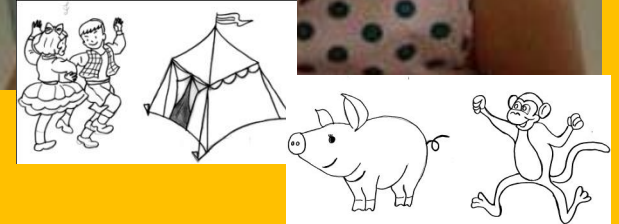




Perception of **lexical tones** in **Thai** children of different age groups



Praneerat Panpraneet and Chutamane Onsuwan

Department of Linguistics, Thammasat University

aya_ploy@hotmail.com, consuwan@tu.ac.th

Motivation

- **Speech perception** can be described as the transformation of an acoustic signal transmitted from a speaker to an intended communication message heard by a listener. (Gierut and Pisoni,1988)
- Thai is known as a **tonal language**.
- **Acquisition of lexical tones** has been found to begin very early in **Thai** children and to complete at around 23 months (Tuaycharoen,1977).
- Wong et al (2005) and Ip (2006) reported that **Chinese** children (Mandarin and Cantonese, respectively) were able to perceive tones when they were 3 and 4-4;11 years old. In those studies, tone perception was examined through the use of **picture-pointing-tasks** in which children listen to a word through headphones and were asked to identify which word they have heard by pointing to one of the pictures.
- To date, not much has been known about **Thai children's perception of lexical tones (from different age groups)**.

Objectives

- This study investigates the development of tone sensitivity (mid, low, high, falling, and rising) in 3 different age groups of young children (2-3;11, 4-5;11, 6-7;11) who speak Thai as their native language.
- Analysis method of **balanced confusion matrix**, similar to that used in Onsuwan et al. (2012) “*Analysis of Thai tonal identification in noise (by adults)*” is employed. This allows us to systematically evaluate **percent correct responses** in each tone pair and to obtain **confusion matrices**.

Background

- There are 5 lexical tones in Thai: three so-called ‘level’ tones, “mid” (ˉ), “low” (ˊ), “high” (ˋ), and two so-called ‘contour’ tones, “falling” (ˆ), and “rising” (ˊ). (Abramson, 1960)

mid	low	falling	high	rising
[nāa]	[nàa]	[nâa]	[náa]	[nǎa]

- Thai syllables may be represented as

$$C_i(C)V^T C_f \quad \text{or} \quad C_i(C)V^T V(C_f)$$

(C_i = an initial consonant, C_f = a final consonant, V = a short vowel, VV = a long vowel, and T = a tone)

- Acoustically, whether spoken in isolation or in connected speech, **F₀ height and shape** have been found to be major cues to differentiate the 5 tones. Perceptually, F₀ height and shape have been shown to be the most relevant cues for the identification of Thai tones (Abramson, 1975; Gandour and Dardarananda, 1983)

- Average F_0 contours of 5 Thai tones in Potisuk et al. (1994) is provided in Fig 1.

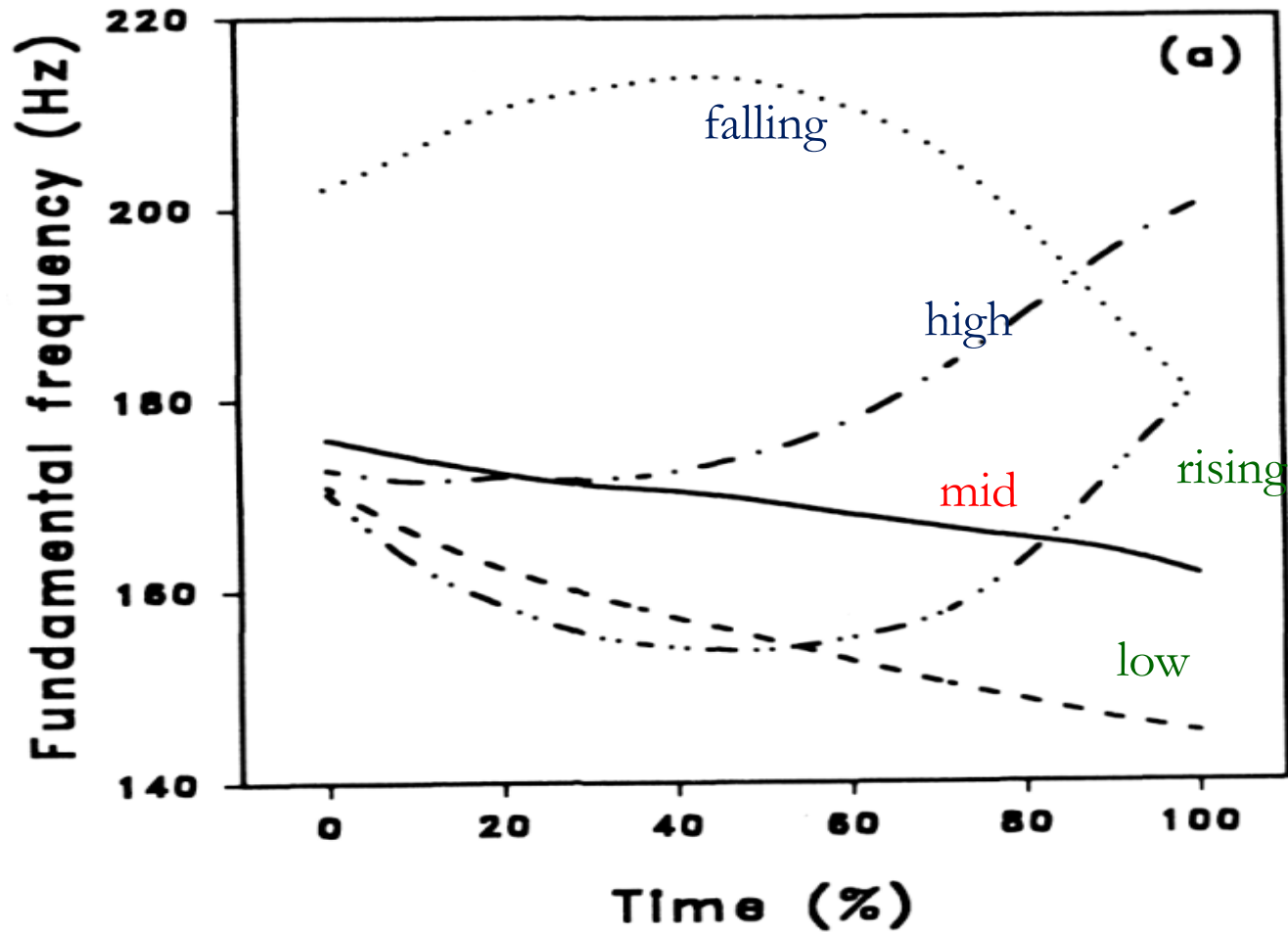


Fig 1. Average F_0 contours of 5 Thai tones in Potisuk et al. (1994).

Experimental Setup

Speech materials:

- 10 pairs (20 monosyllabic words (CVV and CVC)), members in each pair differ only in their lexical tone
- 10 filler words
- Every word is a basic word in the language.

Speaker: Native speaker from Bangkok (female; 31 years old)

Recording procedure:

- Each word (both target words and filler words) was repeated 6 times.
- One token for each word was selected based on impressionistic hearing and acoustic evaluations.

tonal pair	target word pair							
mid-low	1	ปู	'crab'	[pū:]	-	ปู่	'grandfather'	[pù:]
mid-falling	2	ยา	'medicine'	[jā:]	-	หญ้า	'grass'	[jâ:]
mid-high	3	นา	'field'	[nā:]	-	น้า	'aunt'	[ná:]
mid-rising	4	ไฟ	'fire'	[fāj]	-	ไผ่	'mole'	[fǎj]
low-falling	5	กล่อง	'box'	[klòŋ]	-	กล้อง	'camera'	[klôŋ]
low-high	6	หวัด	'cold'	[wàt]	-	วัด	'temple'	[wát]
low-rising	7	เข่า	'knee'	[k ^h àw]	-	เขา	'mountain'	[k ^h ǎw]
falling-high	8	เต้น	'dance'	[tênt]	-	เต็นท์	'tent'	[tént]
falling-rising	9	เสื้อ	'shirt'	[sũa]	-	เสือ	'tiger'	[suǎ]
high-rising	10	ม้า	'horse'	[má:]	-	หมา	'dog'	[mǎ:]

Table 1. Twenty target words (10 tonal pairs).

Perception Test

Participants:

- 75 Thai children (boys and girls) from 3 age groups:

2-3;11	25 children
4-5;11	25 children
6-7;11	25 children

- baseline group: 5 Thai adults

Testing procedure:

- There were 20 trials for tones and 10 trials for filler words.
- In each trial, a 2-choice identification task was carried out using pictures. Children heard a previously recorded monosyllabic word once over their headphones and were then asked to identify which word they had heard by pointing at one of the two picture choices.
- The test was performed individually on each child in a quiet room at their kindergarten and elementary school in Bangkok. Parental permissions were obtained prior to the test.
- Each test session lasted about 10 minutes.

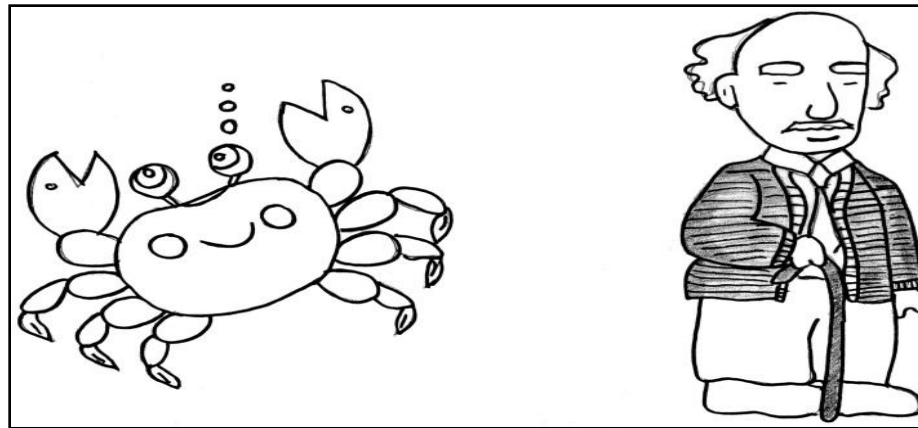


Fig 2. A sample of the 2-choice identification task (ɥ [p̄u:] versus ɥ [p̄u:])

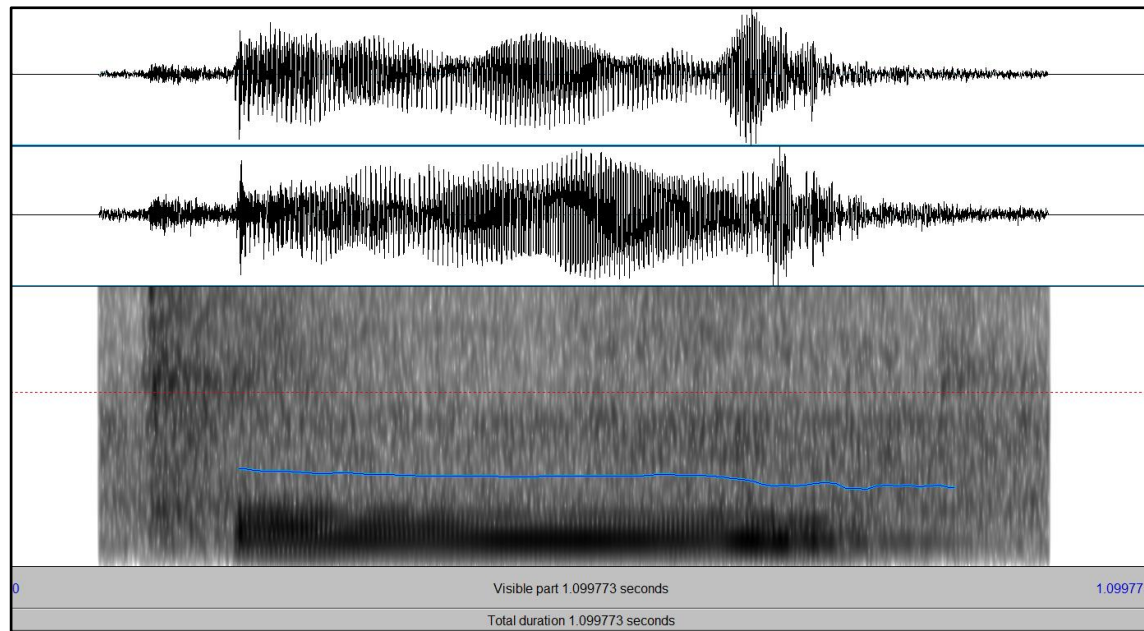
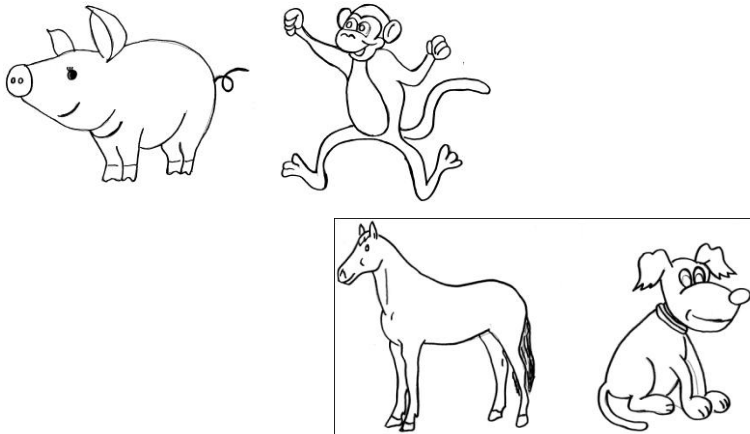


Fig 3. Waveform display (top panel) and wide-band spectrogram (bottom panel) of the token [p̄u:].



Fig 4. A 4-year old during a test session at an elementary school.

Fig 5. A 3-year old during a test session at a kindergarten.



Perceptual Results

age	target word		filler word
	\bar{X}	SD	\bar{X}
2-3;11	13.96	1.88	10
4-5;11	18.16	1.80	10
6-7;11	19.60	0.91	10

Table 2. Average percent correct responses of tone identification across 3 age groups

Percent correct responses of tone identification increase from the youngest to the oldest groups. An ANOVA analysis for 3 age groups revealed that age difference had a *significant effect* on identification scores. [$F(2,72) = 84.78, p < 0.05$]. (Percent correct responses from the adult group were at 100%.)

	mid	low	falling	high	rising	total
mid	72	4	10	9	5	100
low	20	51	7	15	7	100
falling	5	3	87	4	1	100
high	9	4	7	77	3	100
rising	16	14	1	7	62	100

	mid	low	falling	high	rising	total
mid	97	0	2	1	0	100
low	10	81	2	4	3	100
falling	0	1	96	3	0	100
high	3	1	2	93	1	100
rising	3	7	0	3	87	100

	mid	low	falling	high	rising	total
mid	99	0	1	0	0	100
low	3	96	0	1	0	100
falling	0	0	100	0	0	100
high	0	0	0	100	0	100
rising	2	3	0	0	95	100

Tables 3, 4, and 5
Confusion
matrices (in
percent) for the 5
Thai tones from
children aged
2-3;11 (top),
4-5;11 (middle),
and 6-7;11
(bottom).

- Even though tone identification performance improves as children are older, some common confusion patterns emerge. For all age groups, **low tone** almost always shows the lowest scores. Two cases of **unidirectional misperception** are found for low tone (misidentified as mid) and rising tone (misidentified as mid and low). Investigation of children's misidentified responses in every age group reveals that they **avored mid tone** over other tones.
- For the youngest group (2-3;11), **bidirectional misperception** patterns are found in almost every tone pair (such as between mid and low and between rising and high).

Conclusions

- The findings suggest that by age 2, Thai children have already developed sensitivity to lexical tones and that they do not achieve mastery of these contrasts until after the age of 8.
- Among the 5 tones, low tone appears to elicit higher number of misidentification (and confusion).
- An acoustic analysis (F_0 and intensity) of Thai children's production of Thai lexical tones is now underway to investigate possible relationship between the children's perception and production performance .

References

- Abramson, A.S. (1960). *The Vowels and Tones of Standard Thai: Acoustical Measurements and Experiments*. PhD dissertation, Columbia University.
- Abramson, A.S. (1975). The tones of central Thai: some perceptual experiments. In J.G. Harris & J.R. Chamberlain (Eds.), *Studies in Tai linguistics in honor of William J. Gedney*, pp. 1–16. Bangkok: Central Institute of English Language.
- Gandour, J. and Dardarananda, R. (1983). “Identification of tonal contrasts in Thai aphasic patients.” *Brain and Language*, 18(1): 98–114.
- Gierut, J. A. and Pisoni, D. B. (1988). Speech perception. In N. Lass, L. McReynolds, J. Northern, & D. Yoder (Eds.), *Handbook of speech-language pathology and audiology*. pp. 264-287. Philadelphia: B. C. Decker.
- Ip, V. (2006). *Perception and production of lexical tones by young children*. Undergraduate dissertation, School of Science (Speech and Hearing Sciences), University of Hong Kong.
- Onsuwan, C., Tantibundhit, C., Saimai, T., Saimai, N., Chootrakool, P., and Thatphithakkul, S. (2012). “Analysis of Thai tonal identification in noise.” *Proceedings of the 14th Australasian International Conference on Speech Science and Technology (SST)*. Sydney: Macquarie University, Australia. 173-176.
- Potisuk, S., Gandour, J.T., & Harper, M.P. (1994). “F0 correlates of stress in Thai.” *Linguistics of the Tibeto-Burman Area*, 17(2): 1–27.
- Tuaycharoen, P. (1977). *The Phonetic and Phonological Development of a Thai Baby: From Early Communicative Interaction to Speech*. PhD dissertation, School of Oriental and African Studies, University of London.
- Wong, P., Schwartz, R. G., & Jenkins, J. J. (2005). Perception and production of lexical tones by 3-year-old, Mandarin-speaking children. *Journal of Speech, Language and Hearing Research*, 48(5): 1065.