^h rók	ครก	"mortar"
209	k ^h lùk	ขลุ่ก	"occupied with"
210	k ^h wàk	ขวัก	[euphonious prefix]
211	pràk	ปรัก	"silver"
212	plàk	ปลัก	"quagmire"
213	p ^h rík	พริก	"chili pepper"
214	p ^h làk	ผลัก	"to push, to shove"
215	trò:k	ตรอก	"alley, lane"

Appendix D

F1-F2 plots of raw data from Abramson (1962) illustrate, for two native speakers, quality shifts between the long and short variant in the front monophthong pairs.

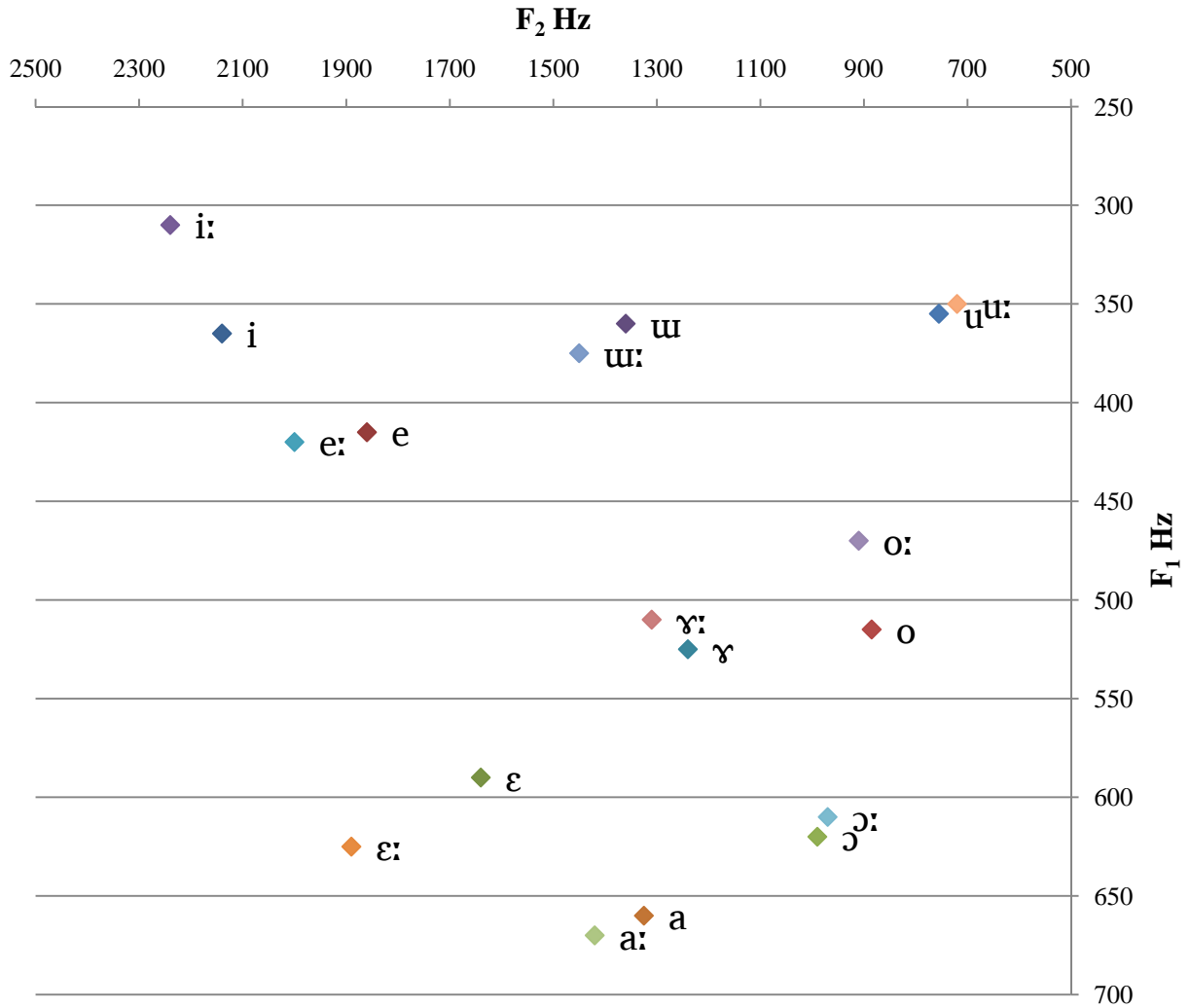


Figure 1. Speaker E.N. (Abramson 1962)

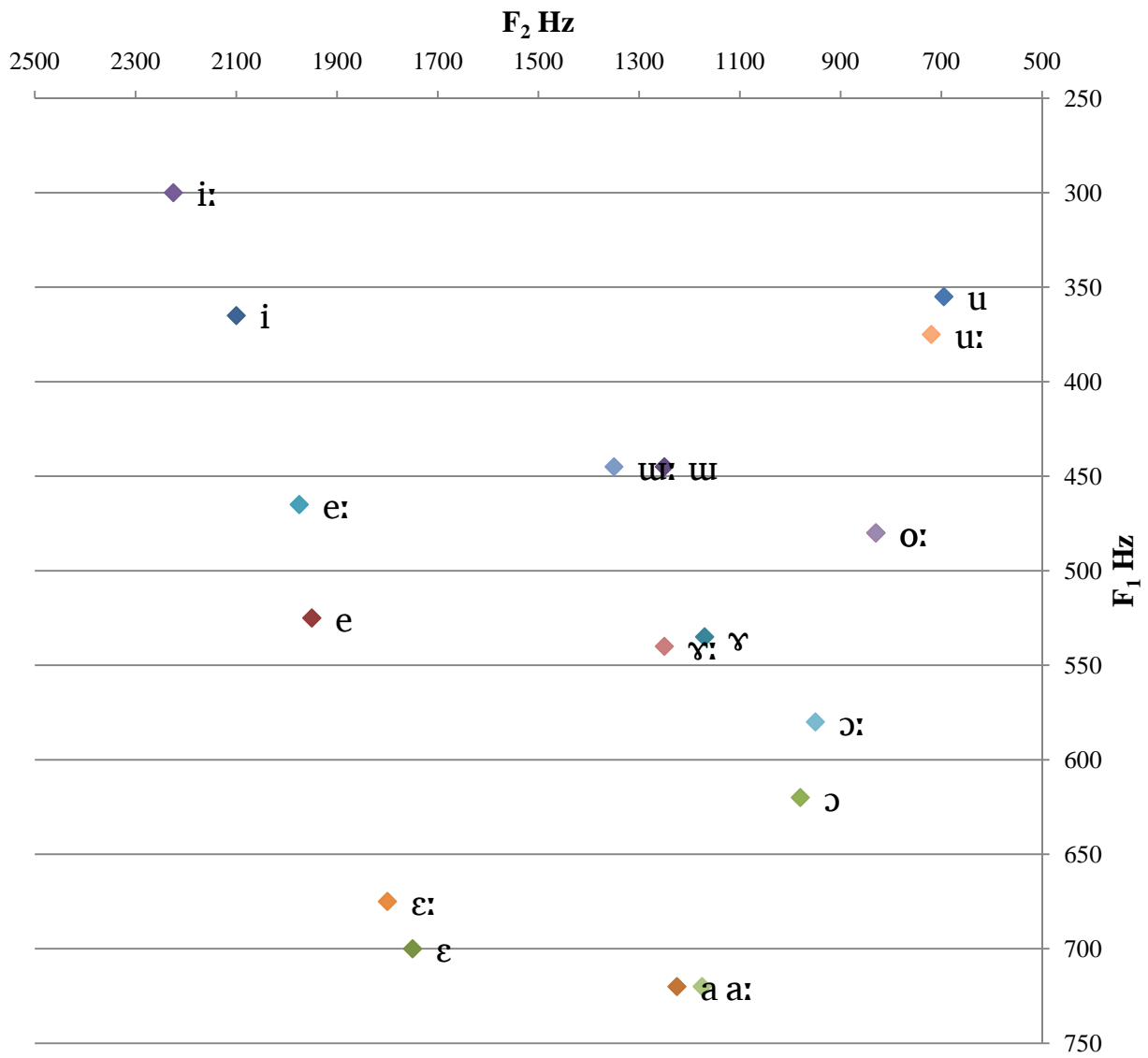


Figure 2. Speaker W.N. (Abramson 1962)