

A Historical and Perceptual Study of Vowel Length in Thai

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Introduction

In Standard Thai, vowel length is contrastive e.g. [cip] ‘to sip’ – [ciip] ‘to pleat,’ although, in historical Tai, Li (1977) reconstructed vowels in Proto-Tai without a length distinction. Short and long contrast of Thai vowels arose from a monophthongization, the change in vowel qualities, a vowel lengthening, and borrowings, as presented below.

Standard-Thai Vowel System

i, ii	i̯, i̯i̯	u, uu
e, ee	ɤ, ɤɤ	o, oo
ɛ, ɛɛ	a, aa	ɔ, ɔɔ

Proto-Tai Vowels

Standard-Thai Vowels

*i	>	i
*i, *iɤ, *ei, *ui	>	ii
*e, *ie	>	e
borrowings	>	ee (Potibai)
no source	>	ɛ
*ɛ, *iɛ	>	ɛɛ

(Brown 1979: from ea)

*i̯	>	*i̯
*i̯, *i̯ɤ, *i̯u	>	*i̯i̯
no source	>	ɤ
no source	>	ɤɤ (schwa)
*ɤ, *uɤ	>	a
*a, *i̯a, *ua	>	aa
*u, *io	>	u
*u, *uɤ, *uo, *i̯u, *eu	>	uu
*o, *uo, *ui̯	>	o

Proto-Tai Vowels

Standard-Thai Vowels

borrowings	>	oo
borrowings	>	ɔ
		(Brown 1979)
*ɔɔ, *i•ɔ, *uɔ, *i•ɔ	>	ɔɔ
		(Brown 1979: from oa)

From above, it can be seen that the distinctive vowel length in Thai came from the change in both vowel quantity and vowel quality. Since vowels in Proto-Tai used to have distinct vowel quality, this paper is aimed to study the relationship between vowel quality and vowel quantity in Thai.

In Standard Thai, Abramson (1962) said that vowel duration is the main cue to distinguish short and long vowels in Thai. In Abramson and Ren (1990), they found that the audible secondary cue for vowel length in Thai is vowel quality. The previous experiment of Roengpitya (1999) confirmed that other perceptual cues besides vowel duration could be vowel quality and final nasal duration. It is found that short vowels are more centralized than long vowels. Moreover, short vowels are followed by longer final nasals and long vowels are followed by shorter final nasals, as also found by Abramson (1962), by Onsuwan and Beddor (1998), and by Roengpitya (1999).

A perceptual experiment was conducted to see whether the cues to distinguish vowel length in Thai are only vowel duration or other cues such as vowel quality and final nasal duration.

Procedures

Eighteen pairs of Thai meaningful and nonsense words were chosen for this experiment, as shown in Table 1.

Table 1 Thai Words and Meanings

Pairs	Meaning
1. p̌ik/ p̌iik	- / wings
2. p̌in/ p̌iin	a pin / -
3. p̌ek/ p̌eek	- / -
4. p̌en/ p̌een	-/ -
5. p̌ak/ p̌aak	to stick in/ a mouth
6. p̌an/ p̌aan	to spin/ ramie
7. p̌uk/ p̌uuk	downy/ -
8. p̌un/ p̌uun	-/-
9. p̌ok/ p̌ook	a cover/ -
10. p̌on/ p̌oon	to grind/ -
11. p̌rk/ p̌r̄rk	-/ -
12. p̌rn/ p̌r̄rn	-/ -
13. p̌ek/ p̌eek	-/ -
14. p̌en/ p̌een	-/ -
15. p̌ok/ p̌oək	-/ to peel
16. p̌on/ p̌oən	-/ -
17. p̌i'k/ p̌i'ik	a pile/ -
18. p̌i'n/ p̌i'in	-/ -

Each pair contained a word with a short vowel and the other with a long vowel. Each word had an initial voiceless unaspirated labial stop /p/, its vowel, a final velar stop /k/ or a final alveolar nasal /n/, and a low tone. A native-Thai male speaker said the word in the frame sentence “faŋ kham waa _____ sɔɔŋ kraŋ .” ‘Listen to the word _____ twice.’ All the tokens were recorded on an analog tape and were digitized at a sample rate of 16 Khz. All the tokens were measured for vowel duration and final nasal duration. The results were in the Table 2.

Table 2 Vowel and Nasal Duration

Pairs	Vowel Duration	Nasal Duration
1. p̌ik/ piik	143.06/ 309.94	-/ -
2. p̌in/ piin	153.94/ 319.94	256.63/ 228.25
3. p̌ek/ p̌eek	157.31/ 323.81	-/ -
4. p̌en/ p̌een	156.81/ 308.25	306.06/ 219.88
5. p̌ak/ p̌aak	168.75/ 323.75	-/ -
6. p̌an/ p̌aan	155.13/ 326.88	241.13/ 189.69
7. p̌uk/ p̌uuk	150.50/ 285.75	-/ -
8. p̌un/ p̌un	137.56/ 326.81	275.00/ 212.69
9. p̌ok/ p̌ook	167.25/ 291.75	-/ -
10. p̌on/ p̌oon	147.63/ 303.88	270.94/ 211.13
11. p̌ɤk/ p̌ɤk	153.50/ 345.31	-/ -
12. p̌ɤn/ p̌ɤn	151.06/ 298.63	284.38/ 207.44
13. p̌ek/ p̌eek	181.81/ 349.88	-/ -
14. p̌en/ p̌een	176.81/ 316.13	261.56/ 176.81
15. p̌ɔk/ p̌ɔk	171.13/ 304.31	-/ -
16. p̌on/ p̌on	186.13/ 319.50	275.50/ 219.75
17. p̌ǐk/ p̌ǐǐk	140.75/ 317.06	-/ -
18. p̌ǐn/ p̌ǐǐn	143.00/ 310.25	273.44/ 248.81

In each pair, a short vowel was lengthened at 10-20 ms steps until it had the same duration as the long vowel of its pair, and a long vowel was shortened at 10-20 ms steps until it had the same duration as the short vowel of its pair. In pairs 2, 4, 6, 8, 10 which had an alveolar nasal as a final, the long nasal after a short vowel was shortened at 10ms step until it had the same duration as the short nasal after a long vowel, and vice versa. All the tokens were resynthesized in the LPC analysis and resynthesis program. All the tokens were randomized. There were 9 sections of this experiment, which contained a total of 1,150 tokens. Fifty-six native-Thai listeners (25 males and 31 females with the age ranging from 18-25 and with the mean age of 20) listened to these tokens and judged whether each token had a short or a long vowel.

Results

Selected figures below show three main results of this experiment. Each figure present the percentage of responses as short vowels of lengthened short vowels (solid line) and of shortened long vowels (dashed line)over different 10-20ms steps of vowel duration.

Fig.1 shows the first main result. In this figure, it can be seen that, at mid range, shortened long vowels for listeners to identify as short vowels had to be shorter than the original short vowels, except for Fig.2 that shortened long vowels at mid range were longer than the original short vowels. This result confirmed Abramson and Ren's results of their perceptual experiment (1990). It can be concluded that duration functions as the main cue for vowel length in Thai.

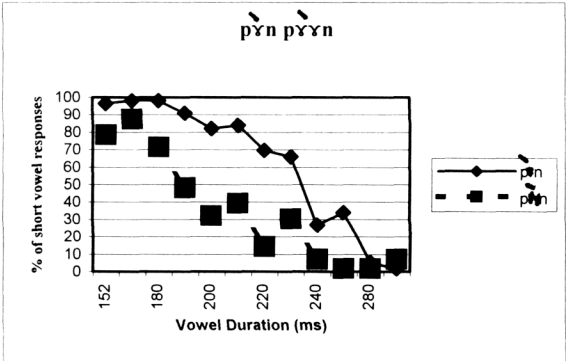


Figure 1. Correct Responses of Short vowels /p̣ṽn-p̣ṽṽn/

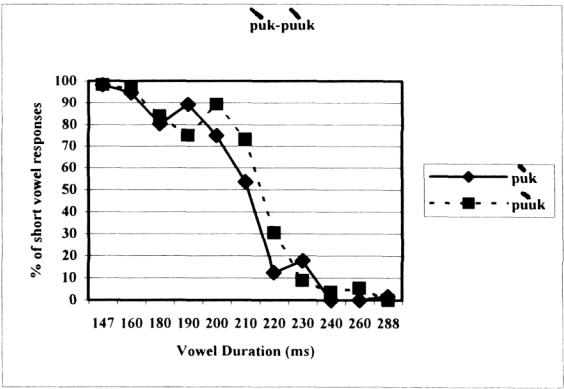


Figure 2. Correct Responses of Short vowels /puk-puuk/

For the second main result, Fig. 3 shows that, at mid range, listeners mainly identified lengthened short vowels as short vowels and shortened long vowels as long vowels, especially in Fig. 4. It can be concluded that, other cues, besides vowel duration, played a role.

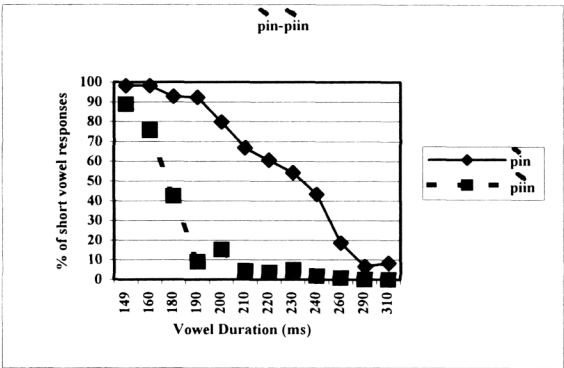


Figure 3. Correct Responses of Short vowels /pin-piin/

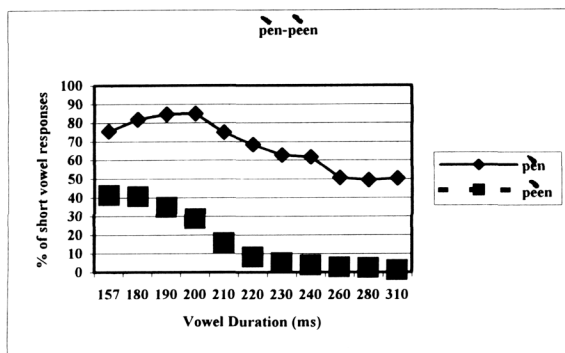


Figure 4. Correct Responses of Short vowels /pen-peen/

However, from Fig.5, there were unexpected 100% responses as a short vowel for the lengthened-short-vowel token at 280ms. The author rerandomized the tokens of pairs /pən-pēn/ (Abramson, p.c.) and found that the unexpected 100% responses as a short vowel occurred because of an effect of randomization, although the duration of the lengthened short vowel was as high as 280ms, which was expected to be perceived as a long vowel.

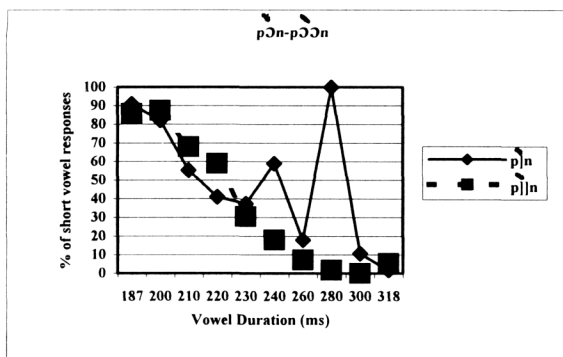


Figure 5. Correct Responses of Short vowels /pən-pēn/

The third main result is the result of gated nasal duration. Fig. 6, as a selected figure, shows the responses of gated nasal duration at 50% crossover point. It can be seen that there was a higher percentage of responses as short vowels when the nasal duration was longer. It can be concluded that at 50% crossover point, in some cases, listeners used nasal duration as an extra cue to distinguish short and long vowels: longer nasal duration for short vowels.

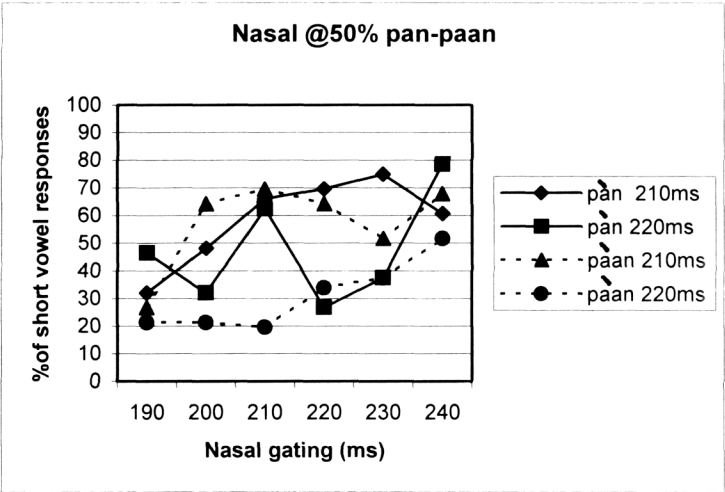


Fig. 6. Nasal gating at 50% crossover point (210-220ms for *pān* and *pāan*)

Discussion

From the results above, it can be seen that although vowel duration is the main perceptual cue for vowel length in Thai, as said by Abramson (1962), other cues besides duration also play a role. An extra cue from the experiment above is nasal duration. In some cases, there were higher responses for lengthened short vowels and shortened long vowels as short vowels when final nasal duration was longer. To see the other

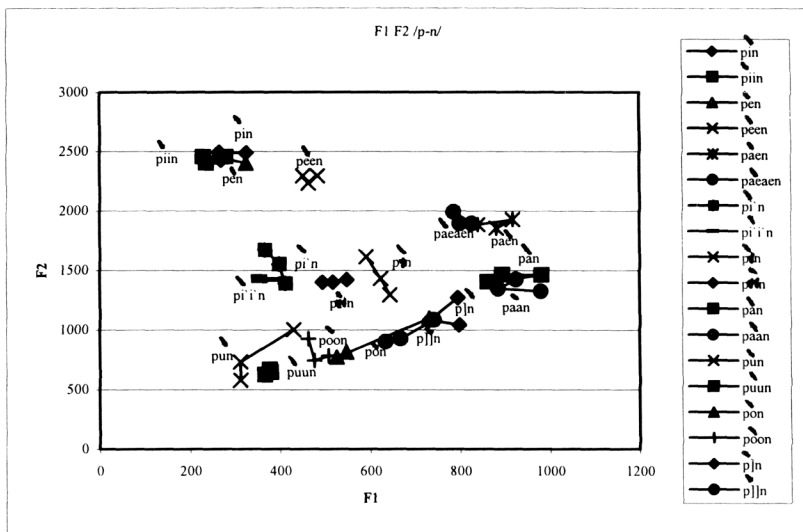


Fig.8. F1 and F2 of pairs 2, 4, 6, 8, 10, 12, 14, and 16.

It can be seen from figs. 24 and 25 that, in many cases, short vowels tended to be more centralized than long vowels e.g. *pin*, *p̃̀k*, *p̃̀k*, *p̃̀n*, *pĩ̂n* (*p̃̀wn*), etc. Comparing fig. 4 and fig.25, it can be seen that short and long vowels in pair /*p̃̀n*-*p̃̀en*/ differed not only in vowel duration but also in vowel quality. This result confirmed Abramson and Ren's results (1990) that vowel quality is a secondary auditory cue for vowel length in Thai.

CONCLUSION

To conclude, the results of this experiment showed that the main cue for vowel length in Thai is vowel duration, which confirmed Abramson's results (1962). Other extra cues are vowel quality, as found by Abramson and Ren (1990) and nasal duration, as found from the perceptual experiment in this paper.

Notes:
 The 50% crossover point is shown in Table 3 below.

Table 3: 50% Crossover Point

Pairs	Cross at vowel (ms)
1. p̣ik/ p̣iik	200-210/ 190-200
2. p̣in/ p̣iin	230-240/ 160-180
3. p̣ek/ p̣eek	230-240/ 200-210
4. p̣en/ p̣een	260/ 157
5. p̣ak/ p̣aak	230-240/ 200-220
6. p̣an/ p̣aan	210-220/ 210-220
7. p̣uk/ p̣uuk	210-220/ 210-220
8. p̣un/ p̣uun	210-230/ 200-210
9. p̣ok/ p̣ook	210-220/ 200-210
10. p̣on/ p̣oon	200-210/ 200-210
11. p̣ɛk/ p̣ɛɛk	240-260/ 220-230
12. p̣ɛn/ p̣ɛɛn	230-240/ 180-190
13. p̣ɛk / p̣ɛɛk	240-260/ 240-260
14. p̣ɛn/ p̣ɛɛn	220/ 210-220
15. p̣ɔk/ p̣ɔɔk	260/ 190-200
16. p̣ɔn/ p̣ɔɔn	210-220/ 220-230
17. p̣ịk/ p̣ịịk	210-220/ 190-200
18. p̣ịn/ p̣ịịn	180/ 180-190

The average of 50% crossover point is between 200-220 ms of vowel duration.

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