Are Tones Phones?

Denis Burnham[†], Chris Davis†, Jeesun Kim†, Zeina Issa[†], Helen Tam[†], Benjawan Kasisopa‡, Prajaree Tantong‡, Colin Schoknecht[†], Caroline Jones[†], Sudaporn Luksaneeyanawin‡

[†] MARCS Auditory Laboratories, UWS, Australia; †University of Melbourne, Australia;

‡ CRSLP, Chulalongkorn University, Thailand

d.burnham@uws.edu.au

ABSTRACT

Using an 'odd one out' task these studies investigate phonological awareness - awareness of phonemes as independent speech units, and also "tonological awareness" using Central Thai, a tonal language with five tones. In Experiment 1 Thai children and Australian English children (Kindergarten, Year 2, 4, 6), and adults are tested and it is found that children and adults perform better on phonological than tonological awareness, and that tonological awareness is a function of Thais' education level. Experiment 2 with good and poor reader Thai children shows that good readers are better at both tasks, and confirms the advantage for phonological over tonological awareness, even for good readers. The psychological equivalence of phonemes and tonemes is discussed.

1. INTRODUCTION

Phonological awareness is the knowledge that spoken words consist of individual phonemes, and is demonstrated by the individual's ability to manipulate phonemes in phoneme deletion, odd-one-out tasks etc. In alphabetic languages Phonological awareness correlates positively with early reading. Indeed there is evidence that explicitly teaching pre-reading children about phonological awareness improves their later reading ability [1].

The connection appears also to flow in the opposite direction. In adults, it has been shown that phonological awareness is greater in people who can read: when relevant variables are matched, phonological awareness, measured by phoneme deletion and addition tasks, is much lower in illiterate than literate Portuguese people, suggesting that learning to read facilitates phonological awareness [2]. More precisely, phonological awareness can be said to be a product of learning to read an *alphabetic* language: Chinese speakers who have learned Pinyin, an alphabetic form of written Chinese, show better phonological awareness than those who have learned just the Chinese character-based ideography, which is essentially not phonetically-based [3].

So it appears that there is a bi-directional connection between phonological awareness and learning to read an alphabetic language, but that learning to read an ideographic language does not facilitate phonological awareness. What about pre-reading phonological awareness experience and learning to read an ideographic orthography? In a four-year longitudinal study with 3-year-old Hong Kong Chinese children, who are taught the ideography and not Pinyin, phonological awareness abilities at age 3, were indeed found to predict children's later reading ability with the ideography [4].

These results are interesting because not only does Chinese have an ideographic script, but Chinese languages are also tone languages, as are numerous other languages of the world. In fact, over half the people of the world speak a tone language. In tone languages word meanings are constituted not only by the consonants and vowels they contain but also by the tone, which is usually thought to consist of pitch variations, but which is also often co-determined by duration and voice register. For example in Cantonese, /fan55/ (pronounced with a high tone) means 'divide', /fan22/, low, 'portion', /fan25/, low-high rising 'powder', /fan33/, mid 'lecture', /fan21/, falling tone, 'grave', and /fan35/, low-mid rising tone is 'angry'.

Despite extensive research on phonological awareness, tonological awareness is relatively understudied. In a test with 5- to 6-year-old children (one group of monolingual Mandarin speakers and another group of bilingual Mandarin/Cantonese speakers) on non-words in an ABX task Hu found that both groups performed better when the basis for the decision was all the sounds after the initial consonant, than in a condition in which the tone on the words was the basis for the decision [5].

The two experiments here are concerned with tone language (Thai) speaking children and adults and (i) their comparative ability on phonological and tonological awareness tasks; (ii) the development of phonological and tonological awareness as a function of age; (iii) the effect of education level on phonological and tonological awareness; and (iv) the effect of reading ability on phonological and tonological awareness. Both Experiments 1 and 2 are concerned with (i), Experiment 1 is also concerned with (ii) and (iii), and Experiment 2 is also concerned with (iv). In both experiments the stimuli consist of Thai words in odd one out tasks designed to test both phonological and tonological awareness.

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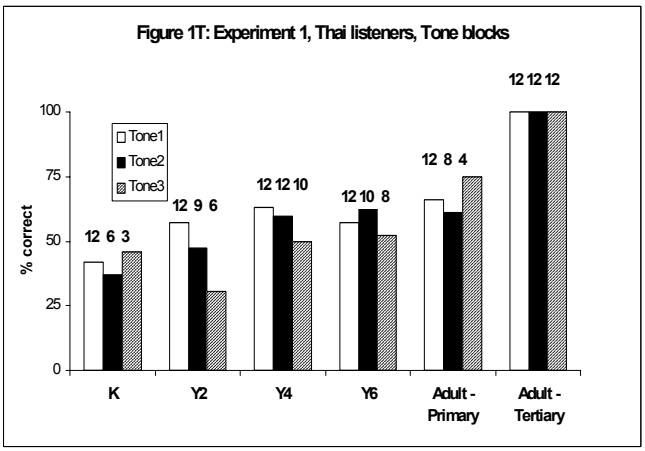
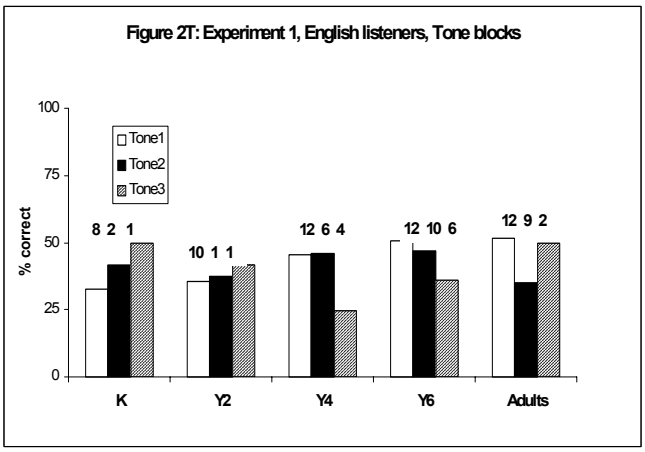
2. EXPERIMENT 1

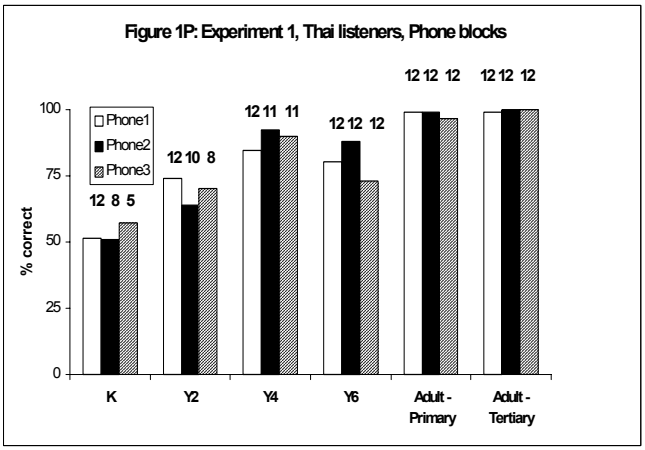
Thai Kindergarten, and Year 2, 4, and 6 children were tested, along with two groups of Thai adults, one primary school educated group, and another tertiary educated group. Control groups of Australian English Kindergarten, Years 2, 4, and 6, children and a group of adults were also tested on the phonological and tonological awareness tests.

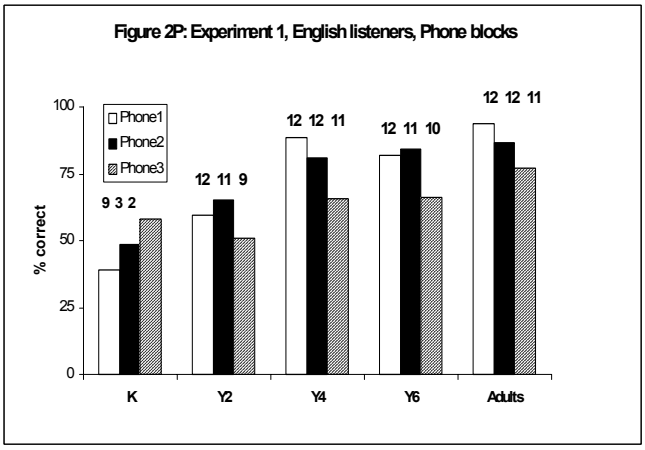
2.1 METHOD

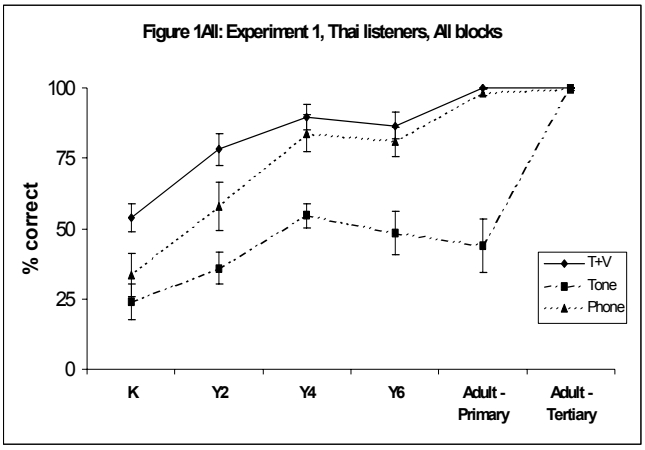
Participants: 12 Thai children (6 boys, 6 girls) in each of the following classes were tested: Kindergarten (mean age = 5.5 years), Year 2 (mean = 6.9 years), Year 4 (mean = 9.2 years), and Year 6 (mean age = 11.2 years). Two groups of adults were also tested, a Primary Educated group (6 men, 6 women, mean age 37.5 years, whose final year of school

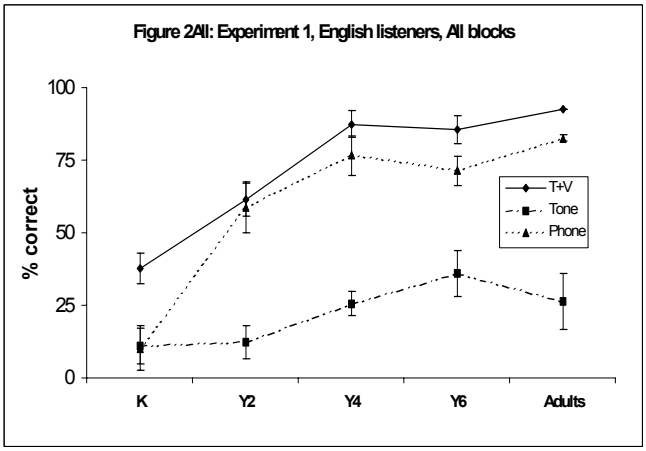












Figures 1T, 1P, and 1All for Phone, Tone, and All blocks respectively for Thai listeners. The numbers above the histograms in Figures 1T and 1P are the numbers of children completing the particular blocks.

Figures 2T, 2P, and 12All for Phone, Tone, and All blocks respectively for Australian English listeners. Numbers above histograms in Figures 2T and 2P are the numbers of children completing the particular blocks.

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ranged from Year 4 to Year 8), and a Tertiary Educated group (6 men, 6 women, mean age 22.1 years, whose tertiary education ranged from BA to PhD). In addition, control monolingual Australian English children and adults were tested, 12 in Kindergarten Year (4 boys, 8 girls, mean age = 5;6), 12 in Year 2 (10 boys, 2 girls, mean age = 7;2), 12 in Year 4 (7 boys, 5 girls, mean age = 9;5), 12 in Year 6 (9 boys, 3 girls, mean age = 12;0), and 12 adults (7 men, 5 women, mean age = 24 years).

Tests: There were 7 blocks of 8 trials, with an additional 2 practice trials at the beginning of each block. Each trial consisted of 3 Thai words and the participants' task was to pick the "odd one out". There were 3 sets of blocks, tone and vowel (T+V), Phone only (Phone), and Tone only (Tone). Block 1 consisted of items in which the odd one out could be gauged from both the tone and the vowel (hence 'T+V'), e.g., /sɔːn4/, /hɔːn4/, /baːn0/ (numbers refer to Thai tones - 0, mid; 1, low; 2, falling; 3, high; 4, rising; and underlined items are the correct alternative). There were 3 Phone blocks in which the vowel was the basis for oddity of one of the 3 items, as follows: varying final, same initial (Phone1 hereafter), e.g., /buam0/, /buaŋ0/, /beːn0/ ; varying initial, same final (Phone2), e.g., /laːŋ3/, /ŋaːŋ3/, /rɔːŋ3/ ; varying initial, varying final (Phone3), e.g., /rɔːŋ0/, /tɕʰɔːn0/, /laːm0/ ; and 3 Tone blocks in which the tone was the basis for the oddity of one of the 3 items, as follows: varying vowel, same initial and final (Tone1), e.g., /juan0/, /jaːn0/, /jɔːn3/; varying initial, same rime (Tone2), e.g., /pʰak3/, /sak3/, / kak1/; and varying initial and vowel (Tone3), e.g., /tɔːn2/, /saːn2/, /joːn0/.

Procedure: Half the participants in each age group received the blocks in the order T+V; Phone1, Phone2, Phone3; Tone1, Tone2, Tone3, and the other half in the order T+V; Tone1, Tone2, Tone3; Phone1, Phone2, Phone3. In order to maintain especially the young children's interest, testing in a particular set of blocks (T+V, Phone, or Tone) was discontinued if a child made three consecutive incorrect responses. In this way children could finish a particular set of set of trials when items became too difficult without becoming discouraged, and then move onto the next set of trials. Thus each participant completed trials in the T+V, Phone, and Tone sets of blocks [6].

2.2 RESULTS AND DISCUSSION

Each participant was given a percent correct score for each of the T+V, Phone, and Tone sets. Score per block was determined by taking the percent correct in a particular block, with the added condition that if a participant made 3 consecutive errors, they received 0 on those trials, and a nominal .33 (chance) on the remainder of trials in that block, and no score on the remaining blocks in that set.

For the Thai sample mean percent correct per block along with the number of children who completed each block is given for the Tone and Phone blocks in Figures 1T and 1P respectively. These scores were then amalgamated for the tone and phone blocks to give a percent correct score on each, which could be compared to the tone plus vowel block. Data for Tone, Phone, and (T+V) blocks are shown in Figure 1All. These Thai data were subjected to an age (K, 2, 4, 6, Adult-Primary, Adult-Tertiary x set (T+V, Phone, Tone) planned contrast analysis of variance (ANOVA) with repeated measures on the second factor with alpha set at .05. Similar data for the Australian English participants are displayed in Figures 2T, 2P, and 2All. T+V, Tone, and Phone set data for the Australian English participants were subjected to a separate ANOVA, identical to the design for the Thai analysis, except that only one adult group was used.

For the Thai participants the ANOVA revealed that adults performed generally better than children, $F(1,66) = 81.32$, and Tertiary better than Primary Educated adults, $F(1,66) = 12.73$. Within the child groups, there were overall linear, $F(1,66) = 52.67$, and quadratic, $F(1,66) = 10.27$, age trends. Participants generally performed better on T+V than Tone, $F(1,66) = 144.83$, and Phone, $F(1,66) = 14.12$, and on Phone than Tone, $F(1,66) = 56.95$, but of more importance are the interactions of age group and stimulus type.

While adults performed equivalently on T+V and Phone, children performed better on T+V than Phone, $F(1,66) = 5.51$, and this advantage decreased linearly over age, $F(1,66) = 4.91$. There was a linear increase in children's ability on the Phone tasks, but the trend was flatter for the Tone tasks, $F(1,66) = 4.38$. Thus children were generally poorer at toneme than phoneme awareness tasks, and also improved less over age for toneme than phoneme awareness. Nevertheless there was some implicit awareness of tones as provision of both tone and phone information in the T+V task facilitated performance over the Phone task alone.

Tertiary educated adults performed equivalently on all tasks, while the primary educated adults performed equivalently on T+V and Phone, $F(1,66) = 56.95$, but poorer on Tone than Phone, $F(1,66) = 56.95$, or T+V, , $F(1,66) = 56.95$. Thus full awareness of the tones appears to be a metalinguistic skill, which only arises as a function of education level.

For the Australian participants the ANOVA revealed that adults performed generally better than children, $F(1,55) = 18.45$, and within the child groups, there were overall linear, $F(1,55) = 71.85$, and quadratic, $F(1,55) = 8.49$, age trends. Participants generally performed better on T+V than Tone, $F(1,55) = 476.27$, and Phone, $F(1,55) = 22.18$, and on Phone than Tone, $F(1,55) = 155.80$. T+V and Phone scores were essentially equivalent at the different ages, except for Kindergarten children as shown by the differences in the quadratic trend for T+V and Phone, $F(1,55) = 5.12$. At all ages performance on Tone was far below that on Phone or T+V, and this difference generally increased with age, $F(1,55)$ linear, T+V/Tone = 12.12, $F(1,55)$ linear, Phone/Tone = 14.03, $F(1,55)$ quadratic, T+V/Tone = 11.20,

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F(1,55) quadratic, Phone/Tone = 21.59; and was greatest in adults, F(1,55) T+V/Tone = 11.43, F(1,55) linear, Phone/Tone = 9.55. Thus Australian English listeners were much poorer on Tone than the other tasks (and this difference appears to be greater than for Thais, see Figures 1 and 2). With increasing experience with a non-tonal language, relative ability with tonological awareness deteriorates. A similar trend is evident for the Thai children, but for tertiary educated adults tonological awareness dramatically improves.

3. EXPERIMENT 2

Experiment 2 was conducted to assess phonological and tonological awareness ability as a function of reading ability in Thai children. A pool of 152 children was given a test battery, and two selected subsets were then given four tasks, one T+V, two Phone, and one Tone task.

3.1 METHOD

Participants: There were 11 Good Reader group children (5 boys, 6 girls mean age = 10.5 years), and 10 in an age matched Poor Reader group (5 boys, 5 girls, mean = 10.4 years). The two groups were matched on non-verbal intelligence, but the Good Reader group were at least 2 standard deviations higher on verbal intelligence scores.

Tests and Procedure: There were 4 blocks of 10 trials with 2 additional practice trials at the beginning of each block. Each trial consisted of 4 Thai words and the participants' task was to pick the "odd one out". There was one T+V block as in Experiment 1, e.g., /fɔːn3/, /jɔːn3/, /kʰɔːn3/, /waːn0/; a Phone block with varying initial same rime (Phone-easy), similar to Phone1 in Experiment 1, e.g., /tɔːn2/, /kʰɔːn2/, /sɔːn2/, /raːŋ2/; a second Phone task with varying initial same final (Phone-Difficult), the same as Phone2 in Experiment 1, e.g., /tɕaːn0/, /pʰaːn0/, /ŋaːn0/, /dɔːn0/; and one Tone block with varying initial same rime, the same as Tone2 in experiment 1, e.g., /baːn2/, /daːn2/, /kaːn2/, /jaːn0/. Testing was conducted in a similar fashion to Experiment 1 except that all participants were presented with all trials. Half the participants had a Phone-easy, Phone-Difficult, T+V, Tone order, and the other half in a T+V, Tone Phone-easy, Phone-Difficult order.

3.2 RESULTS AND DISCUSSION

Percent correct are graphically represented in Figure 3. ANOVA revealed that Phone, F(1,19) = 16.65, and T+V, F(1,19) = 18.78, tasks were performed significantly better than the Tone task. Good Readers were systematically better than Poor Readers, F(1,19) = 6.45, and there was no interaction of factors. Thus good readers are better than poor readers on both phonological and tonological tasks, but their reading ability does immunize them against poorer performance on tonological than phonological tasks.

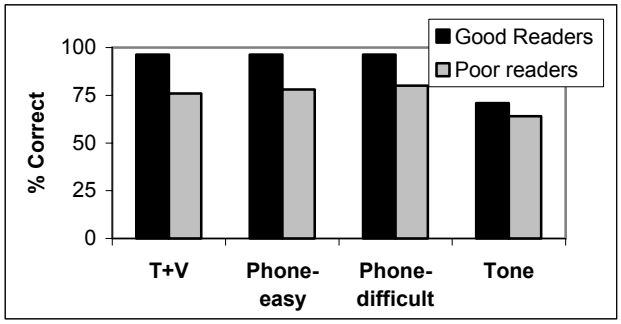

Figure 3: Good and Poor Readers inExperiment 2.

4. SUMMARY AND CONCLUSIONS

The results of these studies show that (a) for non-tonal language speakers tonological awareness tasks are more difficult to perform than phonological awareness tasks, and this difficulty is accentuated with age, (b) the relative difficulty with tonological awareness tasks is experienced even by tone language speakers, and (c) the relative difficulty with tonological awareness tasks is experienced even by children who are very good readers for their age. It appears that performance on tonological and phonological awareness tasks is equivalent only as a product of a high level of education. It remains for further studies to investigate whether this equivalence is a product of some explicit instruction or is more implicitly acquired. The results are sufficiently striking to suggest that there may be a fundamental difference in the manner in which phonological and tonological awareness arise, and, pending further investigation, that the psychological status of tones and phones may not be equivalent.

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