The change of Standard Thai high tone: an acoustic study and a perceptual experiment

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Standard Thai tones are divided into two categories: level tones (mid tone, low tone, and high tone) and contour tones (falling tone and rising tone). The Thai high tone has been found to have changed its shape during the years 1911-2006 (Bradley 1911, Abramson 1962, Tumtavitikul 1992, Morén and Sziga 2006). The shift in tone shape entails a change from mid falling (1911) to high level (1962), and mid rising (2006). This study attempts to show how, acoustically and perceptually, the high tone in Standard Thai is changing from high level to mid rising. The participants for this study are chosen from the following age groups: under-twenty and over-sixty. Each of the two groups consists of male and female. The Praat program, which was used to conduct an acoustic analysis and perceptual experiments, had illustrated from results how the high tone shape in the over-sixty group is of high level, whereas a mid rising in the under-twenty group. The present characteristic of the high tone has been observed to be similar to that of a rising tone; for this reason, the Standard Thai high tone should be categorized as a contour tone.

Keywords: Standard Thai, experimental phonetics, tone

1. Introduction

For many years linguists have pursued acoustic studies along with auditory experiments to discover tones in languages; and so, Thai, among those studied, is classified as a tonal language. Based on a combination of an acoustic study and a perceptual experiment (Abramson 1962, 1975, 1978), there are five distinctive tones in Standard Thai:[1] mid tone [33], low tone [21], falling tone [43], high tone [44 or 45] and rising tone [323]. Acoustically, each Thai tone characteristic is well-defined by fundamental frequency shape (F_0; Hz). This F_0 shape is identified by the F_0 values and F_0 direction–via the starting point, and its movement towards end point respectively. Moreover, in a relative sense, the F_0 shape, together with perceptual experiments, are the basis for grouping Thai tones into two of the following categories (Abramson, 1962), namely level or static tones, and contour or dynamic tones. The level tone category comprises of mid tone, low tone, and high tone, while the contour tones include falling and rising tones. However, following the work of Abramson (1978), major distinctions between the two categories were left unstressed. The term 'level' was more associated with manifestations of the mid tone and occasionally, the high tone. In addition, Abramson (1978: 320) argues from acoustic data the possibility of describing 'high tone' as 'high rising tone', while 'rising tone' as 'low rising tone'. This later finding from Abramson (1978) will be the basis for discussions in this study.

During past decades, the acoustic study of Standard Thai tones, which indicates a relationship to an articulatory dimension, has developed into a long progression of studying tones of monosyllabic words to tones in connected speech (Abramson 1962, 1975, 1979, Erickson 1974, Hiranburana 1972, Potisuk et al. 1994, Tingsabadh and Deeprasert 1997). At this date, the study of Standard Thai tones in isolated monosyllables are observed as less important than in connected speech; yet it has been used as a fundamental reference for a more advanced study of experimental phonetics and phonology. However, a number of

linguists have raised an interesting point concerning Thai tones based on their F_0 shapes in monosyllabic words. The F_0 of high tone in isolated monosyllable words is observed to have changed its shape from high falling (Bradley 1911) to high level (Abramson 1962, 1975, 1979, Erickson 1974, Panroj 1991, Potisuk et al. 1994, Tingsabadh and Deeprasert 1997), and to mid rising (Abramson 1978, 1979, Chuwarahawong 2000, Morén and Zsiga 2006, Panroj 1991, Potisuk et al. 1994, Teeranon 2002a, 2002b, Tingsabadh and Deeprasert 1997, Tumtavitikul 1992). And it is questioned whether the high tone should be recategorized as a dynamic or contour tone (Teeranon 2002a, 2002b, Teeranon and Rungrojsuwan 2008).[2] This change has been proven acoustically to exist but remains to be proven auditorily. The study has two main goals; 1) to attest the change of high tone in both articulatory and auditory aspects to confirm that the change has occurred in the production and perception process of Thai speakers, and 2) to proclaim the importance of studying tones in monosyllabic words.

To examine the change in high tone, an acoustic study of Standard Thai tones and perceptual experiments were analyzed on isolated monosyllables spoken by participants of two generations: over sixty years old and under twenty years old.[3] There is a related chronology in studying the change in these two age groups. The over-sixty group represents the past, and the under-twenty group represents the present and the future.

2. Preliminary background

2.1 *An acoustic study of the change of Standard Thai high tone*

According to the F_0 shape of high tone during the past century, from 1911 to 2007, the development of high tone is divided into three periods as follows:

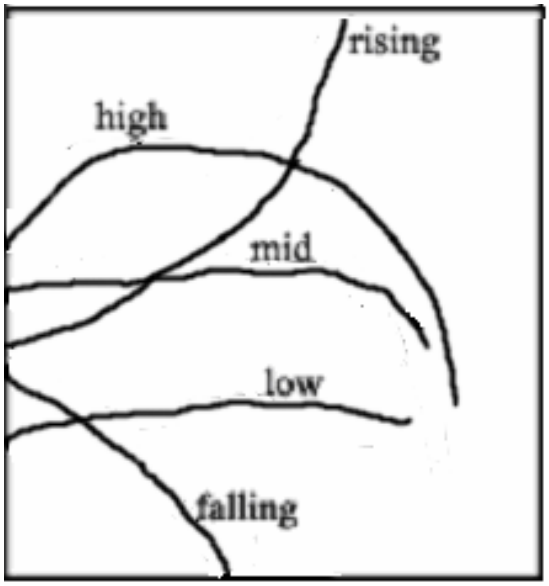


Figure 1 *F_0 shapes of Standard Thai tones in the first period (adapted from Bradley 1911 and Pittayaporn 2007)*

The phonetic characteristics of Standard Thai tones were initially recognized in 1911 by C. B. Bradley (1911),[4] using kymographic recording of Thai tones. The informant may apparently be himself, an English-Thai bilingual; however, it is uncertain whether the curves presented in the graph were genuinely his speech. Additionally, in Bradley's era, the instruments for recording and analysing were unidentified; therefore, the quality of his data is another factor in doubt. The high tone, which was high falling, is observed to be similar to a falling tone of the present time. For the rising tone, it begins slightly below the mid F_0 before steadily increasing. As a result, the factors distinguishing between the high tone and the rising tone are their shapes in F_0 height and direction (see Figure 1).

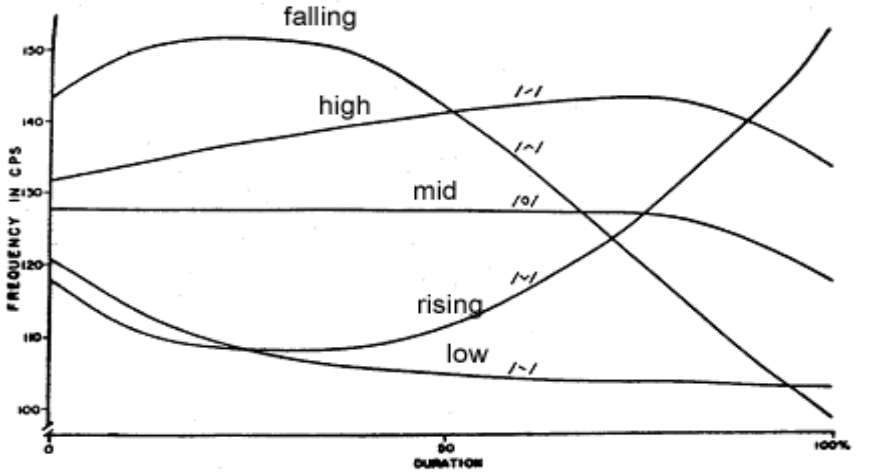


Figure 2 *F_0 shapes of Standard Thai tones in the second period (Abramson, 1962)*

During 1962-1975, while the rising tone experienced minor changes, the shape of high tone showed much greater change. In this period, a rising tone starts below the mid point then drops slightly, making contact with low tone before rising. In contrast, the high tone gradually increases from its starting point with a slight fall at the end (Abramson 1962, 1975, Erickson 1974). The high tone is changing from a contour shape to being levelled. The shape of a falling tone, however, appears very similar to a high tone of the first period (1911) (see Figure 2).

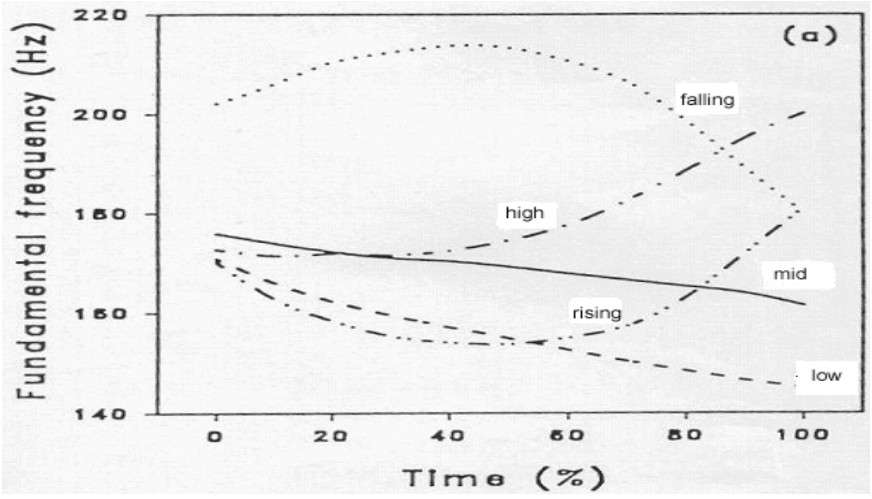


Figure 3 *F_0 shapes of Standard Thai tones in the third period (Potisuk et al., 1994)*

At present, the high tone is observed to have changed its shape again from high level to mid rising (see Figure 3) (Abramson 1979, Chuwarahawong 2000, Morén and Zsiga 2006, Panroj 1991, Potisuk et al. 1994, Teeranon 2002a, 2002b, Teeranon and Rungrojsuwan 2008, Tingsabadh and Deeprasert 1997, Tumtavitikul 1992). Its shape looks like the rising tone.

In order to make a judgement between the high tone shapes in each period, each figure was converted to suit a comparison table. The changes are as follows.

Table 1 consists of six columns. The first column represents each period which is classified by the high tone shape. The second column represents the authors and the years they conducted their studies.[5] Some sociolinguistic factors - sex and age - are represented in the third and fourth columns. The fifth column represents the tone shapes converted from Figures 1, 2, 3 shown in previous pages. Five lines in this column were drawn using the five-level scale concept. Each line represents F_0 level. The lowest F_0 is represented by the lowest line (or number 1 for Five-scale tone numerical system) and the highest line represents the highest F_0 (or number 5 for Five-scale tone numerical system). Finally, the F_0 levels from the fifth column are converted into a numerical system in the sixth column.

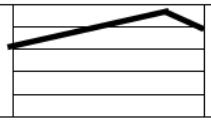
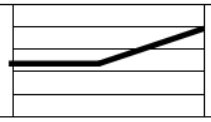
(1) Periods	(2) Authors	(3) Sex of informants	(4) Age of informants	(5) Five-scale tone stick system	(6) Five-scale tone numerical system
1	Bradley (1911)	male	65		442
2	Abramson (1962)	male	23-25		44~45
3	Potisuk et al. (1994)	male and female	22		334

Table 1 *The change of Standard Thai high tone*

Fifty-five years later, in the second period, the tone shape is of high level [44 ~ 45]. The tone shape starts with a high F_0 and rises steadily. However, its slightly falling contour at the end still remains. Its shape is becoming less contoured when compared to the first period.

In the third period, the high tone starts from mid F_0 and levels off before rising. This shape is noted for its similarity to that of a rising tone (Abramson 1979). Hence, the result of this comparison – between the first and the third period high tone shapes – confirms a total change. That is to say, the high tone height has changed from high to mid, and its direction from falling to rising.

2.2 *A perceptual experiment of Standard Thai high tone*

To this date, the number of studies published concerning perceptual aspects of Standard Thai high tone is marginal. On one hand, several experiments were done with normal speech (Abramson 1962, 1975, 1997); and on the other hand, some were conducted with abnormal-Thai speakers (Gandour and Dardarananda 1989, Nasanee 2003). However, only normal speech perception tests will be mentioned in this study.

Abramson (1962, 1975) was the first to examine the Thai tones perception in normal speech. In Standard Thai, there are two types of tones, level tones and contour tones. It was found, both for control tests with natural speech and tests with synthetic stimuli, a slight tendency on the part of some participants to confuse between the mid tones and the low tones; however, the identification rates for those tones were clearly above 90%. This was later confirmed by Gandour and Dardarananda (1989) and Nasanee (2003).

One noteworthy work is of Abramson (1978), which conducted three perceptual experiments testing the validity of distinction between static and dynamic Thai tones. An adult male voice was used to synthesize the three experiments. Thirty-seven participants were to identify the tones in the first and the second experiments, while thirty-one participants were used in the third experiment. In the experiments, a syllable type of [kha:] was prepared on the Haskins Laboratories formant synthesizer. In the first experiment, sixteen variants were made by superimposing sixteen levels of F_0 (F_0 straight contour) ranging from 92 to 152 at intervals of 4 Hz. Participants were found to identify the mid tone at 116 Hz, 73%; the low tone at 92 Hz, 90%; and the high tone at 152 Hz, 88%. The second experiment was made by sixteen movements of F_0 from mid origin, 120 Hz, to end points ranging from top, 152 Hz, to bottom, 92 Hz, in steps of 4 Hz. The mid tone identification rate of the F_0 at the mid origin, 120 Hz, to end point, 116 Hz, was found to decrease; it was 73%, while the first experiment was at 82%. However, the low tone identification rate for the F_0 at 120 Hz to the bottom was close to that of the first experiment – about 90%. On the other hand, the high tone identification rate for the F_0 of the mid origin, 120 Hz, to end point, 145 Hz, was at 88% compared to 98% in the first experiment. The third experiment was made by seventeen movements of the F_0 rising from the bottom to end points ranging from top, 152 Hz, to bottom, 92 Hz, in steps of 4 Hz. The mid tone was found to peak under 12%, and is insignificant. The low tone reached 88% of identification only at the bottom range. The high tone identification was at 40% as the F_0 had risen from the bottom to 112 Hz. And the rising tone identification was at 91% as the F_0 rose from the bottom to 140 Hz.

In a recent study by Abramson (1997), the techniques of acoustic analysis and speech synthesis were combined. The two techniques were used to revalidate and test the distinction of static and dynamic tones in Thai. The word 450ms-long-[khaa] ‘to be stuck’ was synthesized by using the Haskin Laboratories computer-controlled formant synthesizer. The synthesized word is ranges from 90 to 154 Hz. Then, thirty-seven native speakers of Standard Thai were chosen to perceive the randomized-synthesize speech over a period of month. The technique of synthesized speech was used to conduct four experiments from which the central concern and idea of this study arose. The level shape of synthesized speech was found to indicate static tone perception, while the movement of synthesized speech, especially at the onset, is a cue for dynamic tones perception. Additionally, the clear F_0 movement had been noted for its aid to the participants’ high tone identification.

3. Language data

The language data used for test tokens were drawn from Standard Thai belonging to the Tai-Kadai language family. The language has a repertoire of nine monopthongal vowels, /i, ɨ, u, e, ə, o, ɛ, a, ɔ/, all with vowel length distinctions. However, all the test words contained the vowel /aa/ to avoid the effects of F_0 differences in vowels.

For the acoustic study, forty participants were chosen. As language change can be affected by age, these participants were then divided into two groups: twenty participants were over sixty years old, while the remaining were under twenty years old. Each group consists of twenty participants of male and female. In addition, the changing age of participants was used to further the confirmation on the claim of high tone change. It should be noted, the age factor is regarded as one of the most essential factors for testing tone changes overtime (Chambers 1995, Labov 1994). As mentioned before, the over-sixty group represents the past and the under-twenty group represents the present and the future.

Three sets of test tokens[6] were created using the /aa/ vowel together with a variety of initial consonants, as shown in Table 2:

Set 1	**Set 2**	**Set 3**
khaa 'to be stuck'	naa 'rice field'	faa 'a note'
khàa 'galangal'	(nɔ́j) nàa 'custard apple'	fàa 'palm (of the hand), sole (of the foot)'
khâa 'value'	nâa 'face'	fâa 'scum'
kháa 'to trade'	náa 'aunt'	fáa 'sky'
kha→a 'leg'	na→a 'thick'	fa→a 'pot cover'

Table 2 *Thai words for recording*

4. Methodology

4.1 *Acoustic Analysis*

After preparing the appropriate test tokens (For example, all test tokens had voiceless and voiced initials to avoid context effects), the participants were asked to pronounce each test word in isolation five times. Each word was pronounced with a moderate tempo. The number of total test tokens was three thousand (twenty participants x two age groups x five tokens x three sets x five times). Cooledit Pro was used to segment each vocalization. The Praat program version 4.2.09 was used to analyze the F_0 of isolated words. The frequency at five points of time for each vowel was selected for measurement, at 0%, 25%, 50%, 75% and 100%. Microsoft Excel 2003 was used for analyzing and plotting graphs illustrating the overall mean ($\bar{x}$) of high tone F_0.

4.2 *A perceptual experiment*

The fundamental frequency (F_0; Hz), which relates to the rate of vocal folds vibration in the larynx, was used in the process of speech synthesis. The Praat program version 4.2.09 was used to resynthesize the mid-tone word [khaː]. The duration and amplitude were controlled. Subsequently, the digitized version of the word [khaː] on the mid tone was chosen and the manipulation of F_0 series was applied. The range in Hertz (Hz), 150-240 Hz, was drawn from the F_0 measurement in both the over-sixty group and the under-twenty group. Speech ranging from 150-240 Hz was resynthesized into three patterns; each is represented by a graph as the following:

Experiment 1: Figure 4 shows simple straight contours used as stimulus to test static tones. The first variant begins at 150 Hz and then the remaining contours shift to 240 Hz in 5-Hz steps. There are a total of 19 F_0 contours.

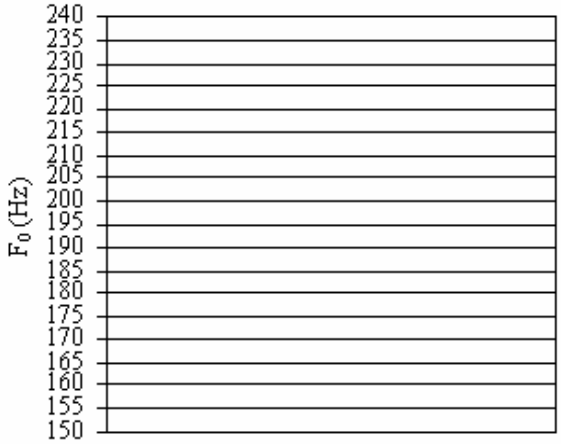


Figure 4 *19 simple straight contours stimulus for experiment 1 ranging from 150 to 240 Hz*

Experiment 2: Figure 5 shows eighteen contours stimulus for this test. The contours start at 150 Hz and rises to endpoints ranging from 155 Hz to 240 Hz (the exception is a contour which starts at 150 Hz and ends at 150 Hz, due to its being tested in experiment 1).

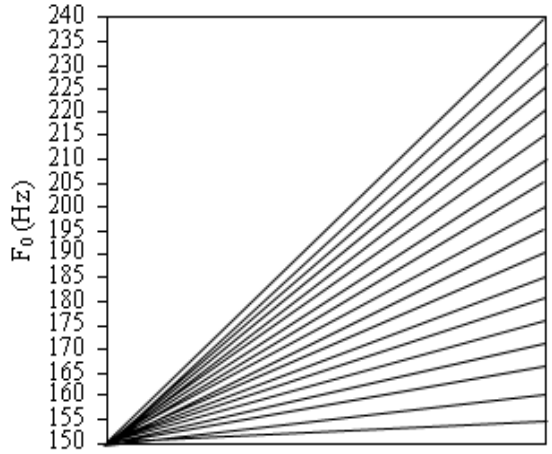


Figure 5 *18 contours stimulus for experiment 2 starting at 150 Hz and arriving at end points ranging from 155 to 240 Hz*

Experiment 3: Figure 6 shows eighteen contours stimulus for this test. The contours begin at the middle of the F_0 range, 195 Hz, and end at points ranging from 150 Hz to 240 Hz (the exception is a contour starting at 195 Hz and ending at 195 Hz, due to its being tested in experiment 1).

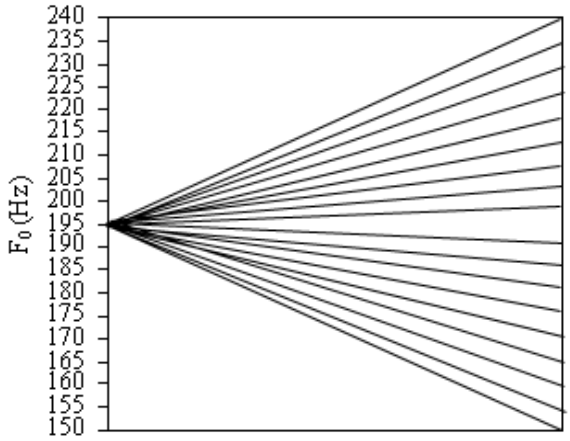


Figure 6 *18 contours stimulus for experiment 3 starting at 195 Hz and arriving at end points ranging from 150 to 195 Hz and 200 to 240 Hz*

For the perceptual experiment, forty participants of male and female were asked to listen to each stimulus and choose the answer from 5 choices, /khaa/ 'to be stuck', /khàa/ 'galangal', /khâa/ 'value', /kháa/ 'to trade', /kha→a/ 'leg'.

5. Results: an acoustic study

5.1 *The overall mean of Thai high tone in the over-sixty group*

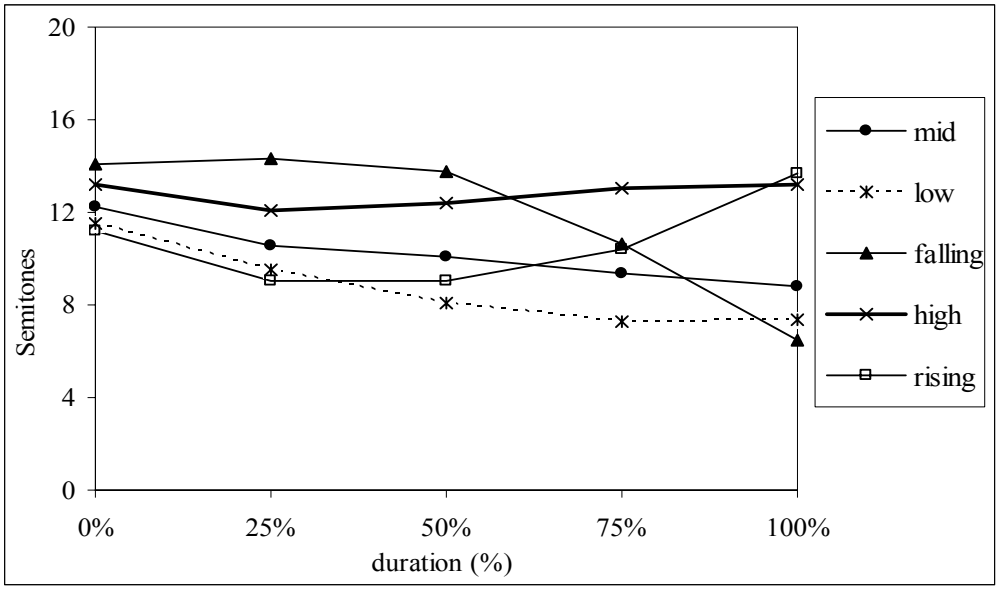


Figure 7 *Semitones of Standard Thai tones in the over-sixty group*

In Figure 7, the results show the Thai high tone among participants of the over-sixty group is similar to that which was found in Abramson (1962). The high tone is relatively high level [44]. It begins with high pitch, then steadily rises before slightly falling. It is because the participants represent the second period of tone change (See Table 1). In comparison with the rising tone, a rising tone begins with much lower pitch then slightly falls before rising.

5.2 *The overall mean of Thai high tone in the under-twenty group*

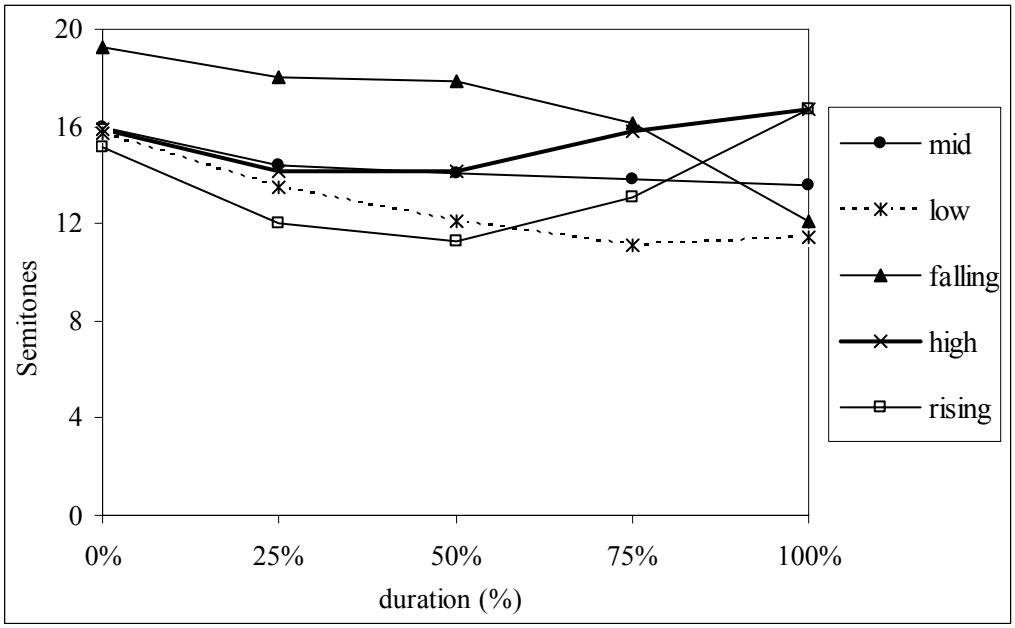


Figure 8 *Semitones of Standard Thai tones in the under-twenty group*

In Figure 8, the under-twenty high tone shape became [334] which is more similar to the rising tone. In addition, the starting point of the pitch for the high and rising tones are lower than that of the over-sixty group. Both tones seem to be more contoured, sharply falling and rising. This result confirms the gradual change of Thai high tone from high level [44] to mid-rising [334]. The findings support the change of high tone reported by Abramson (1979), Panroj (1991), Teeranon (2002a, 2002b), and Tumtavitikul (1992).

As all Thai tones are well-defined by the F_0 shape, the high tone has changed to be more contoured. This leads to the question of whether or not the high tone should be placed as a contour tone instead of a level tone.

In addition, the falling tone is found to be changing. In comparison with the over-sixty group, falling tone shape in the under-twenty group levels off for half of the duration at higher level before gradually dropping (See Figure 7 and 8). This result supports the findings of Lertthana (2005) in which a falling tone is becoming less contoured.

6. Results: a perceptual experiment

6.1 *Experiment 1: identification of straight contours in Figure 4*

In experiment 1, it is hypothesized the percentage of high tone identification in the over-sixty group is greater than that of the under-twenty group, as the stimulus are in static shape or level F_0.

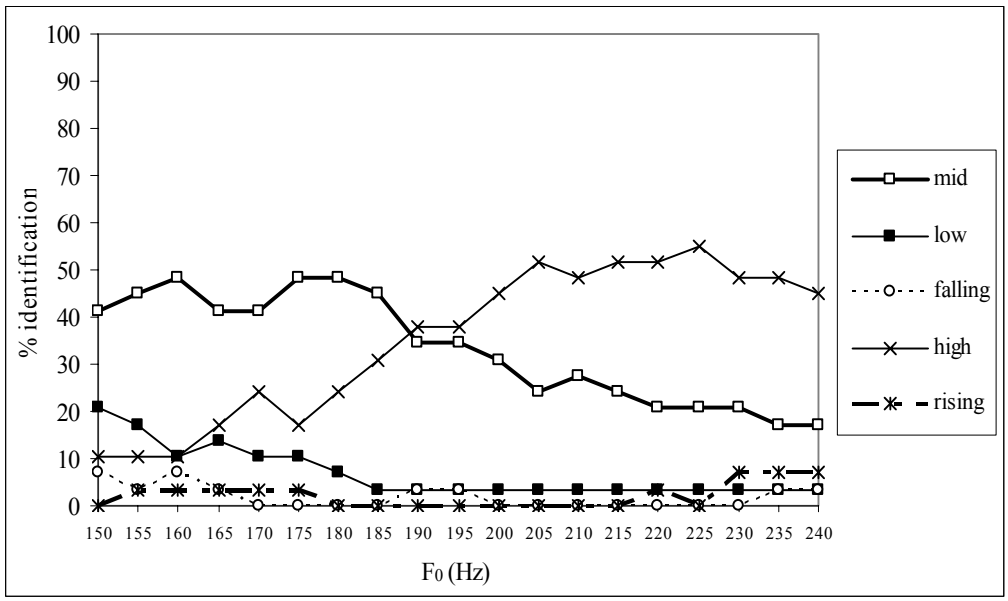


Figure 9 *Identification of straight contours in Figure 4 in the over-sixty group*

Figure 9 shows that in the over-sixty group, the percentage of mid tone identification crashed from 50% to 20% when the F_0 straight contours were moved up to high level, while the percentage of high tone identification gradually peaks to over 50%.

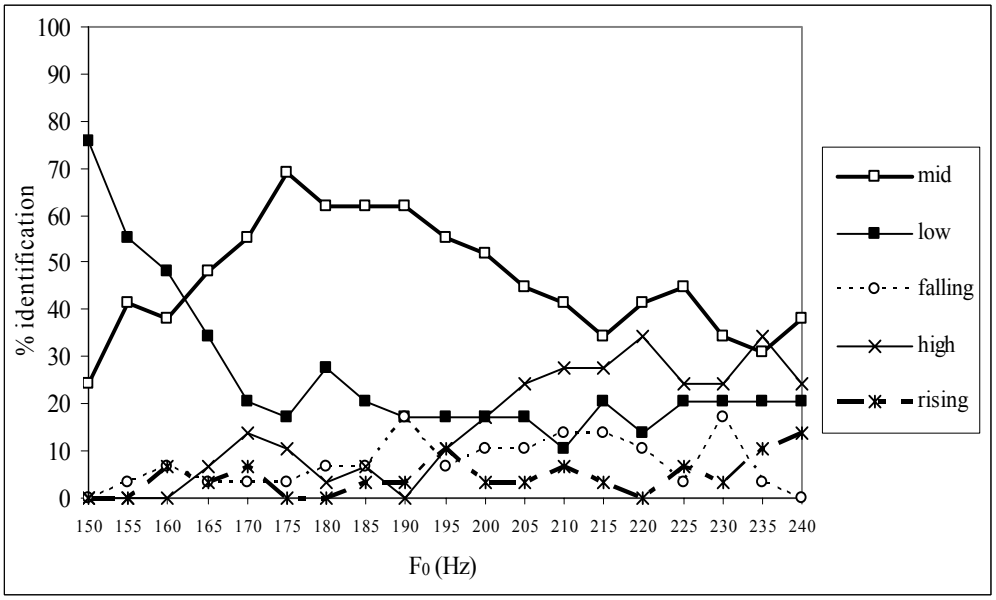


Figure 10 *Identification of straight contours in Figure 4 in the under-twenty group*

Figure 10 shows that low tone identification plunges from above 75% to a point around 20% when the F_0 straight contours were moved up to high level. Mid tone was identified predominantly at about the middle of F_0 range.

In comparing between the percentages of high tone identification in the under-twenty group with the over-sixty group, it was found that, when the F_0 straight contours were increased, the percentage of high tone identification was less than in the under-twenty group. And high tone is presumably perceived more as high level tone in the over-sixty group than in the under-twenty group.

The F_0 straight contours identification in this study were found to be highly identified as a mid tone and a low tone around the mid to bottom of the F_0 range. And when the F_0 straight contours were shifted to high level, high tone identification was found to be highly identified in the over-sixty group. The findings are congruent with Abramson (1978). The F_0 straight contours carry enough information for level tone identification in the past; however, for the under-twenty group, high tone identification was found to be less identified than that was found in Abramson (1978). That is to say, the F_0 straight contours haven't carried enough information for high tone identification in the present time.

6.2 *Experiment 2: identification of contours in Figure 5*

In experiment 2, it is hypothesized the percentage of high tone identification in the over-sixty group is less than that of the under-twenty group because the stimuli are in dynamic shape or contour F_0.

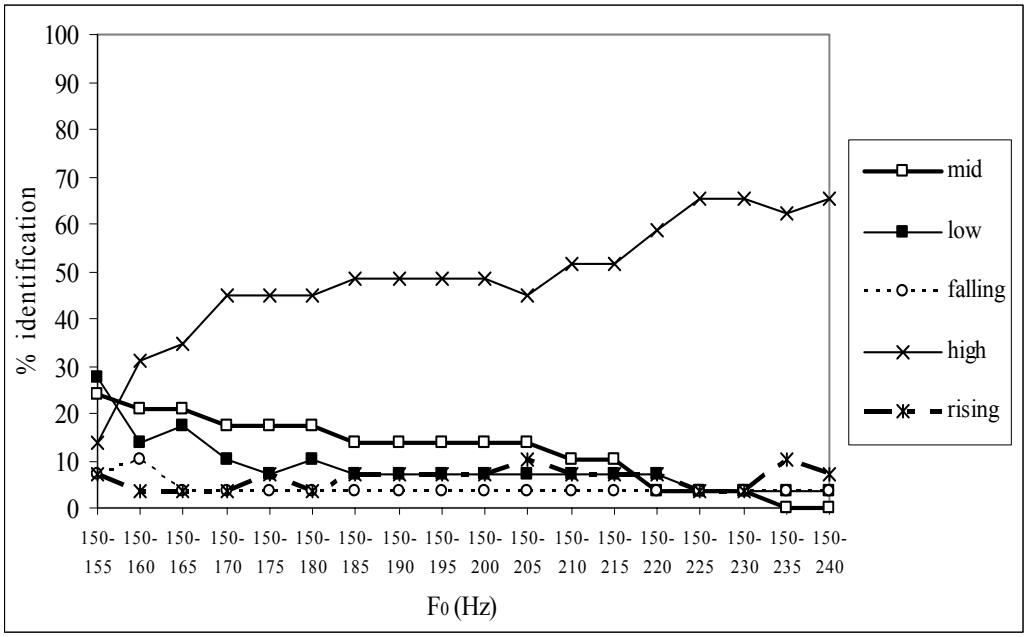


Figure 11 *Identification of contours in Figure 5 in the over-sixty group*

Figure 11 shows that in the over-sixty group, the percentage of high tone identification gradually increases from 15% to more than 60% when the F_0 end points were increased, while the other tones identification are at the bottom line.

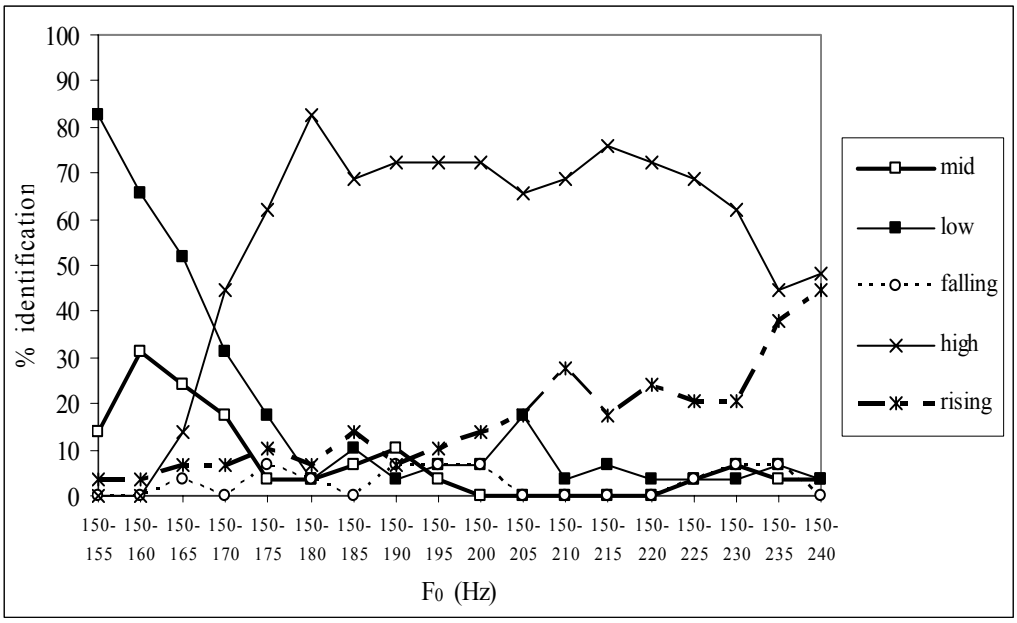


Figure 12 *Identification of contours in Figure 5 in the under-twenty group*

Figure 12 shows that the percentage of low tone identification dramatically drops from 82% to a point below 10% when the F_0 end points were increased. High tone identification seems to peak and separating itself from the other tones identification.

In particular, the percentage of high tone and rising tone identifications seem to come close when the end points of F_0 contour were increased to the highest F_0. In other words, when the synthesized pitch is more contoured or more dynamic, the participants apparently confused high and rising tone. This implies that, at the present time, the F_0 contours carry enough information for high tone identification, and it can be said a rising tone needs more contour of F_0 than a high tone does.

In comparing high tone identification in the under-twenty and over-sixty groups, the percentage was seemingly reduced in the latter. Consequently, the experiment 2 hypothesis is well-supported, and high tone is most certainly perceived as a contour tone in the under-twenty group than in the over-sixty group. Additionally, mid and low tone identification was found to peak only at the bottom range. This results are congruent with that was found in Abramson (1978). In this study, the percentage of mid, low, and falling tone identification was negligible when the F_0 end points were increased.

6.3 *Experiment 3: identification of contours in Figure 6*

In experiment 3, it is hypothesized the percentage of high tone identification in the over-sixty and the under-twenty group is low in the first half of the stimulus, as they are in falling contours. However, in the second half of the stimulus, where the contour shape raises, the percentage of high tone identification in the over-sixty group is less than that of the under-twenty group.

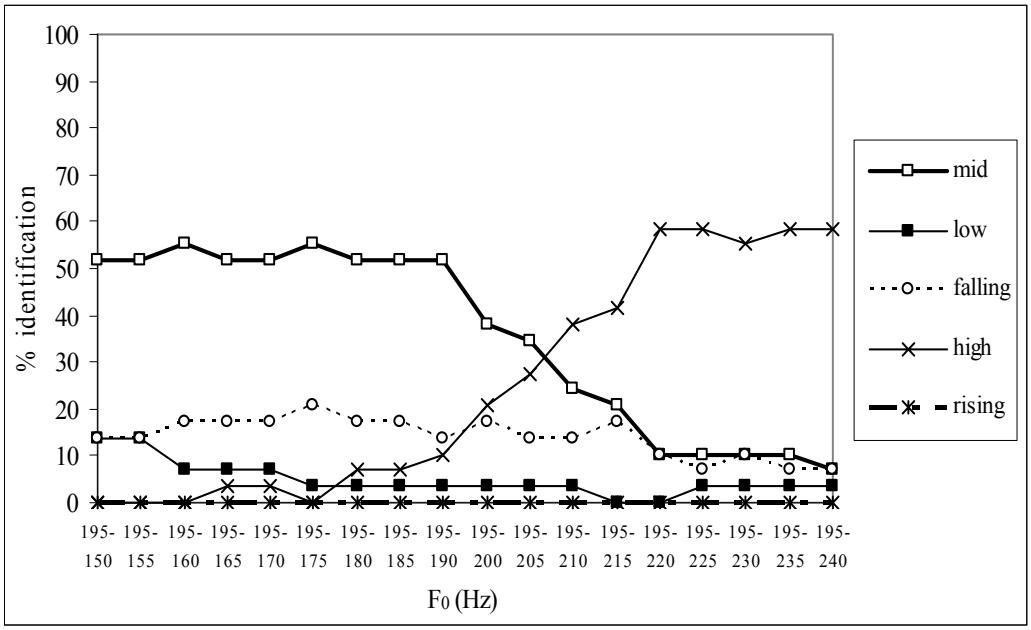


Figure 13 *Identification of contours in Figure 6 in the over-sixty group*

In Figure 13, the percentage of high tone identification in the over-sixty group, which is in the first half of the stimulus, is at the bottom line. By contrast, in the second half of the stimulus, the percentage of high tone identification gradually peaks to 60%. The percentage of mid tone identification is high, amounted to 50%, in the first half of the stimulus (falling shape stimulus). Then the identifications gradually drop to a point around 10% when the F_0 contours were changed from falling shape to rising shape.

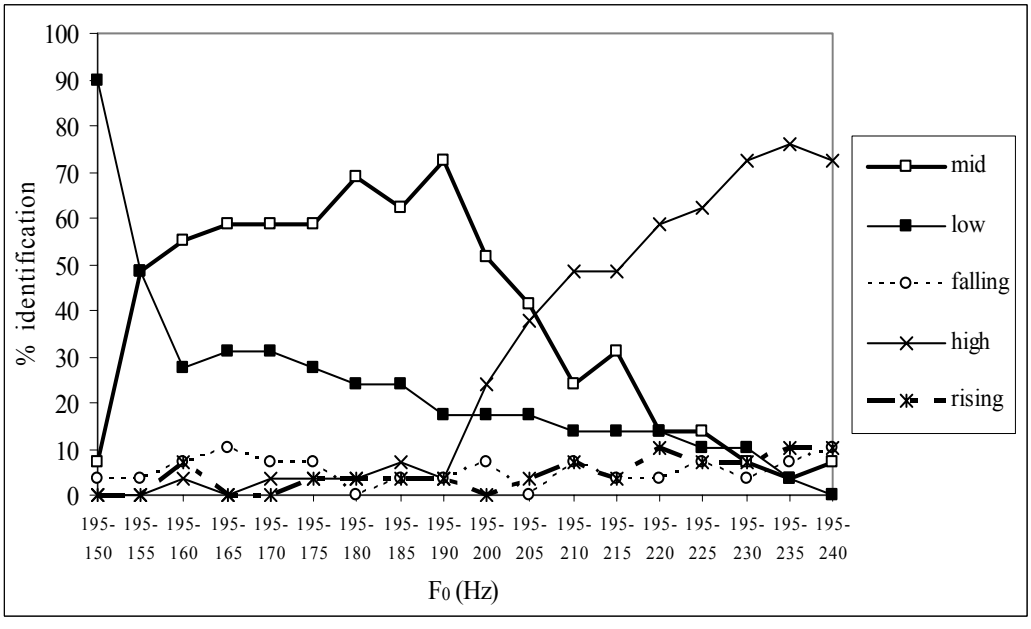


Figure 14 *Identification of contours in Figure 6 in the under-twenty group*

In Figure 14, the percentage of high tone identification in the under-twenty group, which is in the first half of the stimulus, and also of a falling shape, is at the bottom line. By contrast, in the second half of the stimulus, which are rising shape, the percentage of high tone identification gradually peaks at over 70%. Obviously, the percentage of mid tone identification is high, amounted to 60%-70%, in the first half of the stimulus. Then the identification gradually drops to a point around 10% when the F_0 contours were changed from falling shape to rising shape. Besides, it is obvious that the percentage of low tone identification in the first half of the stimulus plunges from 90% to a point under 20%.

In comparing between the results of high tone identification in the under-twenty and the over-sixty group, the percentage was lower in the former group. Consequently, the experiment 3 hypothesis is well-supported, and high tone is most certainly perceived as a contour tone in the under-twenty group than in the over-sixty group.

In Experiment 2, the stimulus starts at 150 Hz and go to endpoints ranging from 155 Hz to 240 Hz. In experiment 3, the stimulus starts at 195 Hz and go to end points ranging from 150 to 240 Hz. That is to say, the rising shape stimulus in experiment 2 is more contoured than experiment 1. Consequently, the percentage of high tone identification in experiment 1 is higher than in experiment 2. It is clear that the percentage of rising tone identification in experiment 1 is higher than in experiment 2.

The finding shows that mid tone identifications increase in Experiment 3 compared with Experiment 1, however, the identifications decrease in Abramson (1978). In comparing between Experiment 3 and Experiment 1, it was also found that low tone identifications increase from 77% to 90% in the under-twenty group. High tone identifications, on the other hand, increase in Experiment 3 when compared with Experiment 1, but again, it was found to decrease in Abramson (1978). In other words, at the present time, the F_0 contours carry information for both low tone and high tone.

7. Discussion and conclusion

Based on the acoustic findings, Standard Thai high tone has changed its shape from high-falling [442] to high level [44 or 45], and to mid rising contour [334]. The shape of high tone manifests itself in rising shape like rising tone. However, it is obvious that the starting point of high tone is mid but the rising tone is low (See Figure 7 and 8).

Despite the fact that studying Thai tones in connected speech are gaining more significance at present (Gandour et al. 1999, 2002, Nasanee 2003, Potisuk et al. 1994, Tingsabadh and Deeprasert 1997), this study stresses the importance of studying Thai tones in isolated words (Abramson 1962, 1975, 1997, Erickson 1974, Gandour 1974).

The perceptual experiments conducted by using "ideal" contour in Abramson's methodology (Abramson 1978, 1997) have generated additional information on the two-generation perception. The over-sixty group, which represents the past, basically perceives high tone as a level tone (See Figure 9 and 10). On the contrary, the under-twenty group, which represents the present, seemingly perceives high tone as a contour tone (See Figure 11, 12, 13, and 14).

In comparing between Figure 12 and Figure 14, the former shows how the under-twenty group is uncertain regarding the difference between a high and a rising tone when the F_0 movement (the difference of the starting point and the end point of F_0) is high. Alternatively, in Figure 14, when the F_0 movement is smaller, only high tone seems to be

perceived. This can be interpreted that a rapid movement of the F_0 is needed for contour tone perception, as stated in Abramson (1997: 9) and Pittayaporn (2007). In addition, the results also show the correspondence between the F_0 shape of high tone found in an acoustic study and the perceptual experiment that high tone shape has not manifested itself as contour as the rising tone (See Figure 9 and 10). This is due to the progressive change of Thai high tone is in progress, the so called an observable change in progress (Aitchison 2001, Labov 1994).

Moreover, in comparing the findings of this study with of Abramson (1978), in the past, the F_0 straight contours carry information for level tone; mid tone, low tone, and high tone. However, the F_0 contours carry enough information for low tone and high tone identifications at the present time. The rising tone needs more F_0 contours for the identifications. And it is obvious that the F_0 contours seem not to carry information for falling tone at the present time. This supports the less contours of F_0 found in the under-twenty group compared with contours of F_0 found in the over-sixty group.

In addition, the schematic F_0 contours needed for this kind of study are, for the most part, anticipated to be unsatisfactory as 'ideal' tones of the language.

The acoustic study within the perceptual study in this study shows that the high tone is arguably a contour tone and not a level tone as classified in earlier works (Abramson 1962, 1975, 1978).

To sum up, the study portrays the change of Standard Thai high tone acoustically and perceptually. It is an open question and the subject further as to whether or not the high tone in Thai should be recategorized as a member of contour tone classification. Finally, the study supports the importance of using age groups in studying language change in progress.

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Notes

[1] Standard Thai is the official language spoken by educated speakers throughout the regions of Thailand. It is used in the media broadcasts, as the medium of instruction for educational institutions, and described in grammar books and dictionaries (Tingsabadh and Abramson, 1993). The term Standard Thai was used since it is classified as a variety of Central Thai on the basis of tone system and one split (Gedney, 1972).

[2] The change of Standard Thai high tone : an acoustic study, studied in P. Teeranon and R. Rungrojsuwan (2008) is a part of this study.

[3] From now on, forty participants from the two generations are referred to as 'the over-sixty group' and 'the under-twenty group', respectively.

[4] Although C. B. Bradley conducted the study in 1908, his paper was first published in 1911. Six curves were printed in the graph, but the sixth one was a token from the variant of the high tone on a short checked syllable. As the tokens of short checked syllable are not used in this study, the variant is not shown in the graph.

[5] There were many studies concerned with Standard Thai tones done by linguists in each period, but we have selected to present only one representative piece of work in each period. In addition, the rule for selection is the age of participants in the earlier periods must not exceed twenty-five; therefore, the participants are now sixty-five years old. In other words, they are of the same generation as the over-sixty group participants, except the study of Bradley (1911) which was selected for its pioneering work. Although the credible works from some linguists, e.g. Eugénie J. A. Henderson, who were well-trained and highly experienced phoneticians, were very much reliable, Bradley (1911) was chosen for his pioneer work.

[6] Mid tone is unmarked in the transcription.

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